# HAND BOOK

## Forest Garden Tea Growers

by Dr. Ranil Senanayake & Sachithra Harshana Yapa

A Public Private Partnership project funded by the poverty alleviation budget ODA of the Government of the Netherlands

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Rainforest Rescue International
working for a sustainably managed world

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# Dedication

This book is hereby dedicated to small scale farmers the world over who are committed to farming in an ecologically sensitive manner thus helping conserve our common resources for all future generations.

# Acknowledgements

The need for more sustainable production is a paramount issue that faces our civilization in the present day. At a time when we are faced with issues such as climate change, global extinctions and resource depletion each industry will have to examine it's impacts upon the earth. We hope this book will help the tea industry search for more sustainable alternatives for the future.

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# Foreword

The Tea industry in Sri Lanka is has found itself at a period that heralds a great change from the traditional systems of agriculture that has been in place for the past one and a half centuries. The monopoly that the large plantations had on Tea production has eroded with great rapidity. The smallholder Tea sector moved from providing under 1% of the Tea exported from Sri Lanka in 1979 to accounting for 74 % by 2011. The majority of the production units in smallholder tea was interspersed in diverse landscapes and presented a radically different ecosystem to the monoculture plantations. The smallholder tea contains a level of biodiversity significantly higher than that of plantation tea. The smallholder tea requires less fossil based inputs than plantations. However, as many smallholders are integrated producers providing their own labour, they cannot benefit from the gains of collective bargaining or from the medical and educational programs of plantations.

It is a sector that provides the greatest response to the global needs of today, sustainability, biodiversity, biomass, clean water, etc. it provides the greatest investment and growth opportunities. The product is also unique in terms of its strength and quality. This Tea, if developed into a recognizable brand, as "Forest Garden Tea" has a great potential to reward the smallholder sector for producing clean, sustainable, biodiversity friendly and carbon neutral teas.

The existence of an accredited and independent, third party certifier for Forest Garden Products in Sri Lanka who can audit and confirm such claims, adds great strength to the sustainability of the management system. The existence of a Sri Lankan marketing companies, with the capacity to service international markets, assures the potential for healthy growth through trade.

In the end, it is the small tea producer who will produce the high value 'Forest Gardens' of tomorrow. This book is intended to provide some guidance for this valuable work.

# Content

# Introduction

This book was produced as a consequence of the Public Private Partnership project supported by the Dutch Government, to develop Certified Forest Garden Tea as a distinct brand that will promote sustainability and biodiversity in the Tea sector. In the course of the project it became clear, that tea smallholdings represented the greatest resource for value addition in Sri Lanka. However this group was also the most under-resourced in literature and information. This booklet attempts to inform the tea smallholder of this potential.

# 01. History

## 1.1 Tea history

The Tea Plant originally came from the mountains of China and the foothills of the Himalayas. In its wild state it grows to become a tree often more than 30ft high. Even today, such huge Tea trees are common in the mountains of Indo-China.

*Fig. 01 : A tree of Tea*

It's use as a beverage can be traced to a time about 2000 years before the birth of The Lord Buddha. In 2737 BC the Chinese Emperor Shen Ning is accredited with discovering the healing and refreshing qualities of tea. From that time on tea became the preferred beverage of China with various healing powers attributed to it. Over the next two thousand years the popularity of tea grew throughout China and when the teaching of the Lord Buddha came to China there was an immediate joining of the tea drinking and Buddhist practice.

Priests who studied Buddhism in China took with them both the teaching and the use of tea to the various countries that they traveled to. In this way tea traveled to Japan, Afghanistan, and Tibet etc. During this time the tea plant of the Himalayas (Assam Tea) was also included in the production of tea together with the tea plant of China (China tea). Today all the tea produced in the world comes from these two plants.

Sri Lanka obtained its Tea fairly recently. It was only in 1824 when the first tea plants were brought to Sri Lanka and planted at the Royal Botanic Gardens at Peradeniya. However the plants were propagated and maintained in the gardens and no attempt at commerce was undertaken, as the country had become famous for its Coffee during that time.

## 1.1. Plantation history

1820 was a sad year for the country when the large scale felling of forests began. This was the year when all land without title was deemed 'crown land' and sold to commercial interests in London and Colombo. It is said that the 'coffee boom' of 1835 saw a rush for land that brought investors from the world over to buy the mountain forests of Sri Lanka and cut them down for the establishment of plantations of Coffee. The intensity of this activity is reflected in the government land sale figures, which show that over 290,000 acres of montane forest were sold for coffee growing in less than 10 years.

Much of the original plantation based agricultural endeavor at this time did not pay any heed to good management practices. This destruction is described in Fredrick Lewis' book Sixty-Four Years in Ceylon. He says:

"I know of no more awe-inspiring sight, than that of a thousand acres on fire. Sheets of flame appear to leap into the air, and yell with a sort of devilish delight at their victory over the magnificent trees they are reducing into charred masses of cinder and charcoal. It is more than impressive; it is fearful, yet grand! After the fire has completed its work, the land is covered with. Black logs, lumps of charred timber, masses, and often great fragments of stones, broken by the heat that has swept over them. A deep black covers the landscape; impressive, but depressing.

*Fig. 02 : Forest devestation infront of Adam's Peak and new tea plantations on that land*

It was in a burned wilderness like this, that I found my new home. It lay at the extreme end of one of the many blocks of land that had been simultaneously burned off. My path, for road it could not be then called led over hundreds of fallen and charred logs, and followed the valley of the Agra stream…….

When morning broke upon the day following the events recorded at the conclusion of the last chapter, I found myself gazing upon a scene not altogether unfamiliar to me. All around me lay hundreds of charred black logs, stumps in fantastic shapes and outlines: fallen branches, broken and distorted by fire: cinder heaps, and little rivulets of sodden ash: all indicative of the fierce, merciless fire that but a few weeks ago, had raged over a spot that so lately had been a beautiful forest land.

It was now a blackened wilderness, to be changed into fields of coffee, by the labour and patience of man. A strange picture; fascinating in one respect: fearful in another and yet so full of a strange mixture of possibilities was this wild heap of ruins, this uncouth mass of slaughtered giants of an inarticulate, yet eloquent world, to be transformed by, industry in the pursuit of fleeting wealth."

From this history we can see that it is on these ashes that the Coffee and Tea industry arose. However, the wanton destruction of the forests, eventually took their toll on the Coffee industry. Attacks by rodents and the proliferation of leaf diseases brought the coffee industry to its knees and bankrupted coffee businesses. For the plantations a substitute had to be found urgently. Thus the tea plant was first trialled as a substitute for coffee. The plant grew so well and produced such flavorsome leaves that the Tea industry blossomed by 1860.

## 1.3. The history of Tea production in Sri Lanka

Tea and Coffee was grown in Sri Lanka as a plantation crop primarily for foreign investors. Sri Lankans were not only excluded from this economy, the early planters showed little respect for the Sinhalese villager. Dahanayake (1976) comment on a petition submitted to the Matale GA in 1916 states " the harassment the people had to face then, was clearly seen from this petition. During this time all of the British planters of Tea and Rubber had taken on themselves the job of the hangman.

They had been given power to kill innocent villagers who had not committed any offence like flies and mosquitoes. Therefore they, who made use of this opportunity, drove away the villages that were living on the borders of their estates. They straightened out the boundaries of their estates. They annexed the lands of the villages too, to their estates"

*Fig. 03 : A tea planter comming from the Mariyawaththa tea estate*

## 1.4. The consequences

The price that this nation has paid for the Tea, Coffee and rubber industries have not been addressed up till now. Although the consequences of this action was commented upon as far back as 1909, Dr. Strange, an agricultural expert made this observation in 1909 with respect to the clearing of the mountain forests;

"It would not have been necessary to notice here (in Sri Lanka) the matter of soil denudation, did it not affect irrigation and water supply. The result of stripping the soil is to make the springs on tea estates dry up quickly; to diminish the fair-weather flow of streams and to increase their storm flow (whereby temporary irrigation weirs are carried away) and to choke with silt the beds of the streams and the irrigation channels led from them. It is also said to reduce the fertilizing property of the water, as there is now less leaf mould in solution. Even paddy fields have been ruined by sandy deposits laid on them. When tanks lie in the course of streams thus affected, the rate of their silting-up will rapidly increase and their storage capacity will greatly diminish. Even the large rivers, such as the Kelani, have had their section diminished by soil debris, so that for this reason, as well as on account of the greater run-off produced by the clearance of the forest entailed by the establishment of estate plantations, the flood waters cannot be contained in the river channel, but are spread over the riparian land and do much damage. If such damage affected only a small area it would not, of course, matter much, but it has to be remembered that the tea and rubber estates are on the hills, and uplands, which are the principal sources of supply to rivers draining two-thirds of the Island; the effect of denudation it thus widespread."

Thus forest denudation, biodiversity loss and soil erosion seem to go side by side. While we have begun to address the questions of forest and tree loss there is much to be done with the question of soil.

# 02. Principal influences on Tea production

## 2.1. The Soil

Along with the great forests of the mountains in Sri Lanka the amazing soil bank that existed undisturbed for millions of years was lost in a short period of two hundred years. We know that such a soil bank existed by the presence of an extraordinary diversity of soil reptiles and amphibians. Who are sadly confined to forest patches and mature homegardens scattered through the country. To understand sustainability in agriculture we must appreciate the real nature of the soil.

*Fig. 04 : Soil erosion in the Central Hills*

The soil ecosystem is comprised of four distinct fractions called the 'organic,' 'inorganic' (mineral), air and water fraction'. These fractions act as reservoirs that can be identified by their history. The organic fraction is largely the breakdown products of photosynthetic compounds and their derivatives. The inorganic fraction is largely the breakdown products of rocks. The Air fraction is increased as the biological activity of the soil increases and the water fraction is also mediated by the first two. Most soils are comprised of a mix of these four fractions in various proportions, the fraction that affects the farmer most is the amount of organic matter in the soil. In most soils the organic matter fraction is typically low ranging from under 1% to about 10%.

