

# Traditional Practices of Soil Management in Agriculture in Sri Lanka

## Traditional Agriculture

**A**s in many parts of the world, traditional agriculture in Sri Lanka has been practised both under irrigation and rain-fed. Irrigated agriculture confined to rice cultivation in lowlands while agriculture under rain-fed included both rice and other crops on highlands. Mainly rice, other cereals and some vegetables were grown under shifting cultivation in the "chena" (slashed and burned land) while fruits, spices and some vegetables were grown in the home gardens. Rain-fed rice has been also grown in asweddumised (stumps and rubble removed and levelled) highlands in different parts of the country. Soil management under these different systems for different crops has been different depending on their requirements and local conditions.

## Objectives of Soil Management

Soil management in traditional agriculture involved two main activities, namely, tillage and soil conservation. Soil conservation includes aspects such as erosion control and sustenance of soil fertility. Like at present, the objective of soil management has been achieving sustainable production. Improving soil fertility, controlling weeds, and retaining soil moisture had been the specific objectives. The ways and means of achieving these objectives were different on the two main systems described above and for different crops in different localities of the country.

## Tillage Practices

Tillage is practised to make a weed-free smooth soil surface for the

germinating seed or growing plant. In lowland rice cultivation, traditional tillage has been described by Davy (1821) as "The farmer commences with repairing banks of the paddy field. He then admits water in sufficient quantity to be an inch or two deep over the whole surface. After the ground has been well macerated and softened, he ploughs it still under water. After further maceration, it is ploughed again or merely trampled over by buffaloes, till reduced to the state of mud. Its surface is now levelled and smoothed. The water is drained off and paddy, having been previously steeped in water till it has begun to germinate, is sown". This description covers the general traditional tillage practice of lowland rice culture in Sri Lanka and very similar to what was described by Knox in 1681. Even at present the same practice is continued except for use of the traditional plough and trampling by buffaloes. Traditional plough has been replaced by modern plough and the trampling operation has been replaced by a second ploughing or harrowing. Buffaloes also have been replaced by the tractors. The type of plough and soil soaking helped use of minimum power for the operation both by the farmer and the animal.

There were variations of the traditional ploughs used in different geographical areas. In areas where soil was soft, a plough made of wood was used. When the soil was harder, wooden plough fitted with an iron blade at the cutting edge was used.

In boggy soil in the wet zone areas, the plough was replaced by turning over the soil by mammoty (hoe) by manual labour. Special mammoties

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were used for this purpose. Gunasekera and Gamage (1999) have described the ploughs and mammoties used for tillage in various parts of the country in detail. These mammoties were energy (manual labour) efficient than the modern mammoties because of wider swath per single strike.

In lowland land preparation for paddy, construction of dykes takes special form. The dykes are plastered with mud so that they are kept weed free for some time and it seals off the dyke from water leakages. Knox (1681) explained that the construction of dykes in the country was a special art of the Ceylon (Sri Lankan) farmer. When plastered with mud the weed seeds cannot germinate and pierced through the compacted plastered layer of the soil and keep the dyke weed free for a longer period of time.

In the asweddumised highland rain-fed rice culture, tillage method is different. In this system, ploughing is done in the dry season with residual moisture or occasional rains in the dry period and the weeds are left for drying. This results in a weed free field at the beginning of the season. With the onset of seasonal rains, unsprouted paddy seed is sown and very light harrowing is done to cover the seeds. These fields are terraced like lowland paddy fields, but there is no supply of irrigation water. This method saves the time in the

season and fully utilises the rainfall for crop growth. Generally, soil is sandy in areas where it is practised. Even today this practice can be seen in some parts of the country.

In slash and burn system (shifting cultivation), no much of tillage is done, because, there is good seed bed produced by burning of slashed vegetation. However, surface soil is scraped after sowing rice seeds to bury them under soil. Rice and other cereals such as corn and finger millet were grown in the traditional system in second and third years after first cultivation of chena. Fields tend to be infested with weeds at this time and weeding has to be done to make the seed bed. This was done by minimum tillage techniques. The weeds are scraped with mammoties and left for drying and burnt in the field itself. If the volume of weeds is low, no burning is done, and the dried weeds are left on the soil surface as mulch. This will reduce soil erosion and conserve the soil moisture in the field.

