

# Green manures: Nature's gift to improve soil fertility

**Excessive use of inorganic fertilizers and pesticides has affected soil and water quality in the Jaffna peninsula, Sri Lanka. Students from the Faculty of Agriculture at the University of Jaffna have been learning about green manures from farmers, and how they have been used to improve soils. Green manures were also used successfully to rehabilitate salinated soils affected by the tsunami. These and other organic practices are now being promoted with and by farmers.**

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Healthy soils lead to healthy plants. Maintaining such soils is a huge task for farmers. The Jaffna peninsula, Sri Lanka, is recorded as having a very high consumption of inorganic inputs (fertilizers and pesticides) per area of crop cultivation. About 65 percent of the farm wells now have excess nitrate nitrogen (above the WHO recommended level of 10 mg/l) in areas where intensive agriculture is practised. Huge amounts of pesticides were used in Jaffna peninsula before 2006. Now, soils are polluted and sick.

The general public, especially farmers, realise these problems and now wish to adopt organic methods. Green manures are a gift from nature, being a suitable alternative to increase the organic matter content of the soil. Partially decomposed or decomposing plant tissues feed the beneficial organisms in the soil that build it up. Some farmers in certain areas of Jaffna have traditionally used green manures. Students in the Faculty of Agriculture at the University of Jaffna learned from farmers, through visits and interviews, about their methods to enrich the soil organically, which plant species they use as green manures alongside which crops, and the difficulties they face in

maintaining soil fertility. More than 250 farmers participated in this study which took place from 2005 to 2007. Farmers from tsunami affected areas and non-tsunami areas were both interviewed, to learn about their different experiences on the use of green manure as a soil improver.

## Green manure dependent crops

About 60 percent of the population in Jaffna are farmers, who cultivate vegetables, cereals, cash crops and fruit crops. Green manure is seen as an essential input when cultivating these crops. Farmers say that with increased and effective use of green manures, chemical fertilizers are not necessary anymore. In addition, green manures add greater organic matter, improve the richness of the soil and help to increase crop yields. Some cash crops depend on specific green manures and without them there is little chance for better production (see Table for common crop combinations).

**Table 1. Crop – Green manure combinations practised in Jaffna**

Green Manures used	Main crop
<i>Thespesia populnea</i>	tobacco, grapes, banana
Sunn hemp ( <i>Crotalaria juncea</i> )	tobacco, onion, tomato
Neem ( <i>Azadirachta indica</i> )	tobacco, grapes
<i>Calotropis gigantea</i>	onion
Palmyrah ( <i>Borassus flabellifer</i> )	paddy
Green gram ( <i>Vigna radiata</i> )	paddy
Black gram ( <i>Vigna mungo</i> )	paddy
<i>Gliricidia sepium</i>	paddy, coconut
Jackfruit ( <i>Artocarpus heterophyllus</i> )	potato
<i>Clausena indica</i>	chilli

## In situ green manure

Green manures are either grown and used *in situ*, or used as green leaf manure. In the *in situ* method, green manure crops are grown in a field prior to crop cultivation and then cut and buried when approximately 50 percent of all plants are flowering. The use of sunn hemp (*Crotalaria juncea*) is popular and well practised by most of the farmers in Jaffna. Because of its ability to grow fast and its efficient nitrogen fixing capacity, these plants are grown and sacrificed to improve the living condition of the main crop. Sunn hemp is grown in tomato, tobacco and onion fields. After ploughing, the sunn hemp seeds are broadcast. Farmers then cut and incorporate the sunn hemp into the soil. After churning, the soil is left for one to two months to allow for the decomposition process. Green gram and black gram are also used as green manure *in situ* in paddy fields. After harvesting the pods, the remaining plant parts are incorporated into the soil and allowed to decompose. During the hottest period of the year, farmers delay cultivation and fallow the field for one or two months. Grasses such as *Mimosa pudica*, *Tephrosia pumila* and other non-legumes are allowed to grow as a cover crop on the soil. At the end of the hot period the soil is ploughed once, and this vegetation is turned into the soil as green manure.

## Green leaf manure

The practice of incorporating green leaf manure is different from green manure grown *in situ*. *Thespesia* and *Gliricidia* are grown in



Using green manure can be labour intensive, but has many benefits – here a farmer is showing the students how he incorporates *Thespesia* as green leaf manure.

live fences, and jackfruit, neem and palmyrah are grown on barren lands. The leaves are cut and brought to the farms in bundles. There is a charge for transportation. However, "...the benefits of its use are innumerable" said one traditional farmer. *Thespesia* is in greatest demand, and is sold at US\$ 20-25 per load (a bull cart). Before incorporating it into the soil, *Thespesia* is allowed to wither for two days. It is kept in the field in a heap and then covered by banana leaves. This helps for partial decomposition, reduces the carbon to nitrogen ratio and makes it easier to apply.

