Evergreen Energy: a mighty nature-based solution

Isuru Seneviratne, January 23, 2020

Photocredit: Biomass Group Ltd (Sri Lanka)

Evergreen agriculture is a type of agroforestry that integrates trees into crop and livestock production systems. Combining this with bio-energy generation is a unique and massively scalable solution for reducing emissions with many ecological and rural empowerment co-benefits.

Sri Lanka has been a pioneer in scaling up such a solution using smallholder-sourced biomass from Gliricidia trees. The fast-growing, easy-to-cultivate Gliricidia can tolerate repeated cutting, every 2 to 4 months depending on the climate. Biomass Group Ltd is aiming to train 500,000 farmers and have a billion trees planted by 2022, as intercrop or live fences. The group actively discourages mono-cropping, and no additional land is cleared to grow biomass.

Energy Security

Many emerging economies are dependent on importing energy, a most critical component of continued development. Engineer Parakrama Jayasinghe has studied how Sri Lanka can become energy independent by 2030, with bio-energy as a key component. Sri Lanka's fossil fuel bill has bloated to over 30% of the total import bill. Beyond petroleum-based transportation, of the 14,671

GWh electricity generated in 2017, 35% was from coal and 34% was from oil. Self-generation of energy will be a major boon to the country.

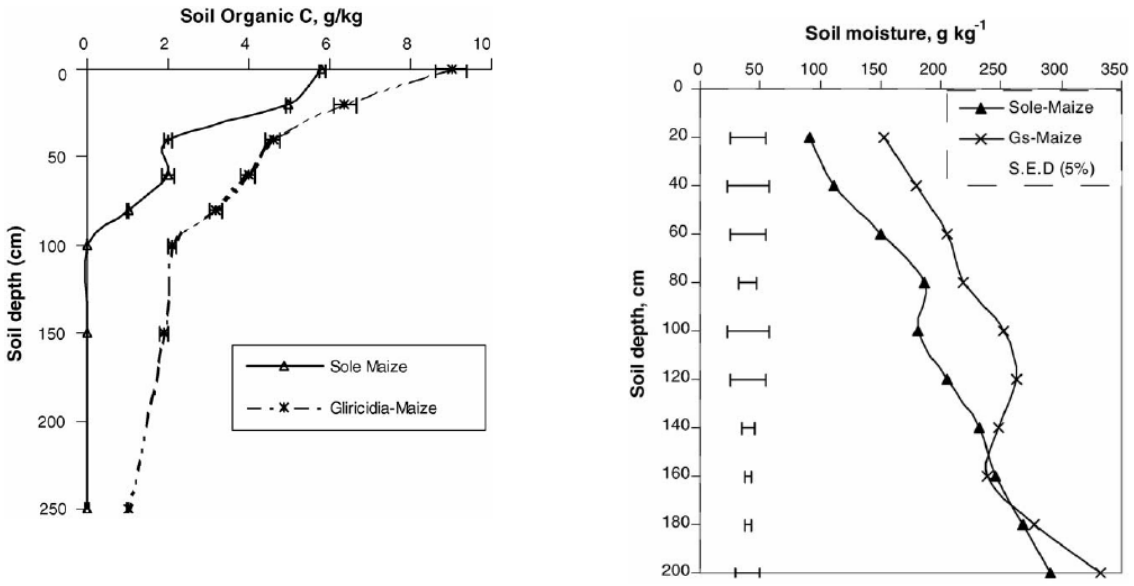
When Gliricidia branches are harvested, they are pelletized and fed into thermal power plants as fuel. Since the carbon emitted in this stage was accumulated via photosynthesis during biomass production, the process **does not release fossilized carbon** into the atmosphere.

Loggal Oya Biomass Power Plant (2MW from 80 metric tons of fuel wood).
Source: Lanka Nature Power

The reliable and sustainable supply of fuel wood is the biggest challenge to smooth operation (consumes 1.7 kg/kWh, as delivered with a moisture content of 40-50%). However, at the current low density of biomass energy plants, even the existing Gliricidia trees in the informal sector are adequate, says Jayasinghe, the past president of Bioenergy Association of Sri Lanka. Close coordination with farmers is essential in the small-scale farmer "outgrow" model. A 10 MW-size plant located strategically to get supplies of 400 tons per day from a radius of about 30 km, limits the use of diesel for haulage.

Ecological Benefits

Gliricidia root structures increase soil organic carbon, enriching the soil. The below results (L) demonstrate the long-term effects of a gliricidia–maize intercropping system in Southem Malawi. Another ecological benefit of evergreen agriculture is improving soil moisture retention, also seen below (R). This helps plantations become drought resilient.



Source: Makumba, W., Janssen, B., Oenema, O., Akinnifesi, F., Mweta, D., Kwesiga, F., 2006. Agriculture, Ecosystems & Environment 116, 85–92.

Gliricidia root structure reduces erosion risk and helps restore degraded lands.

Economic Benefits

Dennis Garrity and Chris Armitage of Global EverGreening Alliance highlight in the white paper EverGreening the Earth Campaign that **photosynthetic or evergreening approaches to carbon capture** are not only the most promising, practical, and cost-effective but they also "have the greatest positive impacts on human livelihoods, resilience and economic development."