At present, there are no forests lands available for practice of slash and burn cultivation in Sri Lanka. The practice has been banned in the government-owned forests. Therefore, farmers have to use the available upland for continuous cultivation. In this case, traditional tillage is practised. First weeds are scraped and removed or burnt. Then the bare land is ploughed with cattle or buffaloes. If not ploughed, soil is worked down by a hoe (mammoty) with manual labour. When the tillage is done manually, soil is worked down to a depth about 15-20 cm. In this operation, weeds are buried under the soil, and they are decayed, and minerals are added to the soil enriching it.

Gunasekera and Gamage (1999) have given a comprehensive description of various tillage implements such as plough and mammoties. Siriweera (2009) also described the types of traditional ploughs used in different parts of

the country. There are variations of these implements in different parts of the country. The variations have been created by the needs in different areas demanded by the nature of the soil. The mammoty with broader cutting edge can improve labour efficiency in softer soils in the upcountry area. Smaller-sized mammoties of this shape is used for tillage work on chena. The pointed ends of it can be used to reach bases of stumps, trees and the rocks in the field. The wedge-shaped mammoty used in the Jaffna area is handy for making irrigation furrows which they make to irrigate crops.

### Erosion control

Much attention seems to have paid by the traditional farmer on the system-level soil erosion control work rather than on individual farms. In individual farms, cultural practices and agronomic practices have been used. The emphasis has been on reducing erosion in channels and streams, tank bunds and on reducing sedimentation of reservoirs. Some of the erosion control and sediment avoiding techniques used in traditional agriculture are described below:

#### "Liyadda" (bench terrace)

Soil erosion control has been achieved by terracing the land, especially, in the rice cultivation. Both highlands and lowlands have been terraced and levelled. Lowland paddy field in the hill slopes in the upcountry areas is the nice example for terracing. The level benches help retaining of water on the surface too. This type of land development has been done only in lands which were used for continuous cultivation. The main land use in the highland

was chena cultivation where the land was abandoned for regeneration after about 3 to 4 year of continuous cultivation. During this period, the land was not subjected to severe soil erosion because of the rough nature of the surface. Further, on sloping chena lands, the farmers used to stack un-burnt debris across the slope at regular intervals. The soil was minimally disturbed which helped reduce soil erosion on these lands.

#### "Gal weti" and Netti kanu" (Stone ridges and Leader drains)

Inspection of very old homesteads shows that stone ridges have been erected across the sloping land to prevent soil erosion. These ridges have been constructed with rubble available in the land itself. In Sinhala language, these are known as "gal weti". The rubble has been put together by soil. In construction of these stone ridges, the farmers have stacked the larger rubble on the down hill side while smaller ones were stacked on uphill side (Figure 1). The soils washed down the hill get collected in the depressions. Later, when the plantation crops such as coffee and tea was introduced, this technique has been used in those plantations. Even today, there are people in the up country area who have mastered the construction of stone ridges. In order to carry water down the slope without subjecting the soil for erosion, the farmers have constructed "netti kanu". These are drains made of rubble without using any cement.

#### "Niyara" (soil ridges)

These are ridges made across the slope of uplands to reduce washing

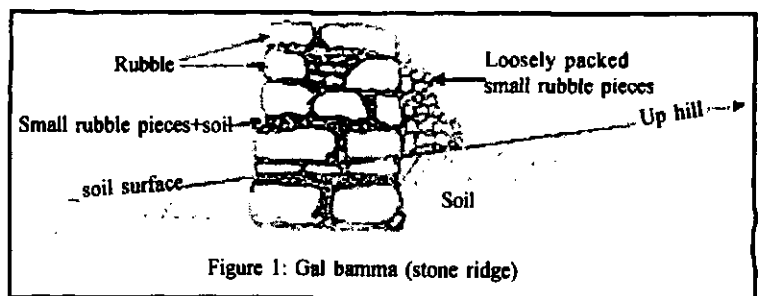


Figure 1: Gal bamma (stone ridge)

Figure 1: Traditional stone ridge (Gal Bamma)

off the soil from field where slopes are very mild. The spacing between the "niyara" had been decided by experience, based on the rainfall, type of crops and the soil. The *niyara* retain the rain water falling within two *niyaras* preventing surface flow thus reducing soil erosion. Openings (Wakkada) have been kept at regular intervals of the *niyara* to flow of excess water in the events of high rainfall.