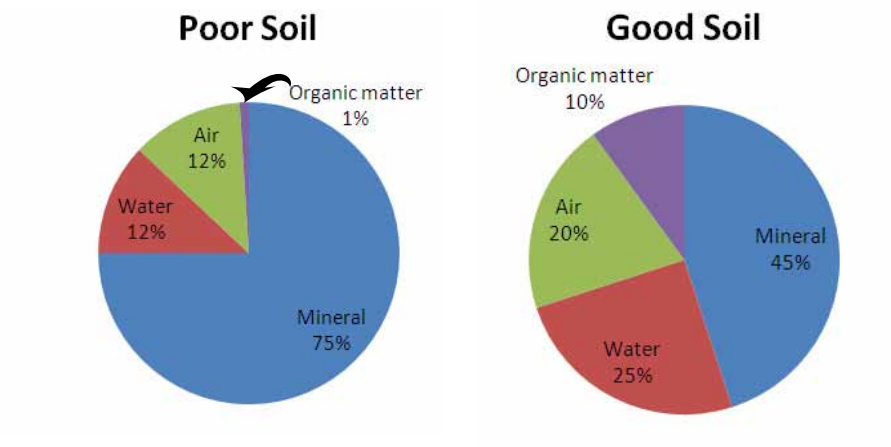


*Fig. 05 : Pie charts of soil fractions in poor and good soil*

But it is this fraction that drives the ecosystem that lies above it. Sustainable agriculture and forestry will be a impossibility without reaching the optimum levels of organic matter for that soil. The organic matter of soil when extracted is seen as a dark, amorphous solid mass. On closer examination this 'solid mass' is seen to be comprised of millions of organisms. In fact, any one-hectare of farmyard soil contains as much biomass as an Elephant. It is also the biological filter that detoxifies a large proportion of the poisons that we apply to the environment we live in. It is a world as complex as, and most certainly older than, the world that lives on its surface. It lies continuous over most of the land surface of the planet it is in a very real sense the 'living skin' of our planet.

*Fig. 06 : Demonstrating the loss of the living skin. The healthy forest in the background is the skin intact, with the clearing of the forest in the foreground the skin gets thinner, removing this to expose the organic soil for agriculture makes it even thinner, finally the loss of all organic matter in the foreground represents a complete loss of the living skin.*

The world of soil is bizarre to us who live on the surface. It is opaque to light and mostly solid. Communication is by chemicals, e.g.. Pheromones or physical, e.g.. vibrations. Movement is slow; the faster organisms like the worms are the giants of this world, tunnelling through at a fairly rapid rate measured in centimetres per minute. More common are the fungi that move by growing through the soil at rates measured in centimetres per month, or the bacteria, which have rates, measured in centimetres per year.

It is a busy world, one gram of ordinary farmyard soil can contain over 1 billion individual bacteria, over 100 million individual actinomyctes and over 1 kilometre of fungal hyphae, notwithstanding plants like algae and animals like collembolids, nematodes or worms. It is these organisms that contribute to the massive weight of biomass in soil.

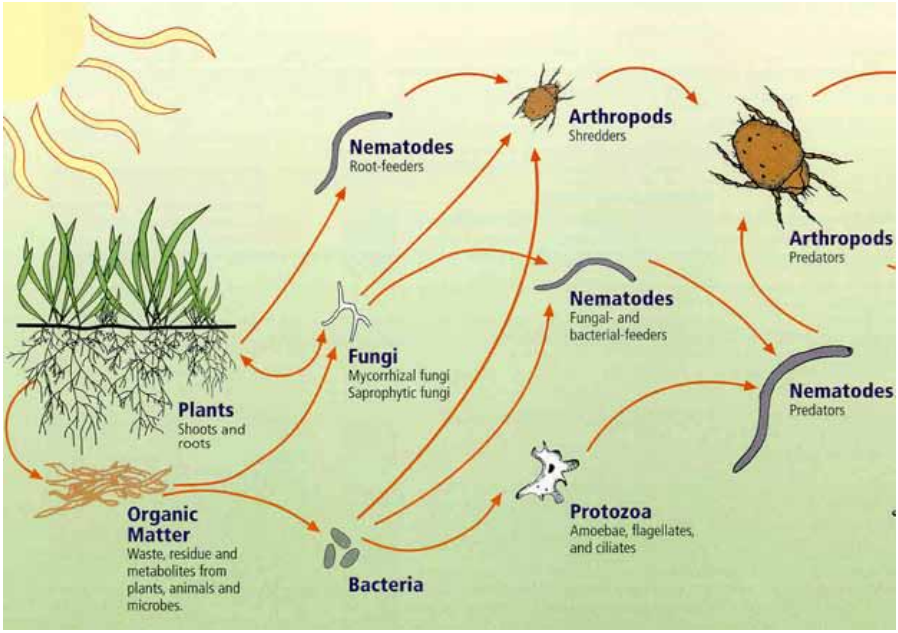


*Fig. 07 : Links among soil biota*

Understanding soil ecosystems and how they work is important for both production and conservation goals. In production systems this information will enable the optimization of inputs and help develop more sustainable agriculture. For instance, while phosphorus is needed as an amendment on most soils to produce good crops, the source of phosphorus used can make a great difference to both productivity and profitability. Phosphorus that has been acted upon by certain soil bacteria can produce a higher volume of crop than that produced by the same amount of phosphorus added as superphosphate.

In 1938 Dr, William Albrecht made the following observation for US agriculture;

*"Soil organic matter is one of our most important national resources; its unwise exploitation has been devastating; and it must be given its proper rank in any conservation policy as one of the major factors affecting the levels of crop production in the future… The Nation should be made aware of the rapid rate at which the organic matter in the soil is being exhausted. Farm-management practices should be adopted that will at least maintain, and in as many cases as possible even increase, the supply of this natural resource in the soil. The maintenance of soil organic matter might well be considered a national responsibility."*

The current approach to tea cultivation would seem to have forgotten the value of living soil. The current tea production is usually done on the sub soils without much organic matter. Productivity is maintained through the addition of fertilizers, weedicides etc. In a good organic field the farmer will always strive for the optimal, living soil ecosystem.

The living soil should be supported by a terrestrial ecosystem that provides it with the critical organic matter increment. In the Analog Forestry approach, the enrichment of poor soils is assisted greatly by the use of trees and plants that help to create a good soil.

Tree Roots provide up to 20% of their total root weight as exudates into the surrounding soil every year. Each Species of tree provides differing chemical compounds. Some provide a high amount of nitrogen, others concentrate phosphorus around their roots, etc. So we can see that different species of trees have distinct species of associated soil organisms. The inclusion of species, with good soil building properties, will provide an increasing degree of sustainability to the tea field.

What is missing in terms of mineral matter and biodiversity should not be replaced exogenously in a single application but in a seral sequence that is analogous to the native systems.

## 2.2. Biodiversity

The capacity of the Tea plantations to maintain biodiversity has been very low. In addition to the application of agro-toxins as a management tool, a culture of 'clean' i.e. uniform landscapes reduced both plant and animal biodiversity to a very small amount. The biodiversity of the country is at a critical point. Many  hwill occur, unless the available habitat is increased. establishing and developing the innovative approach of Analog Ecosystem design will invite much of the lost biodiversity back onto newly designed smallholder tea eco systems. This approach will allow the development of Tea plantations designed as environmentally low impact, biodiversity friendly ecosystems where human introduced and natural fauna and flora can coexist.

The Development of a valid response: History of Smallholder Tea

In 1972 great revolution began in the Tea Industry. The state takeover of privately owned estates, culminating in the nationalization of Rupee and Sterling Companies in 1975 saw the Tea Industry comer into the hands of the state. But most importantly it was the year that the Tea Small Holdings Development Authority (TSHDA) was set up as a body corporate under the Tea Small Holdings Development Law No 35 of 1975. Under this initiative Tea cultivation was promoted as a smallholder crop.

According to the Tea control Act of No. 51 of 1957 below 10 acres are treated as Tea Small Holdings. All privately managed tea holdings which means tea lands of 50 acres or below and under the management of private ownership are entitled to provide the services of the TSHDA.

When the TSHDA was established smallholders accounted for only 411 ha of tea and was miniscule in comparison to the estate sector, today Tea smallholders account for 74 % of the Tea exported from Sri Lanka and have become a central force in maintaining the tea economy of Sri Lanka

# 03. The Tea Plant

Although the Tea plant grows large in nature. In the Tea production system the plant is maintained as a bush by pruning of its branches. So that the optimal shape of bush for bud production is obtained. This involves training the plant from the time it is planted in the field so that a flat surface or 'table' is created on top of the bush, to facilitate the harvesting of the emerging buds.

There are two types of planting material used these are: Seedling and Vegetatively propagated Plants.

## 3.1. Seedling

Propagating from seeds was the original system of increasing the stock of Tea plants. The advantage of seedling plants is that they retain the taproot, which goes deep into the ground and increases its ability to withstand drought. In addition the diversity found in seedling tea provides a diversity of flavors increasing the value of the crop

*Fig. 08 : Seedling Tea plant*

## 3.2. Vegetatively Propagated (VP)

VP plants are valued for their high productivity and consistency as it is composed of cutting derived from an identified high yielding mother plant. All the plants are similar and therefore it is relatively easy to establish a uniform cover of Tea. However there is no diversity of flavors and there is a strong need to build soil organic matter to compensate for lack of taproot and increase ability to withstand drought.

*Fig. 09 : Vegetatively propagated tea plant*

# 4. Nursery management and Vegetative Propagation

1. Choose a suitable site to establish the nursery.
2. Find a source of supply of good soil.
3. While it is prohibited to fumigate the soil, it can be sterilized by covering it with polythene and exposing to solar radiation.
4. Once the soil is placed in bags, they should be watered and kept moist for two weeks.
5. Selection and Preparation of Cuttings -Select vigorously growing bushes for cuttings or acquire from a well-known source like the TRI (Tea Research Institute).
6. Avoid both the woody and the very succulent parts of the branch or any flowering part using a sharp blade, make one-node cuttings taking care not to damage the bud.
7. The cuttings should be put in water as soon as they are cut from the mother bush.

1

2

3

4

*Fig. 10 : Different operations in Tea nursery management*
*1. Correct selection for vegetative shoots 2. Just after cutting shoots put into water*
*3. Correct establishment in poly bag 4. Polythene nursery*

8. Plant the cuttings in the soil ensuring that the leaf does not touch the soil. Place the bags so that the leaf of one cutting does not touch the other. Only the outer rows may contain two cuttings per bag.
9. When handling avoid touching the rooting part.
10. Water the cuttings thoroughly but gently.
11. Cover or shade the cuttings immediately.

