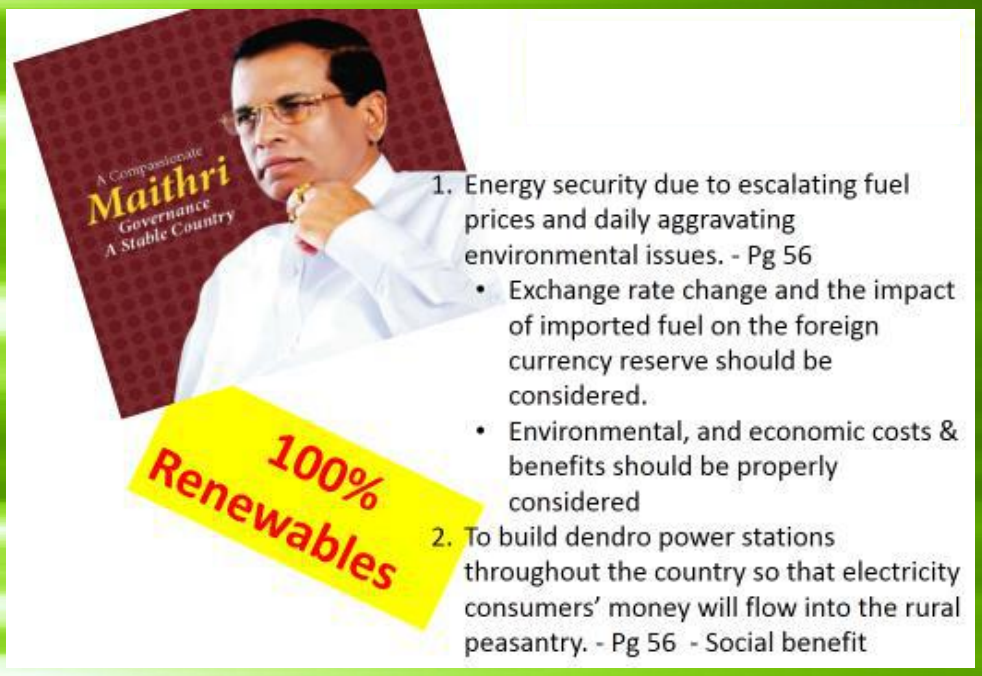
GREEN ENERGY

Bio Energy Association of Sri Lanka
October 2016

HIS EXCELLENCY THE PRESIDENT CHAMPIONS BIO ENERGY

His Excellency the President Maithripala Sirisena has been championing the development of Bio Energy from the time of his Presidential campaign. His election manifesto itself has been most specific in his proposals to develop bio energy as illustrated below.



I will specially take action to build dendro power stations throughout the country so that electricity consumers' money that hitherto drained to the pockets of the coal and oil mafia will flow into the rural peasantry. Thus I will make power generation a chief means of raising the living standards of the peasantry. **Maithree Palanayak - page 56**

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Emphasizing his commitment and the additional drive towards a toxic free agriculture, the President has now declared a most important project to grow **One Billion Gliricidia trees** over the next three years. This is to be spearheaded by programs commencing with the Tree Planting Month starting from the 17th September 2016.

The Bio Energy Association of Sri Lanka (BEASL) has over the years highlighted the need for aggressive planting program to ensure a steady and sustained supply of fuel wood as the most important pre requisite for a successful Bio Energy development program. Our efforts so far have elicited very poor responses from the state sector in spite of the growing realization of the importance of the bio energy as a vital component of the national energy options. The presentations made to the Sustainable Energy Authority vested with the mandate to develop this as a national resource are yet to receive adequate attention and active integration into any focused plantations development plans.

In this background the President's interest and personal intervention with a most challenging target is most welcome and deserve our gratitude and fullest support for its success. To underscore this support the Bio Energy Association through some of its members has already taken action to develop up to a Million Gliricidia trees. Nurseries are being established in readiness to transfer to the field once the next monsoon rains set in to ensure successful establishment.

All members are encouraged to support this development drive by engaging in this planting program at whatever scale, even at the level of the homesteads and keep records of their planting programs. The BEASL web provides valuable information on different planting options and other valuable information for successful establishment of Gliricidia and other Short Rotation Coppicing trees. Further detailed information may be obtained by contacting the Association.

SAY NO TO COAL AT ANY COST!