#### "Goda wala" (upland pit)

This is a man-made water hole to trap sediment produced by soil erosion in the catchment areas of relatively large tanks, and it provides water to wild animals too.

#### "Kulu wewa" or "Ahas wewa" (Mountain tank)

This is a small tank constructed in the catchment above the relatively large reservoirs only to trap sediment and retain water for a longer period and not for irrigation purposes. These are constructed only at higher elevations of the hills in the catchments. The water retained are gradually seep down the soil keeping water even in the dry periods and recharge the water table. It provides the water necessary for cattle and wild animals too.

#### "Iswetiya" or "Pota wetiya"

This is a soil ridge (*niyara*) constructed in the upstream of the tank to prevent entering of the eroded soil from upper catchment area to the tank. This has been designed in a way that all silt deposited in it before water entering the tank. The purpose of *iswetiya* is to reduce siltation of the tanks.

#### Stream/canal bank stabilisation

Banks of streams and canal are subjected to erosion due to the scouring action of the flowing water. Such erosion has been traditionally controlled and embankments stabilized using techniques presently known as "bio-engineering techniques". Trees/plants which grow in wet conditions having very extensive root systems have been grown along the stream banks. Plants such as *Areca catechu* and *Wetakeyya* (*Pandanus species*) were the

common examples. Bamboo is also a plant which is grown to protect river embankments from river bank erosion. The roots of these plants cover the soil and bind them very hardly so that flowing water cannot erode the soil. *Wetakeyya* plants have floating roots which reduces the velocity of flowing water so that they reduce erosion of stream bank and beds. All the plants used for this purpose have economic value too.

#### "Rala panawa"

This is the rubble pavement on the inner side of the tank bund which prevents erosion of the tank bund by wave action of the water. When there is a large free water surface, waves are formed on the water surface due the effect of wind. In order to prevent this erosion, traditionally, rubble is paved on the surface of the bund loosely. The rubble absorbs the energy in the moving water while reducing the soil water contact which reduces soil erosion by wave action.

#### Fertility Management

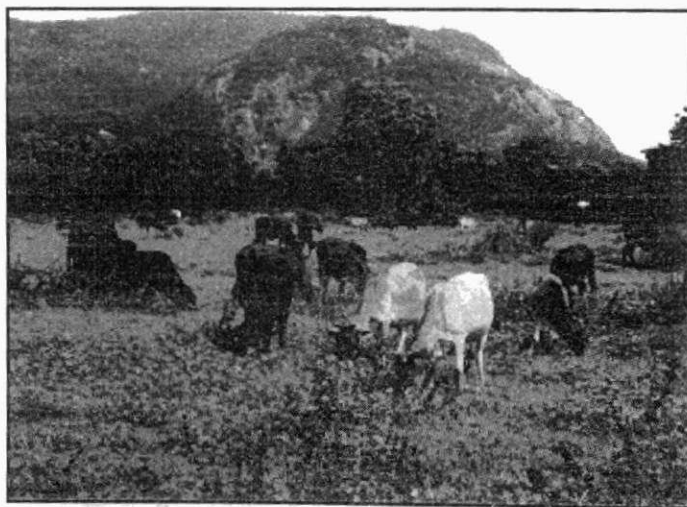
Fertility management in the traditional agriculture has been practised using natural phenomena. Minimising soil and nutrient losses has been given priority while enhancing the fertility by additions of natural material to soil to maintain productivity wherever possible.

#### Fertility management in paddy fields

Addition of biomass (Green manure) of selected tree species, addition of rice straw and fallowing of the land for several seasons had been the traditional methods of fertility management practices used in traditional farming in Sri Lanka. Green manure is the tender vegetative

parts of some selected plants. The type of plants varies according to the geographical area of the country. *Keppetiya* (*Croton lacciferus*), *Gliricidia* (*Gliricidia sepium*), *Kaduru*, *Nattasuriya* (*Tithonia diversifolia*), *Gansooriya* (*Thespesia populnea*) were some prominent plants which were used in many parts of the country. These plants were planted in the fence of the field. In some areas, the selected plants were grown on paddy dykes (*Niyara*). The tender parts including leaves were berried under mud after the first plough. Then these materials decay and minerals in them are released to the soil. Further, the organic matter added through the biomass improves the soil fauna which in turn suppose to improve the soil fertility.