Stretch a polythene sheet over hoops of plastic pipes or bamboos so that the tunnel about 2.5 meters long and 75 cms high is formed. The sides are covered with soil to avoid water loss. Or put branches of Bracken fern branches (Kekilla), planted into the plant bags at a rate of 4 branches per bag so that the cuttings are well shaded. It is also useful to construct a frame of rope or sticks to act as a further shade, by placing a light cover of bracken fern on it.

Water the beds 21 days after planting if completely covered with plastic or when soil is noted to be dry in fern shaded plantings -Regulate shade depending on the weather.

Hardening Off - Done after 3-4 months after planting -Remove the polythene sheet or the fern branches gradually at an interval of one week. -Water after every 2 weeks, at the same time apply foliar sprays once a week. -Reduce the watering and shading 1-2 months before field planting.

# 05. Field Establishment

## 5.1. Check the field soil for its acidity (pH)

The ideal values are between 4.5-5.5. If the pH reading is below 4.5, Lime or Dolomite should be applied at a rate of 500kgs/ha

## 5.2. Planting out

It is best to plant out during the rainy season. The South West monsoon rains (May-June). Or North East monsoon (Oct-Nov)

If in windy areas where the plant will move, place a stick into the soil by the plant and tie the plant onto the supporting stick.

## 5.3. Spacing

1.2 m ( 4ft) x .6m (2.0 ft). The planting holes should be prepared at least two weeks prior to planting.

Planting Holes: 22.5 cms ( 9 inches) x 30cms (1.0 ft) x 45 cms (1.5ft ) . Double size for infilling i.e. 18" x 36"

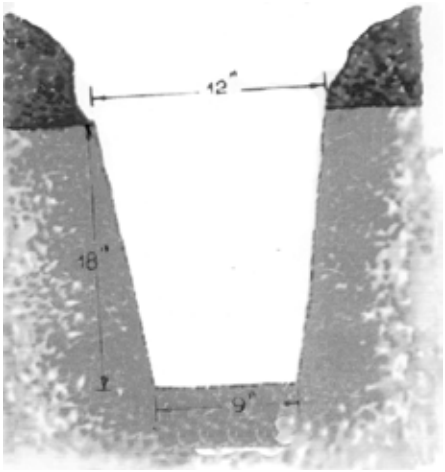


*Fig. 11 : Tea planting hole dimensions*

Separate topsoil from sub-soil. Maintain for two weeks . Mix the top soil with 2 Kg of good compost before filling it into the hole.

When planting out, slit the polythene bag and remove plant without disturbing the roots. Once the plant is in place fill with soil and press the soil down so that it compacts around the plant.

# 06. Bringing young Tea into bearing

This is any operation aimed at forming a permanent branch system from the time the plants are in the nursery to the time they are tipped-to form a plucking table.

Once the nursery plant is 4-5 months old with about 5-6 leaves the top shoot must be pinched off.

*Fig. 12 : Pinching off at nursery*

Once the plant is 9-12 months old it is taken for planting out.

## 6.1. Formative pruning

After one year in the field

(a) All new shoots that are pencil thick are pruned 6" above ground. Allow the rest to grow.

(b) Prune all shoots at 9"- 11" when most are pencil thick.

*Fig. 13 : Formative pruning*

## 6.2. After one and a half years

Prune again to cut all branches above at 16"-18"

*Fig. 14 : Second pruning*

## 6.3. Tipping

This is done after pruning to produce a dense and upper level surface for efficient plucking and to leave an adequate depth of maintenance foliage on the bush. At 2 years remove all vegetative growth over 20-24". At least three rounds of tipping (two months) are carried out at the same level before normal plucking is introduced.

Delay in tipping-in will result in buds just below tipping height becoming mature and thus will take longer to develop into new shoots.

# 07. Proper plucking of the shoots

Only harvest buds with two open leaves that rise above the

- plucking table.
- Remove all 'Banji' leaves.
- Maintain all growing buds.
- Remove all non-productive stem clusters.
- Do not leave broken stems on the bush at harvest.
- If the buds have matured, it is important to remove the fibrous stem from the bush, but retain only two leaves and the bud.
- Pay attention to the weather and the response of the bush to changes in weather.

*Fig. 15*

*Fig. 16*

*Fig. 17*

*Fig. 15 : Well maintained plucking table, Fig. 16 : Correct stage for plucking, Fig. 17 : "Banji" bud*

# 08. Pruning the tea bush

## 8.1. Pruning

Is important to maintain the vigor of the plant. Immediately after pruning there is an increase in growth rate which slowly decreases over time and there is a rise in the height of the plucking table, creating difficulties of harvest.

Soon after pruning the C:N ratio is low as the bush grows more foliage the C:N ratio increases and the bush tends to move to its reproductive phase which reduces vegetative growth. Consequently there is an increase in Banji formation. For this reason it is important to prune the bush at frequency of 3-5 years and is termed the pruning cycle. All pruning is done while the bush is in a robust state
The timing of the pruning cycle varies with the area, altitude and the origin of the bush i.e. Seedling or VP.

| | Seedlings | Vegetative propagated |
|---|---|---|
| Low country | 2 years | 3 years |
| Mid country | 3 years | 4 years |
| Up country | 4 years | 5 years |

*Table 01 : Suitable duration for pruning*

The bush should never be pruned after a season of heavy growth and bud removal. The same caution should be exercised after a period of drought or other stress to the plant. Again, the pruning should not be done just prior to the onset of the dry season as the young buds will get 'burnt'. The best period to prune is after the initial onset of rains and the expectation of rains in the future. Further plants stressed by disease or pests should not be pruned till they have recovered. The benefits of a good pruning cycle are:

## 8.2. When pruning the Tea bush special care must be taken

Create a 'basket' like form so that vertical growth of shoots is unimpeded.

Always use a sharp pruning knife. – If dull or blunt knives are used it will lead to bruising or splitting of the branch allowing entry of diseases and lead to the death of the plant.

1. If possible obtain advice from an experienced pruner.
2. Always cut at an angle with the 'face' of the cut facing the inside of the bush. The cut on each stem should slope slightly inwards.
3. Always do pruning during the relevant season for your area, i.e. outside the season for Shot Hole Borer infestation.
4. Clean the bush well; remove decayed material and termite-affected parts. Remove all branches affected by Shot Hole Borer. Remove all moss and ferns.
5. Maintain two lower branches to act as 'lungs' for the plant. This will enable the bush to overcome stress and will improve yield.
6. To achieve the correct pruning height, a stick clearly marked at the required height is placed vertically at the center of the bush.

*Fig. 18 : Prunning knife and scale*

*Fig. 22 : Scaling for prunning*

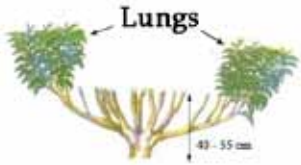


*Fig. 19 : Lung prunning*


*Fig. 20 : Clear prunning*

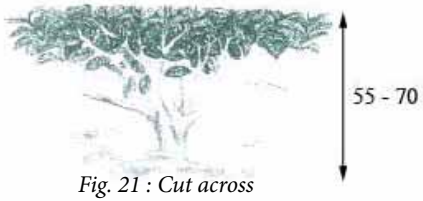


*Fig. 21 : Cut across*

The prunings MUST NEVER be removed from the field. They help:

a) To suppress weeds

b) Prevent soil erosion

c ) Improve soil structure

d) On decomposition release large amounts of plant nutrients into the top soil

c) Form mulch, which reduces loss of water evaporation

'Ramial Chopped Wood' (RCW) Placing a thin soil layer of 3-5cms over the chopped pruning's, will activate the soil faster. This approach termed has been found to be very effective helping build up a healthy soil ecosystem.

The living soil should be supported by a terrestrial ecosystem that provides it with the critical organic matter increment. In the Analog Forestry approach, the enrichment of poor soils is assisted greatly by the use of trees and plants that help to create a good soil.

Tree Roots provide up to 20% of their total root weight as exudates into the surrounding soil every year. Each Species of tree provides differing chemical compounds. Some provide a high amount of nitrogen, other concentrate phosphorus around their roots, etc. Further Different species of trees have distinct species of associated soil organisms. The inclusion of species, with good soil building properties, will provide an increasing degree of sustainability to the tea field.

# 09. Establishing Tea on Organic and Forest Garden production systems

## 9.1. What is Organic Agriculture?

Organic agriculture is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs that can cause adverse effects. The definition of Organic Agriculture as defined by IFOAM is Organic agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved. It is also recognized as one form of resilient agriculture that can help farmers adapt to changes in the climate. It encourages, Crop diversification, Green Manuring, Composting , biological pest control methods, improving soil fertility and controlling pests without the use of agrotoxins.

## 9.2. In all organic systems it is important that no weedicides or other agrotoxins be used to clear the land

All material from beyond the farm, composting material, plants etc should be obtained from clean preferably organic sources

In all Forest Garden systems the whole landscape of the farm must be addressed in accordance with Analog Forestry principles (see annex 1)

1. The plants should be placed uniformly along the planting contour
2. Before planting, the planting hole should be prepared with the addition of about 2KG compost in each.
3. Apply compost twice a year, this will account for about 10 tons ofcompost per annum per acre.
4. Apply foliar sprays after each plucking round
5. Trim and shape the top of the bush so that a flat 'table' is maintained
6. In weeding cut and remove all weeds that rise above the table, attheir root level.
7. Establish a good 'mulch' with straw , pruning residue or other plant matter below the bush. The application of a good mulch is evenmore important in areas with poor shade or exposed soils.
8. Maintain good shade plants to protect the first planting. The climate and amount of shelter or shade given to the tea plant, will affect the quality and strength of the final product.
9. Any treatment of pest attack or disease must be dealt with using organic inputs or management. NO agrotoxins should be applied.

Mid and low country Tea benefit greatly by the maintenance of shade trees, this enhances flavor and quality.

Further, the provision of good shade trees and good mulch around the bush helps greatly in overcoming the stress of drought and dry weather.

*Fig. 23 : Diversity of a forest garden*

## 9.3. Maintaining a good yield with Organic Tea

Organic conversion is the first step to sustainable Tea production by improving the soil nutrition, biodiversity and income for the farmer.