The timing of application of green leaf manure depends on the moisture content of the soil. Farmers measure this by digging to a depth of 5cm, and taking a soil sample. They make a clod by pressing the soil between their hands. If the clod breaks up immediately, this indicates insufficient soil moisture. If there is enough moisture in the soil, farmers will start to add green manure. Farmers also have their own method of detecting soil fertility. They refer to the organic matter content as "soil fat", characterised by the sticky nature of the soil. If they find that the soil is not very sticky, they confirm that the soil is less fertile, and will use green manures. To test for fertility, some farmers press their feet into the soil – if they can do this easily, they believe it is rich in organic matter content. Otherwise it needs to be supplemented with green manure or farmyard manure.

### Green manures for salinity reclamation

On December 26<sup>th</sup> 2004, tsunami tidal waves hit the east coast of Sri Lanka, devastating both fisheries and agriculture. In Jaffna, more than 300 acres of cultivable land were flooded with sea water and about 560 farm families were directly affected by the tidal waves. The soils and fresh water bodies therefore became saline. Onion, tobacco, chilli and other vegetable fields were totally devastated. After the tsunami, cultivation of such crops failed. The crops planted in tsunami affected lands appeared burnt and their growth was retarded. However, farmers solved this problem by planting appropriate green manures. They succeeded and reclaimed the soil within 4-6 months of the tsunami disaster.

Partially withered tamarind (*Tamarindus indicus*) leaves were used as a good salinity reclamation agent by most of the traditional farmers in the coastal regions. This was known among farmers as an effective method. Tamarind leaves are slightly acidic in nature, and can create a favourable environment for soil microbes. Also, the Department of Agriculture (Extension) conducted a project, with one hundred farmers, to solve the salinity problems in tsunami affected land. Finger millet seeds were distributed to them. After harvesting this millet, crop residues were turned into the soil and allowed to decompose for two months. Interestingly, the soil recovered and the farmers benefited. They restarted crop cultivation six months after the tsunami.

In addition, *Pavetta indica*, *Thespesia*, neem and sunn hemp were also effective against salinity and were used to improve the soil fertility. These species were mixed and dug into the soil twice, at an interval of six months. Farmers said that the combination of using both farmyard manure and these green manures in equal amounts gave encouraging results and enhanced the productivity of the tsunami affected soil. Among all the green manure species, however, tamarind leaves and finger millet were the best and acted as fast and effective salinity reclamation agents. The reclamation of alkaline soil basically involves replacing the sodium ions with more favourable calcium ions. There is an intimate relationship between soil pH, level of CO<sub>2</sub> and calcium ion activity in calcareous alkaline soils like tsunami affected soils in Jaffna. Evidence has shown that increasing the amount of plant tissues in such soil facilitates rapid production of CO<sub>2</sub> and enhances the soluble calcium status of soils. That, in turn, replaces the sodium ions, resulting in the improvement of saline soils.

### SWOT analysis for using green manures

This analysis was done by the students, with the farmers, as part of their study programme.

#### Strengths

Farmers believe the application of green manures has several advantages over application of compost or fertilizers.

- Greater soil fertility;
- Improves soil structure;
- Serves as good food for earthworms;
- Zero risk to soil health;
- Increases soil biodiversity of beneficial microbes by stimulating their growth; and
- Green manures are cheap and affordable to almost everybody.

#### Weaknesses

- Large amounts of green manures are needed;
- Labour intensive; and
- The nutrients only become available after the decomposition process, which may mean a wait of 2-3 months.

#### Opportunities

- Green leaves and manures are cheap, organic and readily available;
- Green manures species have the potential to suppress soil borne fungal diseases; and
- Green manures can be used to reclaim saline soils.

#### Threats/challenges

- Termites are becoming a problem in alluvial soils;
- Salinity - Jaffna is surrounded by the sea, and calcium is the bedrock for the formation of soil, so the soil is always alkaline in nature;
- Lack of research on green manure crops; and
- Poor availability of good quality green manure seeds.

### Healthy soils

Many farmers have chosen to use green manures, and expressed their intention to contribute to long-term agricultural sustainability through better soil fertility management. However, green manuring is not currently practised by all farmers. Together with the Department of Agriculture and the Coconut Cultivation Board, the Faculty of Agriculture, University of Jaffna is working with farmers to demonstrate that having a healthy soil is the basis for creating healthy plants. The next step is the work being done with the farmers on developing healthy soils, through seminars, newspaper articles, and projects promoting organic farming. As the reality is that there is not enough green manure available, the Faculty of Agriculture is also promoting other organic manures and methods. These include making compost using earthworms, promotion of medicinal plants, and agroforestry techniques.

Through local groups and community based organisations, farmers understand that "soil is a community resource and an active reservoir" and "green manures are nature's tonic for the soil". These notions inspire and enlighten the concept and help in building knowledge and skills for developing a more integrated soil fertility management.

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