The fight to keep the killer coal power option alive still rages. Ignoring the fact that Sampur coal power plant will require at least five years to build, fears of an impending power shortage in 2018 is used to hoodwink the policy makers. The myth of cheap electricity from coal is still used with highly innovative accounting methods to support the premise.

Demonstrations at Sampur

However, the many negative impacts of such a coal power plant are being hidden from the public.

THE DANGERS OF COAL POWER

The choice of coal power is fundamentally flawed by consideration of its negative impacts, which overrides any purely monitory or economic arguments. Coal has to be rejected in toto before even considering financial or economic values, based on environmental and health reasons which should take precedence. Someone has to speak on behalf the silent majority who are not given any chance to express their views on this issue, but are expected to accept whatever danger is forced on them.

The world is moving away from coal as fast as possible, even those countries with large deposits still intact. Sri Lanka with no coal has no earthly reason to import the millions of tons of coal replete with many pollutants, which will remain forever in Sri Lanka. The most efficient cleaning mechanisms and mitigatory measures will

only transfer the pollution from one medium to the other and will remain within Sri Lanka.

But the numbers do not matter. The engineers do not have the right to impose on the people such a grave environmental and health hazard when other alternative solutions do exist, as the value of peoples' health and human lives cannot be valued in rupees and cents.

The fact that many countries have decided to shut their coal power plants realizing their inherent dangers should be enough for us to stay clear of the disasters that would ensue. We are still arguing what is responsible for the CKDu, while thousands are dead or dying. Some "experts" in the energy sector are heartlessly following a similar path.

Therefore, it is time that the general public are made aware of the dangers they are already placed under and would have to face increasingly in the future.

The approval of the Wayamba Province Environmental Authority via the Environmental Impact Assessment (EIA) has been questioned on the basis of the adequacy of the scope of EIA and the hazards addressed, which has ignored the graver hazards of coal power now well recognized world over.

The public has no access to data to ascertain if even the limited safe guards against the few hazards such as particulates and Sulfur, are in fact being observed. The recent TV footage and the photographs taken recently vividly demonstrated that even the few mitigation measures imposed by the conditional approval of the EIA for Norochcolai have not been installed. If such is the case, the plant is operating illegally and any private sector industry would have been shut down by the CEA under similar circumstances.

The recent newspaper articles extolling the virtues of the Norochcolai coal power plant admits intension to grow a barrier of trees now, which should have been done years ago. Contrary to the accolades given in this article of the chimneys free of any visible emissions, the reality is quite different

Coal dust on every inch on vegetation and buildings

More pictures can be seen by accessing the links

https://www.facebook.com/otaradel/photos/pcb.10153667395842183/10153667393282183/?type=3

https://www.facebook.com/otaradel/posts/10153754009907183

https://www.facebook.com/otaradel/posts/10153753975897183

Pictures by courtesy of Otara Gunawardene Foundation

The Invisible and Long Term Health Hazards

But what is of greater concern are the toxins freely emitted without any control. In the absence of any local data or specifications, the following estimates of likely emissions have been calculated based on the level of these toxins present in coal, as reported by the Environmental Protection Agency of the USA.

USA Standards for Emissions (Source : EPA standards in USA)

Metal Emitted	Emission Rate without mitigation g/GWh	Emission Standard g/GWh
Lead	220	9.1
Mercury	117	1.4
Chromium	114	3.2
Nickel	110	1.8
Arsenic	76	1.4
Cobalt	29	0.9
Cadmium	5	0.2