Beyond this, better management of the Tea garden can be gained through developing Biodynamic and Analog Forestry techniques. These will help increase the benefits at a production, biodiversity and income levels.

**9.3.1. Maintaining organic fields always:**

(a) No material from outside the farm should enter the farm
(b) Do not apply prohibited materials
(c) Avoid the entry of contaminants through water
(d) Increase the fertility of the soil

## 9.4. Why organic materials

As shown before the soil is a complex ecosystem that has the power to maintain forests or agriculture with low and locally derived the farm inputs. Traditionally this was well appreciated and the use of green manure, animal manure and the farm ecosystem was an integral part of agriculture.

All plants have evolved through millions of years of co-existence to depend on the soil ecosystem for its health and well being. That is why the farmers of old have a saying: " do not feed the plant, feed the soil, the soil will feed the plant."

Traditionally the farmer was never dependent on any outside agency to maintain productivity. The farmer was an independent producer, who was respected for his knowledge of production. The farmer was never dependent on any outside agency.

The problems with fertilizer salts:

Soon after the World War a great change happened in farming. The multinational corporations began to produce artificial fertilizers and pesticides as aids to farming. In reality this move was prompted by the huge stocks of poisons left after the war and the interest in the chemical companies to find a 'peacetime' market for their deadly products.

Fertilizer salts had two problematical out comes, one was the fact that salts force the plant to take up the dissolved salts due to osmotic pressure. This result is great growth, but the growth was mostly due to swelling up with water. Nutrients and plant protection chemical that are built up in normal natural growth of the plant are reduced, exposing the plant to attack by pests and diseases. Which requires the application of pesticides to control the pests, making the farmer more dependent on increasing quantities of external inputs.

The other dangerous out come is the destruction of the living soil ecosystem that maintained agriculture for millennia. Putting artificial fertilizer into the soil destroys the organisms that make up the soil ecosystem and therefore rob the soil of its agricultural sustainability. This means that after a few applications of artificial fertilizer, the soil gets 'burnt' and the soil ecosystem destroyed. Once this happens, the farmer is forced to buy artificial fertilizers to maintain productivity. Such a process makes the farmer lose his/her independence and will be forever dependent on chemical companies to maintain his crop.

The solution to the problem is to restore the vigor and vitality of the soil ecosystem. It is the only way to ensure sustainability and will act as insurance against year of extreme weather. However, to build the soil ecosystem, is not an immediate process. It is a system of applied management that can span from two to five years depending on the severity of the degradation. It relies of a good planting, composting and mulching program, which is discussed below.

## 9.5. Composting

*Fig. 24*

*Fig. 25*

*Fig. 26*

*Fig. 27*

*Fig. 24 : Dry matter, fresh matter and cow dung used in the composting*
*Fig. 25 : Different layers of compost heap*
*Fig 26 : Cow dung is essential in organic farming and always cover the compost heap*
*Fig. 27 : Desirable quality of compost*

The building of good topsoil is a very long, often centuries long process. Adding compost to the soil helps to restore life and fertility into the soil quickly and helps return it to its original active state in a much shorter time.

When making compost it is always better to create a pile above the ground rather than burying it. A pile helps keep the moisture levels relatively constant, allows for aeration and prevents both leaching and water logging. A compost pile must be maintained at a high level of moisture (50-60%), as this is the optimal range for microorganism operation. A pile of material is easily covered and maintained, thus it is recommended to pile up the compost unless composting bins are being used.

There are three necessities for making good compost.

1) Moisture
2) Oxygen (air)
3) Balanced Diet

### 9.5.1. Moisture

Compost needs to be kept moist in order for the microorganisms to work effectively. A dry pile will not work. A compost pile needs moisture because a lot of moisture is lost during the composting process.

During the composting process not only does the volume of the pile shrink 40-80% of the original but it also loses moisture. Initial moisture content of 65% can dwindle down to 20-30% in the first week or two. However when composting in the open in high rainfall areas the watering needs may be greatly reduced and the compost heap may have to be sheltered from the rain to avoid leaching and water logging. The secret in good composting to keep the compost heap moist but not soggy. Composting is an aerobic process that requires the input of oxygen from the air to drive it Finally too much water can also leach the nutrients away from the heap and render the compost low in nutrient. A volume of about 200-300 gallons of water for each cubic yard of finished compost is the optimum.

### 9.5.2. Oxygen (Air)

Good composting requires the cultivation of bacteria that require oxygen to function. These bacteria are also heat loving (thermophilic) and produce the high temperatures observed in good compost piles. This it is important to ensure the addition of bulky materials that will provide for air spaces and airflow through the heap. . Too much water or water logging can make the heap anaerobic (without air), although there are a group of bacteria that can decompose organic material under anaerobic conditions, it is a much slower process which, can make the heap stink and be unattractive to the operator. Good healthy compost does not stink. If such problems are being encountered, lower the amounts of water supplied and place some organic converting material such as straw or coconut fiber dust over the heap.

### 9.5.3. Balanced Diet

A compost heap is a large collection of microorganisms working as a community and like all living things they require a balanced diet for optimum performance. A good blend of materials or a good Carbon/ Nitrogen Ratio is required to generate a nice, hot compost pile. This means that while a good amount of Carbon can be obtained from agricultural waste such as straw, green clippings etc. a quantity of materials high in Nitrogen must also be added. Materials high in Nitrogen are animal manures, seed cake after expelling oil, etc. In composting a critical aspect is the Carbon to Nitrogen ratio usually expressed as the C/N ratio.

A good C/N ratio for a compost pile lies between 20/1 and 35/1. This means that there will be 20-35 times more carbon than nitrogen in an ideal compost pile. The C/N ratio can also be seen as supplying a balanced diet for the compost microorganisms. While carbon is the essential building blocks of living things and provides for much of the energy transfer, nitrogen is also essential to the maintenance of proteins, genetic and structural elements of cells. If there is too much nitrogen it is lost in the form of ammonia gas, which not only smells bad but also adds to the climate problem.

Another way to increase the nitrogen in compost is to work with 'brown' material such as straw, sawdust, dried leaves etc, and 'green' material such as fresh clippings of leaves and green stems.

Here, two to three volumes of brown be mixed with one volume of greens, with a light dressing of animal manure to produce a mixture with a good C/N ratio for composting.

A basic composting plan is given in *Fig. 24 - 27* . As more experience is gained in composting that is best for each area, more sophistication in the types of materials, timing of turns etc will be gained.

## 9.6. Foliar sprays

Plants do not only absorb nutrients from the roots. They also absorb nutrients efficiently through their leaves. To feed plants in this manner a range of foliar sprays are used. Much like compost there are many recipes. During the project many recipes were tried. The most popular recipe of the project farmers is listed below.


*Fig. 28 : Steps of liquid fertilizer preparation*
*1. Adding raw materials into a poly sack bag 2. Put the poly sack bag into a plastic can*
*3. Addition of cow urine 4. Addition of water 5. Mixing daily 6. Ready to use liquid fertilizer*

### 9.6.1. Inputs

1 Part Glricidia sepium ( Gliiciria), 1 Part Lantana camara ( Ghandapana), 1 Part Ageratum conyzoides or Micania scandens (Hulanthala or WatuPalu), 1 Part Croton lacciferus (Keppetiya), 1 Part Tithoina diversifolia (Wal suriya), 2 Parts Raw Cattle dung, 1 Part cattle urine, 10 Parts water

### 9.6.2. Method

Mix the solid material and place in a sack or porous bag. The bag is tied and placed in a container with the water and urine. The material is stirred by moving the bag in the liquid and the container is covered with a lid. It is stirred daily and maintained for 21 days. After this time, the resulting slurry is filtered through a cloth. The filtrate is the foliar spray. This is diluted by adding three parts water to each part of the filtrate and applied on the field every ten to fourteen days using a sprayer or mister.

## 9.7. Remineralisation

The effect of compost on the soil can be amplified through the addition of another critical set of ingredients. These are the soil minerals. The mineral complex that existed in the topsoils of this land also disappeared along with erosion and the loss of biodiversity that followed the clearing of forests, thus in order to create sustainable farming soils remineralization has to be considered.

The concept of Soil Remineralisation is based on the theory that rock dust is an original ingredient for soil formation but is limited supply.

This supply is created by glaciation or weathering and erosion, which breaks down the rocks and blows the dust around the earth. Microorganisms bind and concentrate its components in the topsoil and make these minerals available for plants. To make up for this loss composts can be enriched with mineral fines produced by finely grinding minerals rich in plant nutrients.

Such mineral fines are chosen for contents with most of the nutrients essential for growth except Nitrogen. The release of nutrients in this mineral form is slow and resistant to weathering. Consequently, their beneficial effect could last for many years before needing replacement, and even longer if used in conjunction with sustainable farming techniques. The problem of nutrient leaching is minimized as plants take up the nutrients at the same rate as they are being released; it also minimizes the problem of toxicity from oversupply of trace nutrients. Some mineral fines raise pH, countering the effects of soil acidity often found in certain soils. If the soil is healthier then the plants will be healthier. Mixed mineral fines can restore the full spectrum of minerals to the soil.

In much the same way as a cake is make with flour, eggs, sugar, and oil, but the way they are combined and processed gives rise to the diversity of flavors and textures of the cakes today. Making compost is similar, there is no one recipe, it is basically composed of brown plant material, green plant material, animal manures and mineral fines, but the way it is processed gives rise to a vast range in quality. Composting is not just making a pile of organic material; it is an art of creating a live, vibrant, ecosystem that will energize the soil.

# 10. Harvesting

The containers used for collecting the leaves while harvesting should be baskets, (cane or plastic) that do not bruise the leaves. Use jute or plastic baskets that will maintain leaf quality.

## 10.1. Maintaining freshness of the leaves until transport to the factory

Wherever possible follow the recommendations below

1. Do not press or bruise the leaves by compaction.
2. Always maintain the plucking basket behind the plucker.
3. After harvest maintain the leaves in shade.
4. If there is a delay in transport, spread the leaves lightly on a shaded cool area.
5. Use plastic baskets for transport to factory.