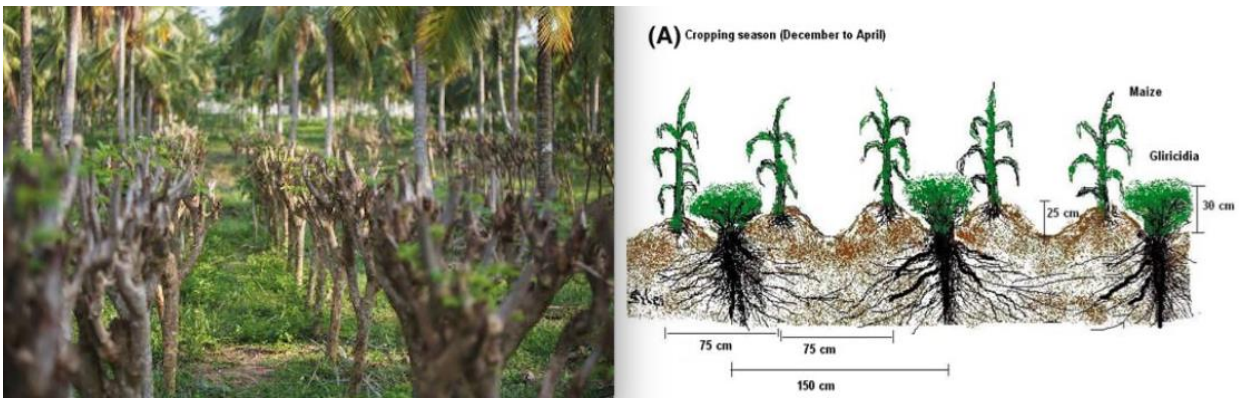
Gliricidia is a nitrogen-fixing tree, making it an ideal intercropping plant. This evergreening practice reduces the amount of chemical fertilizer that farmers have to buy. Since industrial fertilizer production is highly carbon-intensive, lowering its use has an associated climate benefit.

Gliricidia leaves can be used as high protein 'cut and carry' forage for cattle, sheep, and goats. The leaves can also be used to make organic pesticide and fungicide.

Source: Biomass Group

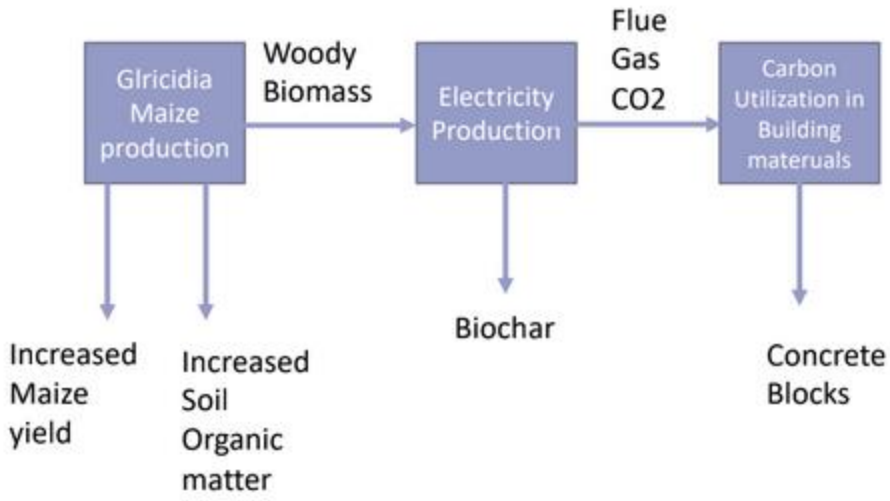
Climate Benefits

Since only the branches are harvested, the tree's trunk and root structure remain sequestering carbon over a 20-year period. Soil organic carbon (SOC) accounts for about 58% of mass in soil organic matter, the organic constituents in the soil: tissues from dead plants and animals in various stages of decomposition (Corsi & FAO, 2012). Plants, which extract carbohydrates from CO2 and water during photosynthesis, extrude some of these sugars from their roots (Rodale Institute, n.d.). Bacteria and fungi in the nearby soil that feed on these sugars, convert them into more stable materials that trap carbon in the soil (Rodale Institute, n.d.).



Source: Biomass Group (L)
Akinnifesi, F.K., Makumba, W., Sileshi, G., Ajayi, O.C., Mweta, D., 2007 (R)

At Biomass Group, this carbon sequestration is registered under the Verified Carbon Standard (VCS) by South Pole Group and used to generate forestry carbon credits from global carbon markets. Professor Jonathan Haskett of the Global Evergreening Alliance calls this "**Evergreen Biomass Energy Carbon Capture and Storage (EBECCS)**."



Source: Jonathan Haskett – Global Evergreening Alliance

Prof Haskett also points to the possibility of generating biochar, a charcoal-like substance, by burning biomass in an oxygen-limited environment through a process called pyrolysis. Resilient to degradation, biochar safely stores carbon in soils for hundreds of years. Added to the soil it provides a myriad of benefits to the soil and increases crop yields.

The fly ash from the electricity generation process can be used to produce building materials, which fix CO_2 near-permanently. Beyond sequestering carbon in this process, replacing traditional emissions-intensive cement production has a huge climate benefit.

Another possibility is to feed buffalo with Gliricidia leaves mixed with paddy straw, which seems to create an ideal feed. The cattle dung can be used to generate bio gas using a digester, which can power an engine or electricity generator.

Let's Green Up to Cool Down!