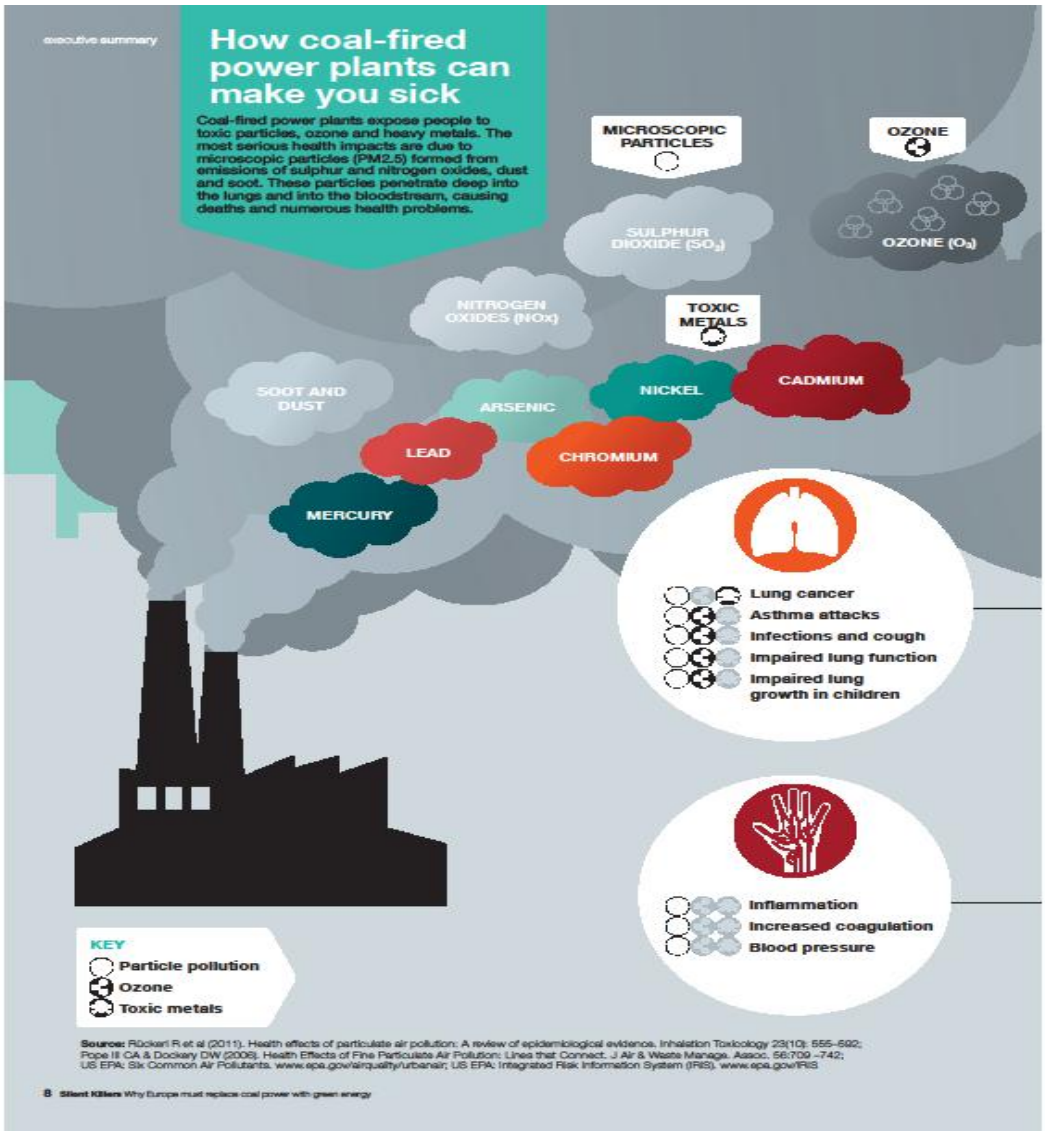
Heavy Metal emissions already released and Annual Additions at Full power from Norochcolai Coal Power Plant

Since the inception of the coal power plant at Norochcholai, the heavy metals in the coal imported have been released to the environment without any attempt at control. This is a most dangerous health hazard, hitherto not even mentioned by the CEB or even by the CEA, the watch dog on environment for the nation.

The amounts already discharged can be estimated based on the amount of energy generated. This stands at 10532 GWh for the period 2011-2015, using the data published by the EPA shown above.

Heavy Metal	Amount released up to 2015 in kg	Annual release at full capacity of 900 MW
Lead	2317	1474
Mercury	1232	784
Chromium	1201	764
Nickel	1159	737
Arsenic	800	509
Cobalt	305	194
Cadmium	53	34

The health impacts of coal power are well illustrated in the front page of the publication "The Silent Killers" by Green Peace organization shown below.



This is a vivid picture of the grave danger to health of the nation, by choosing coal as the means of power generation, with the myopic vision of only financial considerations. The probable quantitative health impact of these has been reported in different studies including neighboring India. It will be necessary to relate these numbers to Sri Lanka., which has already received a heavy dose of these dangerous toxins as described earlier. The least that could be done is to institute whatever mitigation measures possible, instead of planning to add more coal power.

The Clean Air Task Force of USA reports in their publication "The Toll from Coal" estimates the health and other Impacts (2010 est) in USA.