*Fig. 29 : Fresh leaves transported in poly sack bags are easily crushed , this creates quality defects . plastic crates are more advisable to use for Tea transporting as they do not crush the leaves*

## 10.2. Maintaining the harvested leaves

1. Place the leaves in areas where it cannot be contaminated by animals
2. Keep leaves in a cool, shady area
3. Maintain in a dust free area
4. There should be no possibility of chemicals or foodstuffs contaminating the leaves

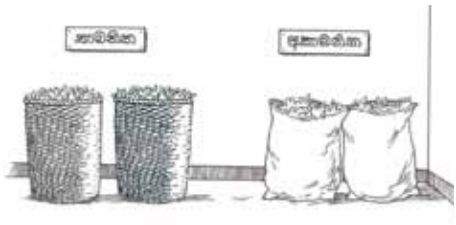

*Fig. 30 :Do not use poly sack bags to store fresh tea leaves*

*Fig. 31 : Store the fresh Tea leaves in a Clean shady place*

## 10.3. Leaf quality

1. Always examine the stock to ensures high quality
2. Always ensure that there are no bruised or dry leaves in the batch

# 11. Infilling

- In a Tea field if there are vacancies there will be a loss of crop and erosion of soil.
- There will be a greater growth of if the Tea cover is poor (Weeds).
- A lack of standardization will create management problems.
- Infilling should be done at every pruning cycle.
- All Tea lands that have a large area of poor cover should be replanted in-toto.
- Establish soil binding plants such as Cymbopogon etc for 18 months prior to planting a new filed.

# 12. Weed control

- Weeds reduce the crop in the Tea field
- Weeds can serve to add organic material to the compost heap.
- Weeds can often be controlled using good mulch such as straw, which is best if used in a semi-decomposed state.
- Weeds are always suppressed by a good cover of Tea or a good shade maintained by the high and medium shade plants.

# 13. Maintaince of shade plants

The Tea plant grows best under some shade and shelter. Traditionally a combination of high and medium shade is used in the low grown teas. When planting medium shade it is important to choose plants with a coppicing potential if a close planting less than 15 meters x 15 meters is considered. At such close plantings the shade providing branches should be lopped off at the onset of the monsoon  At this time the tea plant will require maximum sunlight due to the gloomy days for good growth and the free flow of air around the plants prevents problems associated with high humidity, such as blister blight from infecting.

If the medium shade is a crop tree such as cloves or cashew  which will not be  coppiced, ,it should be planted at wide centers exceeding 15 meters x 15 meters so that the tree can be maintained within the Tea without its shade adversely affecting the production of Tea.

In using Analog Forestry design most utility trees that are not aggressive feeders can be used as both tall and medium shade. Some examples are given below.  A good feature to look for when choosing  such trees is their ability to coppice or be pruned.

1. Maintain the shade plants through pruning to obtain an optimum level of shade.
2. Maintain the trunk and cut the side branches
3. Maintain your shade trees so that you do not affect your neighbor

Conventional Tree species recommended as high shade low grown tea

1. *Albizzia moluccana*

Tree species recommended as medium shade low grown tea

1. *Gliricidia sepium*

*Fig. 32 : Vegetative parts of Gliricidia sepium*

2. *Tithonia diversifolia*

*Fig. 33 : Vegetative parts of Tithonia diversifolia*

Analagous Tree species recommended as high shade for low grown tea

1. *Albizzia moluccana*
2. *Artocarpus integrifolius*
3. *Cocos nucifera*
4. *Schizolobium parahyba*
5. *Bassia longifolia*
6. *Swietenia macroehyla*

Analogous Tree species recommended as medium shade for low grown tea

1. *Gliricidia sepium*
2. *Euginia caryoehyllata*
3. *Anancardium occidentale*
4. *Psidium guyava*
5. *Inga edulis*
6. *Erythrina lithosperma*

(Shade, Effect on Soil, Mulching potential, coppicing potential, crop value, biodiversity impact, moisture retention)

| Scientific name | shade | Effect on soil | Mulching potential | Coppicing potential | Crop value | Biodiversity potential | Moisture retention |
|---|---|---|---|---|---|---|---|
| *Albizzia moluccana* | Medium | Nitrogen fixing | Light | None | None | Medium | Medium |
| *Artocarpus integrifolius* | Heavy | Organic matter increase | medium | High | Fruit, timber | High | Medium |
| *Cocos Nucifera* | Light (when mature) | light | none | High | fruit | low | low |
| *Schizolobium parahyba* | light | Nitrogen fixing | none | none | Timber | medium | low |
| *Bassia longifolia* | medium | Organic matter increase | light | medium | Oil, timber | high | medium |
| *Swietenia macrophyla* | heavy | light | light | none | Timber | low | low |
| *Gliricidia sepium* | Medium | Nitrogen fixing | light | High | Firewood | High | medium |
| *Syzigium aromaticum* | Medium | light | light | none | Spice(buds) | low | low |
| *Anacardium occidentale* | Medium | light | light | none | Fruit | medium | medium |
| *Psidium guyava* | Medium | light | none | High | Fruit | High | low |
| *Inga edulis* | Medium | Nitrogen fixing | high | High | Fruit | High | high |
| *Erythrina lithosperma* | Medium | Nitrogen fixing | high | none | Firewood | High | medium |

*Table 2 : Different uses of tree species used in analog forest designs*

# 14. Biodiversity required for required for Environmental farming

- Beneficial organisms will extend natural pest control
- A diversity of organisms will develop the fertility of the farm
- Other fruit, spice and medicinal plants will increase the income stream for the farmer
- Creating a low input sustainable Ecosystem

Modern agriculture driven by commercial goals has reduced the biodiversity of natural ecosystems to monocultures containing only one crop species. But this approach dispensed with natural controls for chemical and high input controls. But in smallholder systems it is possible to compensate for the decreasing frequency of native biodiversity by increasing the frequency of both native and exotic biodiversity. Such farms are referred to as Forest Gardens. These human influenced areas contains a mix of natural and exotic species termed, hybrid biodiversity.

The pattern of increasing ecological stability with increasing diversity in land use is also corroborated by studies of traditional land managers, whose management systems are sustainable and conserve a much higher level of biodiversity than conventional responses. High levels of diversity in the agricultural field produce positive effects of biological control, spread the risk in marketing and production, as well as distributing labor needs to fit with a single family unit. These traditional methods of land management have much to contribute to biodiversity management.

Increasing the biodiversity on farm gains the following benefits :

- The plant diversity will encourage a greater diversity of beneficial or ganisms for pest control and reduce the need for human control
- A greater diversity of plants will ensure a better build up of soil and increase the fertility of the farm
- An increase of soil organic matter in highly biodiverse farms will encourage water retention and mitigate drought stress
- A greater variety of crops on the farm as a consequence of increasing diversity will increase the income stream to the farmer and act as buffer for price variations on one crop
- An increase in biodiversity will act as an indicator of management-success
- It will help develop a low input, sustainable ecosystem on the farm.

# 15. Analog Forestry

Interplanting with other crop and conservation species so that the optimum shade is maintained.

*Fig. 34 : A number of crop species in one land unit*

As a complement to a rural farmer's subsistence cropping by a mix of annual and perennial crops that mimic the natural forest has been developed as Analog Forestry. An Analog Forest is a tree-dominated farm plot vegetated with a mix of plant species that produce high-value natural products.

An Analog Forest includes canopy trees, vines, understory shrubs, and herbs - a mix that can mature to approximate a natural forest in structure and complexity. Analog Forests, provide increased income for the local farmer as well as improved habitat for wildlife and a range of native plants. Analog Forests are thus ideal buffer-zone systems and is particularly appropriate to degraded agricultural land near protected areas.

Analog Forests seek to replace non-sustainable, high input dependant monocultures with a diverse income generating, sustainable production system that increases in both output and capital value with time.

At the household level, a map should be developed showing only the household and the immediate boundaries. In this map, the house, other buildings, roads and infrastructure should be marked. The kitchen and toilet area should also be identified. Next, the existing crops and trees should be marked. The planning must then proceed to include the AF application goals of Food Security, income generation and biodiversity conservation.

In this map the landscape elements that abut and flow through the farm such as streams, ponds, native vegetation etc must also be identified. Finally the variables considered in farm mapping such as, contours, soil, crops and vegetation should be added. The planning must then proceed to include the AF application goals of income generation, biodiversity conservation, restoration of degraded ecosystems and carbon sequestration.

## 15.1. Ecological succession

Analog forestry uses the natural succession either starting with barren land/grassland to climax forest or by enhancing and accelerating maturity in established home gardens as a model for agricultural and forestry production. Under natural conditions, bare land will become grassland which will slowly progress to shrub land with pioneer trees, pioneer forest, sub-climax forest and finally climax forest (if people do not interfere). Also the soil conditions will similarly increase from underdeveloped soils with no humus layers to well-developed soils with thick humus layers. This is called ecological succession. The follow-up of different stages in the ecological succession is called seral progression.

### 15.1.1. 1st seral stage: Grass dominate

In this first stage grasses dominate. The topsoil is not developed and only plants with a shallow rooting system can survive.

### 15.1.2. 2nd seral stage: Shrub land and pioneer trees

In this stage shrubs gradually dominate with pioneer tree species while grasses disappear. The soil structure is improved and a new topsoil layer and a deeper rooting system is under development.

### 15.1.3. 3rd seral stage: Pioneer forest

In this stage the pioneer trees form the main canopy. Under this canopy seedlings and saplings of sub climax species are growing that need shade when young. The soil structure and the new topsoil layer and rooting system are further improved.

### 15.1.4. 4th seral stage: Sub-climax forest

In this stage the site is inhabited by more diverse plant and animal species. The forest structure is becoming complex and several forest layers are getting formed (i.e. herb layer, shrub layer, lower canopy and upper canopy). The topsoil is developed with the beginnings of humus formation.

### 15.1.5. 5th seral stage: Climax forest

In this stage all the different forest layers are formed and the highest possible biodiversity level is reached. The soil is well developed with a thick humus layer.

In general seral progression to a climax forest can take anywhere from 50 to 1,000 years. In analog forestry it is also necessary to follow a seral progression. One goal of analog forestry is to speed up the progression of the seral stages.

Sometimes the land has already been planted with trees and represents a pioneer or sub climax stage. Here the addition of missing elements and/or growth forms (for example climbers and epiphytes such as orchids) is used to help develop the agricultural/forest land towards higher maturity.

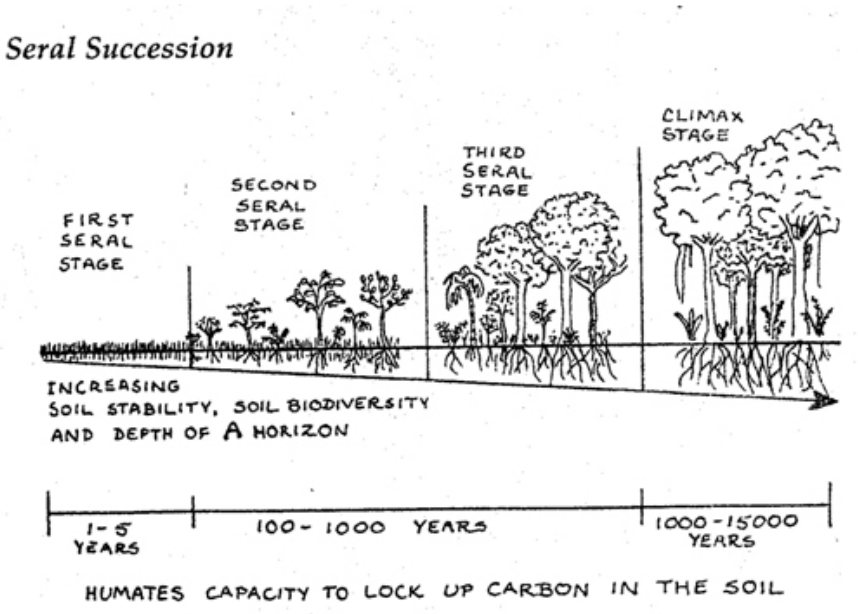


*Fig. 35 : Seral succession; depleated land to a dense forest*

## 15.2. Forest Garden Farm Plan (FGFP)

1. The Forest Garden Farm Plan (FGFP) s a detailed map that records the existing physical and ecological structure of the property. It also serves to provide a clear work plan for the establishment of a Forest Garden. Although a plan could begin as rudimentary, it is expected that in all cases the FGFP will demonstrate increasing sophistication and full conformity over a five-year time horizon. A completed FGFP must have the following features at a minimum:

1. existing drainage patterns
2. cropping pattern
3. existing buildings
4. existing roadways
5. existing vegetation patterns
6. ecological valuation
7. AF design
8. Implementation plan
9. By way of derogation to above requirements only (1), (2) and (3) need to be submitted by unlettered farmers or indigenous peoples until their capacity to produce a FGFP or Area Treatment Plan (ATP) had been developed. An accredited certifier should set the time period.

2. All FGFP 's submitted must have an Analog Forest design for the tree dominated component based on the structure and function of the original vegetation
3. All FGFP 's will incorporate a Total Ecosystem Management (TEM) approach
4. All FGFP 's must address the flow systems and corridors connecting it to other aspects of the landscape
5. Baselines can be measured by the operator, but needs to be verified by the inspector

# 16. Record Keeping

Written records are required for all materials brought onto the farm. These records must include data on the type of material, source, ingredients and post-delivery treatment

All records must be maintained and be kept on file for at least two years even after the crop has been sold.

Where relevant, records must be kept for the following :

- Materials from off farm sources including seed, fertilizer, manure, soil amendments, sprays etc.
- Details of fertilizer and spray applications
- Details of veterinary treatments and fodder sources.
- Details of forest establishment procedure.
- Details of tree species and non-tree species planted.
- Details of biodiversity enhancement.

# 17. Marketing

## 17.1. The tea market

Tea is hot; it is trendy and continuously attracting an ever-expanding group of avid and knowledgeable consumers. Tea is appealing to consumers for its naturalness and tradition. This interest manifests itself in several internet blogs from Tea enthusiasts around the globe. In these blogs, people evaluate various teas and provide insight into the nuances of flavour and aroma and frequently draw comparisons to established norms.

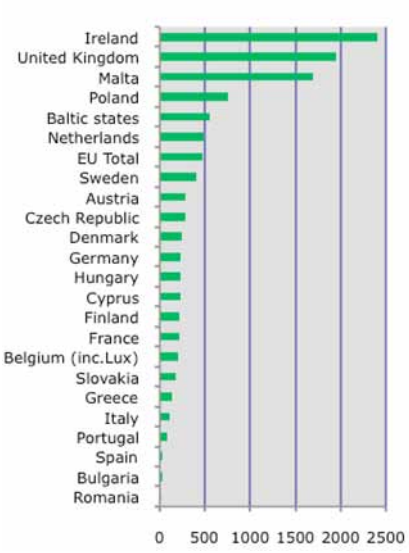


*Fig. 36 : Per capita tea consumption in Europe (in grams/2009)*

Modern consumers are better aware of the products they buy and educated buyer is a smart buyer! The attention paid to tea is therefore not leading to drinking more but increasing demand for better teas. Specialty products are therefore on the rise.

Globally the tea market is showing a decline in sales of the consumption of black tea. In 2009, 61% of the global tea was black tea while in 2007 and 2008, the share of black tea was stronger at 73% and 63%. Green tea accounts for around one third of the market while the balance consisted of Oolong, Jasmine and Puérh teas, mostly from China.

Besides the consumption of pure black and green tea consumers drink flavoured teas on the basis of black or green tea. These flavoured teas were introduced as a response to an increased demand for variety in tea. Teas with an added fruit-flavour but especially herbal infusions (not actually containing tea) are becoming increasingly popular, often at the expense of other hot drinks, and especially black tea.

## 17.2. The EU market

The United Kingdom is one of the world's leading consumers of Tea, accounting for over half of total EU tea consumption. Other leading EU markets are Poland, Germany, France, Ireland and The Netherlands but follow at a distance. In terms of per capita consumption, tea is particularly popular in Ireland, the United Kingdom and Malta, where on average each person consumes around 2 kilograms per year.

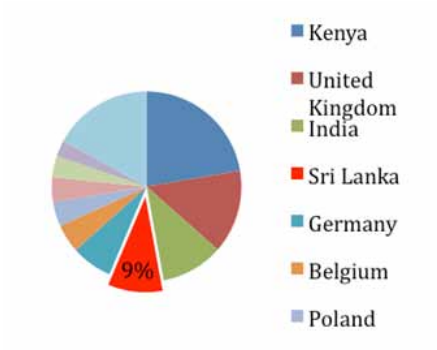


*Fig. 37 : 10 largest black tea suppliers, EU 2009*

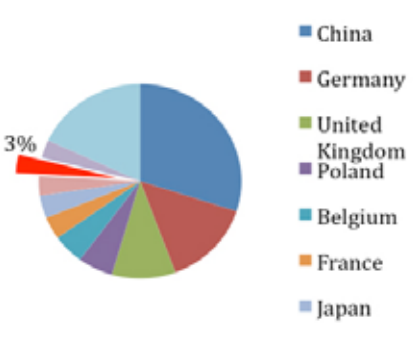


*Fig. 38 : 10 largest green tea suppliers, EU 2009*

## 17.3. Developing your market

There are various ways to develop your market. Firstly, you can market your products in new countries or regions like Europe or the USA. These markets are however dominated by large multinational companies and there is a lot of competition. Next to that you will find that although the European countries might look the same there are many differences. Marketing your products directly can be very difficult. Innovative strategies will be needed to overcome this.

For smallholder farmers developing new distribution channels will be more appropriate. For example, instead of working indirectly through the auction, you can approach agents and importers directly. This is a good option for producers who offer specialty teas of high quality, distinctive tastes or certification. As such, working though new channels for entering new segments is closely related to product development.

## 17.4. A boost in sustainable markets

Besides the social and economic sustainability issues, tea production has considerable environmental impacts like biodiversity loss and extensive deforestation. Unregulated use of pesticides also has very strong negatively affects on the local and wider environment Already for some years, there has been a growing public awareness in the EU of the social hardships associated with tea cultivation. This increasing awareness of the environmental and social aspects of production methods employed, and their impact on poor people and the environment, have been translated into various standards systems which seek to address these concerns.

*96% of Europeans say that protecting the environment is important for them personally. Two-thirds of this group say that it is "very important".*

The best-known and most relevant initiatives are Fairtrade, Organic Certification, Rainforest Alliance and UTZ Certified. The market share of certified teas has grown rapidly over the past 3 years; it was just 1% in 2007, but is now around 10% of the global production. Most of the certified teas are consumed in the EU. As many large EU brand owners have committed themselves to a certification scheme, certification is increasingly the standard in the tea market.

The demand for certified is different in each country. In some markets, certified teas are only served in the catering market, while in other its availability is more widespread. The fact is that almost all major tea brands have committed themselves to sustainability programs and certification.

Going by the current trends and commitments, by 2015, the Tropical Commodity Coalition expects certified teas to constitute around 75% of the British tea market. This development is spreading further across the EU.

Sri Lanka plays an important role in Europe as is the 4th largest supplier of black tea when looking at trade figures. For green tea the share of Sri Lanka is more limited with only 3% of the market but still considerable. Interesting is that the supplies of the UK, Germany, Belgium, Poland and the Netherlands consist of re-exports of tea coming from for example Sri Lanka, as these countries have no domestic production of tea.

FGP is based on the principles of organic agriculture but it has also has incorporated standards of biodiversity, social equity, environmental care and concern for organic or natural methods practiced. This makes FGP certification an holistic system, containing diverse and complementary attributes and providing an integral service which ensure sustainable production. This approach makes FGP an unique certification on the market. It combines the good elements of Organic and Fairtrade but goes much further. By including biodiversity and water quality into the Fairtrade and organic standard it is the only really sustainable certification for producers as well as consumers. Unlike the other certification systems, a system developed in the south it really focuses on the farmer instead of the buyer. By obtaining FGP certification you will be able to tap into the ever growing sustainable and specialist market!

# 18. Conclusion

The Potential of smallholder tea producers create a value added tea product while at the same time  reversing the destructive actions of the past and creating a Tea ecosystem that is sustainable and profitable.

It is now evident that the only people who can help reverse the damage brought about in the early years of tea plantations are well informed, organic and forest garden Tea smallholders. It is also clear that the emerging world market is looking for clean food, produced without agrochemicals and poisons; Systems that protect biodiversity and systems that provide a fair return to the farmer.

It is our hope that this booklet will facilitate the smallholder Tea producers to be effective producers for the emerging markets for clean, environmentally and socially responsible product.