Health Impact	Incidence	Valuation in $ Millions
Mortality	13,200	
Hospital Admissions	9700	
ER Visits for Asthma	12,300	
Heart Attacks	20,400	100 Billion
Chronic Bronchitis	8000	
Asthma Attacks	217,600	
Lost Work Days	1,627,800	

Ref www.catf.us

1. "Scientific Evidence of Health Effects from Coal Use in Energy Generation" by the School of Public Health of the University of Illinois, Chicago (Burt *et al*, 2013) has found that:
   For **every TWh** of electricity produced from coal in Europe, there are 24.5 deaths, 225 serious illnesses including hospital admissions, congestive heart failure and chronic bronchitis, and 13,288 minor illnesses these figures will have to be multiplied by the actual amount of energy that Sri Lanka proposes to generate from coal. We have already generated 10.5 TWh of coal power.
2. "The Health Effects of Coal Electricity Generation in India" June 2012, by Maureen Cropper, Shama Gankar et al. reports that,
   "W*e estimate health damages by combining data on power plant emissions of particulate matter, SOx and NOx and are used to estimate premature cardiopulmonary deaths associated with air emissions for persons 30 and older. Our results suggest that 75% of premature deaths are associated with these pollutants*"

3. An EU Report (2016) indicates that **Coal dust kills 23,000 per year.**

Sri Lanka with no coal reserves at all, having done the mistake of installing the first coal power plant, an ostrich-attitude is being adopted not even acknowledging the existence of these grave health hazards, and is trying hard to add to the problem.

Those who try to justify this insanity, quote savings in rupees. But what is the value of human health and lives? What are our guardians of environment and public health doing to even try to monitor the ongoing disaster?

Naturally the argument used by the CEB that coal power is cheap is no longer valid if we put any kind of value for the health and lives of our people, which cannot be measured in rupees and cents or even in Dollars.

The choice is quite clear. The addition of any more coal power plants cannot be justified by any means. What is now necessary is to minimize the danger caused by the already operating Norochcholai Coal power plant and institute actions to either changing the fuel used and failing which, to close it down as early as possible to limit the damage already caused.

Eng. Parakrama Jayasinghe

Past President - Bio Energy Association of Sri Lanka
Email : parajayasinghe@gmail.com (5th July 2016)

GLIRICIDIA AS A PLANT NUTRIENT

This commonly found leguminous plant (fixes nitrogen from the atmosphere through root-nodular bacteria) is widely used to enrich the soil in different ways.

In-situ Compost

The gliricidia leaves could be used for *in-situ* production of compost. The leaves, either green or dry, could be mixed with paddy straw and retained in the soil which can be quickly converted to compost by adding cow dung slurry and using a hoe to chop and mix thoroughly.

Liquid-fertilizer

The following preparation is sufficient to supply nutrients for one acre of vegetable plants:

- **100 L of water**
- **10 kg of wet cow dung**
- **25 kg of green gliricidia leaves**
- **5 kg of *Baloliya, Higuru or Gandapana* leaves**
- **½ kg of *Murunga* leaves**
- **A handful of fresh soil from the surface layer**

The mixture must be kept in a vessel and mixed well for about 14 days. At the end of the 14 days, the not decomposed material that comes to the surface should be removed and the remaining liquid is diluted with three parts of water to one part of the liquid.
Add 100 g of soap to 10 L of the prepared liquid and sprinkle the plant every seven days as a foliage fertilizer.

Jeewamrutha (a microbial culture)

The following preparation is sufficient for application to one acre of vegetable plants:

- **200 L water**
- **10 kg cow dung from indigenous cattle**
- **4-5 L of cow urine**
- **2 kg of jaggery (*Sakkara* – cane-sugar jaggery)(*Alternative* – use 4 L of coconut water or 2-3 kg of ripe fruit)**
- **2 kg of flour of a pulse such as cowpea, green-gram or black-gram (*Alternative* - use 6 -8 kg of gliricidia leaves dried for two days and shredded)**
- **A handful of earth from the top surface**

Prepare the mixture in a barrel and stir vigorously three times a day for 5-6 days. The filtered solution must be used within two days by sprinkling on the plants. As it is a microbial culture it cannot be kept too long unlike the liquid-fertilizer.

Dr.Gamini Kulatunga

PLANTING MATERIALS OF GLIRICIDIA

Seedling nursery

Gliricidia flowers in January and seeds mature at the end of March or April.