# ANNEX 1

## 01. Principles of Analog Forestry

### Principle 1 - Observe and record

Record the species and ecosystems present in the area under treatment. The initial data will assist in setting a baseline against which future observations their changes can be evaluated. Recording is also of importance in evaluating the management activity and in maintaining a management history.

### Principle 2 - Understand and Evaluate

Understand the farm in as many perspectives as possible. It will function in one way for birds, another for the wild medicinal plants another for the waterflow performance and yet another for its social and economic performance. The landscape will have certain physiognomic features and taxonomic features. A synthesis of many variables will always yield better choices of the species and patterns to be used in design. This is when the farm observations and records must be synthesised with as much scientific and traditional information as possible. Once an understanding of the components of the ecosystem in question is gained, it is possible to evaluate the species within it in terms of the management goals.

## Principle 3 - Know your land

The better a manager understands his or her land the better will be the management response. A good understanding of the geography of the land, its peculiarities and its history is important prior to design. A powerful tool, in understanding the land is a carefully drawn out map that identifies the most pertinent features of the farm. Mapping the land is best done if developed as a series of overlays. Once the physical boundaries have been mapped, overlays that demarcate the contours, the hedges, fence lines, vegetation, soils, wind direction and water flow are some useful variables. The farm map or farm plan should reflect not only the current situation but also the desired future condition.

## Principle 4 - Identify levels of yield

The yield required will differ depending on the priorities of the landowner or manager. If the goal is conservation the yield will be measured by increases in the target species, if the goal is economic gain the yield will be measured in terms of income or production. If the demand for yield is focused on a single crop the higher the yield required the more the production system would move towards a single species monoculture. Finally, the levels of yield should correspond to the value set on different aspects of the design by the operator. For instance one operator might look for Bird and Butterfly increase as yield because ecotourism is seen as the income source, while another operator might look for high value market crop production because traditional agriculture is seen as the income source.

## Principle 5 - Map out flow and reservoir systems

Every landscape has flow systems, solid. Liquid, gas and genetic that produce distinct patterns. Usually the direction of flow in solids, liquids and gasses is governed by gravity, resulting in the very characteristic drainage patters of water or soil flowing on land. Similarly wind moving across the landscape produce some significant patterns. While genes usually follow existing corridors of ecosystems conducive for that species. The other consideration in looking at flow systems across a landscape its the ability to form reservoirs. In waterflow systems, reservoirs, be it natural or artificial can contribute greatly to local productivity. A similar relationship can be seen in the soil, with mineral soils weathering and flowing to form reservoirs of concentrate and in the flow of the organic fraction of the soil.

## Principle 6 - Reduce ratio of external energy in production

All ecosystems use energy to maintain their identity. In agricultural ecosystems, productivity is a goal and energy is expended at meeting this goal. Often energy subsidies from outside the farm have to be provided. As an increase in the flow of energy tends to organize and simplify the system, increases in external energy inputs such as artificial fertilizer and agrotoxins impact both biodiversity and sustainability. Increases of energy to an ecosystem represent a measure by which ecosystem modification can be addressed. In a heavily energy dependent agricultural system, the natural or biological system has been dispensed with and an artificial environment has been created to allow for increased production.

Such a system is not only unsustainable; it creates a dependency cycle that the operator will find difficult to break out of.

## Principle 7 - Be guided by landscape needs

All farming land will be a part of a natural landscape. The boundaries of which are often set by definition. A common criterion to delineate a landscape is on a watershed basis. Once identified, each landscape can be divided into various replicating, such as open fields, tree covered, homesteads, roads, streams etc. A landscape will often have many vegetation components ranging from mature native vegetation to open meadows. The patches of remnant vegetation often being the only habitat left for native biodiversity.

## Principle 8 - Follow ecological succession

In the development of a forest system maturity brings changes in the trophic web which are demonstrated by changes in species composition.

The tree species that are characteristic of each stage confer stability to that particular stage, thus mid-seral successional stages are often better adopted as design criteria for woodlots, orchards, home gardens, tree farms or agroforests, the use of mid-seral leguminous trees such as Erythrina, Gliricidia, and Inga as shade trees for tea, coffee and is common. As the crop plants such as Tea and Coffee are shade adapted mid seral plants which do best in a microclimate created by light shade, the use of shade trees is important to achieve optimum production.

In this design it is clear that the species of shade tree above the crop plant can change in composition but not in structure. The structure of this system means that crop trees up to 2 m in height are protected by shade trees at about 7-10 m. Sometimes, this structure is developed into a more mature ecosystem by adding larger trees such as Albizzia or Michelia.

## Principle 9 - Utilize ecological processes

Incorporation of ecological processes into your design always contributes to further stability. All ecosystems are driven by a series of processes some of which are significant important and contribute to maintaining stability and productivity. Ecological processes in every ecosystem, allow for increases in efficiency through management. An example will be the use of keystone species: A species on which the persistence of a large number of other species on the ecosystem depends and whose impacts are greater than would be expected from its relative abundance or total biomass. or the use of indicator species, organisms that correspond to a certain level or state of biodiversity.

## Principle 10 - Value Biodiversity

Biodiversity has been perceived in many ways over the ages. It is the pattern wrought in biomass at any time. It provides the variety of our living world, has been the source of human inspiration across cultures and ages. Biodiversity provides the material as well as the indicators for sustainable land management.

In modern times it is invaluable as a management tool as the level of biodiversity is an extremely useful measure of the health of ecosystems. Biodiversity measures have also been correlated with environmental stability. Similar patterns have been found in studies of the sustainability of agricultural and forestry practice. High levels of diversity in the agricultural field produce positive effects of biological control, spread the risk in marketing and production, as well as distributing labour needs to fit with a single family unit .

## Principle 11 - Respect Maturity

Maturity is the end condition all ecosystems tend to develop towards. It represents the ability to stay sustainable in any given geographical site. Seral succession or the gradual changing of species and structures in an ecosystem as it moves towards maturity is a singularly important consideration in design. Maturity is a process more than an end condition. Mature ecosystems are usually higher in biomass, than more immature systems. As maturity confers stability every element of a landscape that can mature should be encouraged to do so.

## Principle 12 Respond creatively

In the end, every good farmer has to work with the materials at hand. The species of plants available may be small, the maps may be poor. Often, data on the region may be lacking, but familiarity with landscapes or ecosystems are often superior to poor data. Every landscape and its associated ecosystems will have unique characteristics, some at a level significant for design, others not.

Every landscape, every ecosystem has nestled within it many more. Responding to changes on the landscape must be biased towards increasing system biodiversity . All this requires the farmer to respond skillfully and creatively.

## 02. Exotic species

The use of exotic species in human ecosystems is a fact of life today. The tea plant, rubber, sugar, chillies , etc are all species that came from outside this country, but are a part of our human ecosystems today. Studies on the Kandyan Forest Gardens have found that over 70% of the trees are exotics. Therefore much of Sri Lanka's agricultural production is based on exotic species today. The use of exotics in human ecosystems are fundamental, the only point of concern is if they are invasive and enter the natural forests like Alstonia macrophylla (Hawari Nuga).

## 03. Water

The most important input for sustainable agriculture is water. The ability of a soil to retain water is determined by the rate of infiltration that is determined by the rooting depth of the trees and the organic matter in the soil that helps in the storage of water in the upper layers. One aspect that is often neglected is the importance of deep rooted trees not only to transmit water into the soil but also to bring up water from deep layers to the upper soil horizon to help maintain the shallower rooted plants. A good, diverse planting design helps in water collection, conservation and water cleaning.

The ideal protection for water catchments designated to the production of drinkable water is forest cover. Creating farms that are analogous to natural systems, help greatly in the protection of local water quality.

## 04. Mapping

Before beginning the mapping exercise, it is important to have a general understanding of the area to be worked. This can be achieved by consulting existing maps as well as talking with members of the community.

Mapping is an exercise that requires drawing the contours of the land and emphasizing the principal landmarks that exist within the space. One of the first things that will be identified in the map are the hydraulic courses, the topography of the land, and the direction of the wind. These are significant factors that influence other existing elements and resources. One method of differentiating land resources is by dividing the parcel according to soil productivity: pasture, cultivated land, forest, living area, etc., and using symbols to designate their location. Mapping is a useful and important instrument, giving the farmer an integrated vision of the components involved in farm management.

# ANNEX 2

## Important documentations in the Analog forest gardens

### 1. ICS

An Internal Control System (ICS) is the part of a documented quality assurance system that allows an external certification body to delegate the periodical inspection of individual group members to an identified body or unit within the certified operator. This means that the third party certification bodies only have to inspect the well-functioning of the system, as well as to perform a few spot-check re-inspections of individual smallholders.

The basic elements of an ICS

- A documented description of the ICS
- A documented management structure
- One person responsible
- An internal regulation (production standard, conversion rules, sanctions etc.)
- Conversion rules, i.e. traditional farming/virgin land/known field history
- A contract between the group and the certification body
- Identified internal inspectors
- Training of personnel: manager, internal inspectors, producers and handlers

- Some form of formal commitment of growers
- Field records, maps for each farm
- Annual inspection protocols
- A farm inspection report/form, filled in per farm
- An approval committee that decides to enter the producer on the Growers List
- Use of internal sanctions
- Regularly updated Growers List
- Use of risk assessment to address risks, threats to integrity of organic production
- Use of social control/community surveillance (depending on culture)
- Documented post harvest procedures, including product flow and quantities

# FGP Farmer agreement

| | | |
|---|---|---|
| Name client | : | |
| Address client | : | |
| Client number | : | Country : |
| Name field officer (if any) | : | |
| Name and number unit | : | |
| Name farmer | : | |
| Code/number farmer on farmer list | : | |
| Address farmer | : | |

1. I as farmer declare that I understand the standards for organic agriculture of which the most important aspects are:

- I will maintain and improve soil-fertility by mixed cropping, an appropriate crop rotation, use of animal excrements/ compost, green-manure, cultivation of legumes, erosion control etc.
- I will not use disallowed substances like artificial fertiliser or chemicals (herbicides, pesticides, insecticides, fungicides)
- Control pests and diseases by natural ways and control weeds by hand or me chanically
- Use of organic propagation material
- Avoid contamination of fields and products with disallowed substances.
- Label the certified products correctly as FGP, organic or under conversion.

2. I declare that the on-farm first processing of products, conform the above mentioned standards for FGP / organic production.

3.I will allow FGP inspectors access to all my fields and premises for inspection purposes and I will fully co-operate with them

4.
- I will maintain bio diversity, a detailed land use map of the field, a farm garden farm plan etc.
- I will maintain adequate written bookkeeping of all incoming and outgoing products.

5. In case of non-compliance with the above-mentioned standards I will inform the above mentioned field officer, and I will not sell the products as FGP, organic or under conversion to organic.

| | |
|---|---|
| Date and signature of farmer | : |
| Date and signature of field officer (if any) | : |

# ANNEX 3

## Forest Garden Farm Plan (FGFP)

1. The Forest Garden Farm Plan (FGFP) s a detailed map that records the existing physical and ecological structure of the property. It also serves to provide a clear work plan for the establishment of a Forest Garden. Although a plan could begin as rudimentary, it is expected that in all cases the FGFP will demonstrate increasing sophistication and full conformity over a five-year time horizon. A completed FGFP must have the following features at a minimum:

    1. existing drainage patterns
    2. cropping pattern
    3. existing buildings
    4. existing roadways
    5. existing vegetation patterns
    6. ecological valuation
    7. AF design
    8. Implementation plan
    9. By way of derogation to above requirements only (1), (2) and (3) need to be submitted by unlettered farmers or indigenous peoples until their capacity to produce a FGFP or Area Treatment Plan (ATP) had been developed. An accredited certifier should set the time period.

2. All FGFP 's submitted must have an Analog Forest design for the tree dominated component based on the structure and function of the original vegetation

3. All FGFP 's will incorporate a Total Ecosystem Management (TEM) approach

4. All FGFP 's must address the flow systems and corridors connecting it to other aspects of the landscape

5. Baselines can be measured by the operator, but needs to be verified by the inspector

# ANNEX 4

## Social Criteria

In developing a fair and equitable response to the pattern of trade, this standard addresses participants along the market chain. The producers have individual and social responsibility by his/her family and by his/her community. The exporter has a responsibility in ensuring a fair share of the profitability is repatriated to the production area. The importer has a responsibility by the producers to be transparent on pricing and by maintain auditable records to ensure full customer confidence.

### 1. For individual smallholders.

- All land under this standard, must have the operators rights be recognized at national or local levels. The holding size is usually small and the holding is managed without the use of regular outside labour.

- No land managed by the family shall use child labour to the detriment of the education and development of the child.

- No land under this standard may be sub leased or contracted to other operators.

- There will be a demonstrable investment in family infrastructure and education.

- The fossil energy input to crop output must not exceed 40%
- In cases where regular outside labour is used, minimum wage, provident fund requirement or workplace insurance must be provided.

## 2. For corporate smallholders

2.1. All land administered by a cooperative or corporate structure must have a ratified policy of FGP implementation in its lands under certification.

2.2. Capacity building and education of members must be an institutional goal

2.3. An Internal Control System (ICS) should be in place.

2.4. A transparent decision making process in prioritizing community needs for address through premium payments.

2.5. Child labour will be disallowed.

2.6. The fossil energy input to crop output must not exceed 40%

3. For large corporate landholders

    3.1. A program of Corporate Social Responsibility (CSR) should be in place.

    3.3. A program of collective bargaining must be in place.

    3.4. Child labour will be disallowed

    3.5. The fossil energy input to crop output must not exceed 40%

4. The activity must assist in developing the community to become more aware of itself and assist in developing community health, nutrition and education

# ANNEX 5

## Record keeping

Data on harvest

| Date | Harvest Kg | Man days | Labor cost |
|---|---|---|---|
| | | | |

Organic fertilizer production

| Date | Materials | Quantity Kg | First mix | Second mix | Third mix | Production Kg | Recommandation |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

Usage of organic fertilizer

| Date | Variety (Crop) | Quantity Kg | Farmer post observations | Field officer post observation |
|---|---|---|---|---|
| | | | | |

Cattle husbandry

| Date | Item (Food) | Quantity Kg | Milk production L | Cow dong production Kg | Vetenary instructions | Recommandation |
|---|---|---|---|---|---|---|
| | | | | | | |

Tea forest garden production and plant distribution

| Date | Item | Quantity | Planting Date | Quantity | Harvest Kg | Recommandation |
|---|---|---|---|---|---|---|
| | | | | | | |

Land activities

| Date | Activity | Cost for labor | Recommandation |
|---|---|---|---|
| | | | |

# ANNEX 6

## Certification agencies

Forest Garden Product Certification Service

| | |
|---|---|
| Contact Person | : Mr. Deva Vikrantha - Senior International Inspector |
| Address | : 125/2, Castle lane, Colombo 4 |
| Phone | : 011 2552494 |
| Fax: | : 011 2552494 |
| E-mail | : info@forestgardencertification.com |
| Web | : www.forestgardencertification.com |

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Control Union Inspection PVT ltd

| | |
|---|---|
| Contact Person | : Mr. Sanjaya K. Pathirage |
| Address | : 39/2A, Sir Marcus Fernando Mawatha, Colombo 07 |
| Phone | : 011 2678607-9 |
| Fax: | : 011 2678610 |
| E-mail | : skpathirage@controlunion.com |
| Web | : www. controlunion.com |

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SriCert

| | |
|---|---|
| Contact Person | : Mr. Thilak Kariyawasam |
| Address | : No 546 /3 Wata Mawatha, Gangodawela, Nugegoda. |
| Phone | : 0112803139 |
| E-mail | : sricert@sltnet.lk |
| Web | : www.sricert.org |

## ECOCERT INTERNATIONAL

Gueterbannnofstr. 10, 37154 Northeim, Germany
Tel. : +49 (5551) 90843-0,
Fax : +49 (5551) 90843-80
Email : info@ecocert.de
Web : www.ecocert.de

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## National Association for Sustainable Agriculture, Australia (NASAA)

Tel : +61 8 8370 8455
Fax : +61 8 8370 8381
Email : enquiries@nasaa.com.au
Web : www.nasaa.com.au/

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## BIO SUISSE

BIO SUISSE Margarethenstrasse 87 4053 Basel
Tel : 061 385 96 10
Fax : 061 385 96 11
Web : www.bio-suisse.ch
E-mail : bio@bio-suisse.ch

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## Organic Farmers & Growers Limited

Elim Centre Lancaster Road Shrewsbury Shropshire SY1 3LE
Tel : 0845 330 5122 (local rate call)
Fax : 0845 330 5123 (local rate call)
Email : info@organicfarmers.org.uk
Web : www.organicfarmers.org.uk

## Naturland - Association for Organic Agriculture

Naturland e.V.
Kleinhaderner Weg 1 D-82166 Gräfelfing Germany
Tel. : +49 89 - 898 08 20
Fax : +49 89 - 89 80 82 90
E-mail : naturland@naturland.de
Web : www.naturland.de

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## Institute for Marketecology (IMO)

Institut für Marktökologie, IMO Weststrasse 51 CH-8570 Weinfelden – Switzerland
Contact Person : Mr. M Rajasingham
Address : 2/1, Maliban Arama Rd Baddegana South CL – Pita Kotte
Phone : 011 492 6560
Fax: : 011 5524765 7
E-mail : raj@eureka.lk
Web : www. imo.ch

# ANNEX 7

## Permitted Materials for use in Soil Fertilizing and soil conditioning

For soil management and improving fertility the following materials are permitted:

- Composts from organic farm or household refuse
- Composts from plant residues
- Peat
- Coconut Fibre Dust
- Wood Ash
- Sawdust, wood waste, bark or rice hull from untreated sources
- Organic by products from food and textile industries
- Straw
- Slurry or urine
- Heat composted animal manures*
- Blood and bone, fish meal, hoof and horn meal, or other waste products from fish or animal processing *
- Seaweed or seaweed meal *
- Bio-Dynamic preparations 500 -507
- Approved microbial or biological preparations
- Massive Soil Inoculation (MSI) from identified sources
- Naturally occurring biological organisms (ie.worms) but excluding products from recombinant DNA technology

- Fish products
- Homeopathic preparations
- Ayurvedic and other traditional plant based preparations.
- Basic slag
- Dolomite and Lime
- Gypsum (Calcium sulphate) from a natural source
- Calcined or rock phosphate
- Rock Potash and sulphate potash
- Crushed mineral bearing rock
- Stone meal
- Clay
- Trace minerals (includes materials such as Borax, Epsom salts, but notsynthetically chelated elements). Natural chelates such as lingo sulphates areacceptable, as are those using natural chelating agents such as citric, malic,tartaric and other di- and tri- acids.

- Radioactive rock

Note: *The repeated use of any product has the potential to introduce unwanted residues and contaminants. Heavy or repeated use of any productsshould be supervised by and accredited certifying organization and based onan assessment of need and with knowledge of chemical analyses.*

*These products must be free of additives that are prohibited substances such as artificial fertilizers.

- Must be applied as active compost or re mineralizing rock four and must not exceed the radiation levels of native basaltic or igneous rock.

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The Tea industry in Sri Lanka is just over 150 years old. During this time the Tea sector in Sri Lanka has flourished and established it'self as a brand known widely as "CeylonTea" and one of the world loved beverages. Much of the modern tea industry is built upon innovative knowledge gained from Tea production and processing in Sri Lanka. However challenges are surfacing in the Sri Lankan Tea estate sector such as reduced productivity due to degraded soils and an acute labor shortage.

These have seen the emergence of the smallholder producer as alternative green leaf supplier to the sector. At the present over 70% of Sri Lanka's Tea is grown by the small holder sector and this has shown a steady increase in the past decade. The need to support and enhance the operational actions of these Tea small holdings is essential for the sector to reach it's production targets while restoration of soil productivity and other related ecosystem services will provide poor farm families the opportunity to reach a more healthy and sustainable future.

This handbook is an outcome of The Forest garden Tea project- a Private Public Partnership Project funded by the Dutch foreign ministry. With an objective of sharing knowledge gained during the project while informing the Small Holder Tea farmers best practices in Tea production and the opportunities that exist in the value added forest garden certified and organic certified Tea markets the world over. The partners hope that this handbook will create a dialogue within the Tea sector of Sri Lanka and invite the whole Tea industry to build a truly sustainable future for Sri Lanka's Tea.

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