A lengthy dry season, before and after flowering, induces fruit bearing. Pods must be harvested when they are pale yellow and allowed to dry in the shade till they split open. Around 9,000 seeds, brown in colour, will weigh one kilogram.

Small seeds would not thrive in the

open field and hence it is necessary to germinate in nursery bags. Nursery bags of 12.5 to 22.5 cm diameter filled with a suitable potting medium for germination.

Place only one viable seed at a depth of 1 cm in each pot as procurement of seeds is difficult and care must be taken not to waste any.

At the beginning of the nursery daily irrigation is required and care should be taken to protect seedlings from cattle and goats.

Seedling nursery prepared in the field

Seedlings after eight weeks from the time seeds are sown and more than half a meter in height are suitable for planting in the field.

Planting materials - Cuttings nursery

Availability of Gliricidia seeds is very rare in many parts of Sri Lanka.

Diameter of cuttings should be less than 3 cm of mature sticks. Sticks are cut into 20 cm long pieces.

Nursery bags of 12.5 cm in diameter and optimum depth of 12.5 to 22.5 cm filled with suitable potting media.

Nursery bags need to be arranged in a bed of maximum 1 m width and necessary length to accommodate the bags.

Extracted cuttings, treated with fungicide and suitable rooting hormone for growth acceleration, will also minimize the percentage of dead plants.

Arch type propagator need to be prepared over the nursery bed to stimulate germination of small sticks. Transparent polythene and flexible thin sticks (conduits or PVC pipes or bamboo strips) are suitable to prepare curved structure to lay polythene.

Water saturation of nursery pots is required before covering with polythene as intermediate irrigation is not possible until the polythene tunnel is removed.

Propagator polythene cover lies on top of the structure and made air tight by compacting soil at the bottom.

Keep this structure air tight for two to three weeks until germination percentage is adequate.

Remove the polythene cover gradually in the morning or evening to minimise the evaporation and water-stress of small plants. Train small plants to the normal environment within few days and allow them to grow under 50% shade conditions for two to three weeks. Small plants need to be given adequate care and weeding after establishment in the field until they are strong enough to survive in a harsh environment.

Cuttings nursery just after the removal of polythene cover

Piyasiri Gunasekara

Soil Nitrogen Abstract

Knowledge of the status and dynamics of soil N is essential to improving the production and management of silvopastoral system in the tropics. Soil N status and dynamics were analyzed as key factors affecting productivity and sustainability of a cut-and-carry silvopastoral system. The total soil N and N mineralization as affected by soil moisture and temperature were studied in a Gliricidia sepium (Jacq.) Walp Dichanthiumaristatum (Poir) C.E. Hubbard grassland association and in an adjacent open grassland located in a subhumid tropical region. The plot was installed in 1989 and the pruning residues and cut grass were removed from the site. No N fertilizer was applied. Total soil N increased at an average rate of 180 kg N ha−1 in the 0–0.2 m soil layer of the silvopastoral plot. Only a third of this value could be explained by the litter, nodule and root turnover. Nitrogen mineralization in both soils varied as a function of temperature but it was not affected by soil moisture. Even if mean soil temperature was 1 °C to 2 °C greater in the open grassland, the estimated daily rate of in-situ N mineralization was 20% greater in the silvopastoral system. Our results indicated that greater N mineralization in the silvopastoral system was due to greater soil biological activity associated with higher soil organic matter rather than due to more favorable soil temperature and water conditions.

Tropical Ecology 48(1): 87-97, 2007 ISSN 0564-3295

www.tropecol.com

Nitrogen cycling in gliricidia (Gliricidia sepium) alley cropping in humid tropics

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Abstract: An experiment was conducted to evaluate the effect of method and time of application on the decomposition pattern of Gliricidia leaf manure and nitrogen release, mineralization and soil N pools, nitrogen uptake and shoot biomass and grain yield of maize in humid climate of South Andaman, India. Treatments included two methods (leaves being incorporated into soil vs. surface) and three times of application i.e. zero week after sowing (0 WAS), two week after sowing (2 WAS) and four week after sowing (4 WAS). Two additional treatments, urea (120 kg ha-1, equal to the leaves) and control (no urea + no leaves) were also maintained to compute recovery of nitrogen from the leaves by the crop; and to know if the leaf manure could produce grain yield equal to that of equivalent urea. There was no effect of the method of application on the decomposition and release of nitrogen from the leaves, soil N mineralization, nitrogen uptake, shoot biomass and yield of the crop, but time of application affected these parameters significantly. Maximum 50% nitrogen was released quickly from the leaves within

Picture courtesy - IITA image library

15 days and remaining 48-49% gradually in 60 days. Rate of soil N mineralization, nitrogen uptake, shoot biomass and grain yield in maize were highest in 2 WAS and lowest in 4 WAS treatment. Recovery of nitrogen from the leaves was very low ranging from 4.5 to 9.3 kg ha-1. The leaves could not produce yield in maize equal to that of equivalent urea. However, for synchronization of maximum release of N from Gliricidia leaves and its uptake by maize crop, the leaf manure should be applied two week after sowing.

PROPAGATION OF GLIRICIDIA BEFORE FIELD PLANTING

Propagation and multiplication of *gliricidia* are very easy when compared with other fuel wood species grown in Sri Lanka. Usual planting material for *gliricidia* is cuttings obtained from trees more than one year old. Although, in germination some percentage of sticks die due to various reasons, even under optimum field conditions, it is unlikely to get 100% germination. Planting programme with a large number of sticks will result in a significant labour wastage if sticks die after field establishment. Therefore mature sticks are kept in the nursery for a minimum 3 to 6 weeks until roots establish and fresh shoots appear. It is advisable to bring healthy germinated planting materials to the field to get 95 to 100% success rate in the field.

Guidelines to extract planting sticks

Selection and extraction of suitable planting material from existing trees is the most important part of the exercise. Following guidelines can be used to choose optimum branches from existing trees:

- Selected trees should be more than one year old.
- Branches must be harvested without splitting them at the top edge.
- Minimum diameter should be 2 cm at the top and 2.5 cm at the base of sticks.
- Length of the sticks should be between 1.2 to 1.5 meters
- Extract only one stick from a branch to avoid young cuttings
- Cut must be sharp and slanted at the base and the top

Things not to do !

There are things not to do in harvesting and handling of planting material for nurseries to get better results in nursery practices:

- Avoid young, green, and too mature parts of the stick
- Avoid splits at the top end of the stick
- Avoid sun burns after sticks are collected by placing under a shade resting against a tree
- Avoid mechanical damage to the bark when handling

Nursery site selection

Look for a good site for the nursery nearby to the plantation to minimises the cost involved and increase the rate of success. Even though the entire requirement is not being met,

accept sites with few important requirements, such as:

- Ensure more than 50% shade and placing under a tree shade is preferred
- Flat ground with good drainage condition is preferred
- Whenever possible select a place close to a water source
- Avoid sandy and clayey soils; loamy soil is preferred
- Select a site within the plantation- may be under a tree leftover while clearing the land.

Preparation of a Nursery

The purpose of the nursery is to propagate sticks to provide a good media at the lower end for root initiation while microclimate adjustment (reduced direct sunlight and increased humidity) to induce germination.

Useful step to follow in setting up a *Gliricidia* nursery are listed below:

- Draw lines 2.5 m apart in east-west direction
- Open shallow (15x15cm) ditches 0.5 m apart from each side of the line drawn to the required length.

- Hammer two pointed poles (5 cm diameter) 20 cm long to the ground, slanting over opened ditches towards middle of the drawn lines so as to cross the top ends at a 0.75m height.
- Repeat same 2 m apart along the line drawn.
- Place poles horizontally on top of the crossed poles and bind them tightly using coir rope.
- Adjust the height of the horizontal pole to suit the length of the sticks.
- Extra crossed poles are not necessary when there are tree stems to bind the horizontal pole.

- Place planting sticks in the ditch and lean them on the horizontal pole (what angle?).
- Continue this alternatively on both ditches along the length of the line.
- Ensure that the sticks touch and cross each other at the horizontal pole and maintain clearance at the base for the sticks placed on the opposite side.
- Place dry cow dung, compost, coir dust or loamy soil in the ditches Place coconut leaves over the top of the nursery line for shade.

Maintenance of the nursery and planting

Following the minimum care given below will ensure good success rate.

Such plants with shoots and roots will give successful trees in the field with more than 90% rate of establishment.

- Apply water to moisten the soil but avoid excessive water. Sprouts are initiated from first week of planting and the root mass matures after 3 weeks.
- Prevent stray cattle and goats coming near the nursery by erecting a temporary fence.
- Maximum duration of the plants to be kept in the nursery is 6 weeks and it is necessary to start transplanting them after the 4th week.

Piyasiri Gunasekara