Some paddy fields are cultivated only in the wet season. In the dry season, they are fallowed. During fallow period, cattle and buffaloes are let in for grazing on these lands (Plate 1). These animals add considerable amount of dung and urine in to the field improving the fertility status. This happens even in the shorter time period in between *Yala* (dry) and *Maha* (wet) seasons. When the fertility drops considerably in the paddy fields, then the length of fallow period is increased until the fertility is restored. In some cases, the cattle and buffaloes are tethered in the paddy fields. When this is done routinely, in one point, the animals are tethered several times during the fallow period which helps addition of sufficient quantities of dung and urine. Further, a large volume of biomass is produced by leguminous plants such as *Thora*



**Plate 1:** Cattle have been allowed grazing in a paddy field during off season. They add considerable amount of dung and urine into the soil

(*Cassia species*) and *Nidikumba* (*Mimosa species*) naturally growing in the field. These leguminous plants fix atmospheric nitrogen by the bacteria associated in the roots of the plants and add them to the soil.

Uluwishewa (1991), after conducting a study on the fertility of dry zone paddy fields, concludes that the traditional farmers in the Dry Zone of Sri Lanka maintained soil fertility of paddy fields for centuries without applying mineral fertilisers. Some of their traditional cultivation practices not only preserved the natural processes which lead to the regeneration of fertility, but also added nutrients to the soil. This study highlights those traditional practices, namely, fallowing of land, application of green manure and animal waste, aquaculture in paddy fields, utilisation of nutrients in irrigation water and planting trees on paddy fields. However, there is hardly any evidence on application of animal manure to paddy fields carrying them from outside the field.

#### **Fertility management in shifting cultivation (in chena)**

Fertility in a chena is very high due to accumulated organic matter content in the soil during fallow period and ash received by burning of vegetative parts of the forest. This fertility remains in the soil for several years because higher Cation Exchange Capacity (CEC) of the organic matter in the soil retain the plant nutrients. However, control of weeds becomes a problem before fertility drops to very low levels. Hence land is left fallow again after 3 to 4 years of cultivation.

#### **Soil enrichment with decomposed organic materials**

This is similar to use of compost at present. All wastes from kitchen including wood ash from the fire place, debris collected by sweeping the compound, other vegetative material, etc. were collected in a heap in the home garden. Even the kitchen waste water was thrown in to this heap when collected. When the materials are decayed, they make very good organic fertiliser, presently known as compost. This

material is used to enrich the soil when they grow crops in the home garden. Sometimes, the heap of the decomposed material is spread in the same place and crops were planted. A new place was chosen for the next heap of waste.

Shanthini and Walgama (2003) described a system of traditional compost making in northern Sri Lanka. The authors explain the procedure followed as way back in 1960s as follows:

"In January every year, my grandmother used to isolate a plot of about 1.5 metre by 2 metre area at a fresh location in her small land, not so far away from her small house, by planting about 1 to 1.5 metre long live branches of the trees *Gliricidia sepium* and *Erythrina verigeta*, having the indigenous names 'Giniseeriya'/'Seemaikilluwa' and 'Erabadu'/'Mulmurunga', respectively. These live branches were planted close to each other, and onto which she fixed thatched leaves so as to make a fence of about 1 metre high surrounding the isolated area.

This isolated area served as her composting unit, into which she added the remaining part of the solid waste from her kitchen. Everyday, she swept her little garden very early in the morning and collected a considerable amount of garden waste, which contained mainly leaves from the trees in her garden. The garden waste was also added to her composting unit.

The live branches of *Gliricidia sepium* and *Erythrina verigeta* that she used for isolating her composting unit and for making a live-tree fence around her land, grew into young trees in no time. These young trees were trimmed time and again, and the leaves and branches that were cut and removed from these trees were added to her composting unit.

Owing to the nitrogen-rich nature of these leaves, they were also used for feeding her goats that she always had. In addition, her goats were fed with all sorts of herbal and medicinal plants, whose indigenous names are 'Nidikumba'/'Thottachchurugi', 'Kaladuru'/'Korai Pull' and 'Penela'/'Mudakkoththan', which she collected from the unused part of her land".

The authors further describes that the final product is a soil-like material, known presently as compost, was dark in colour and was uniform in texture. It gave off a clean, earthy smell, and was inhabited by earthworms and other similar life forms. (Personnel communication with the authors revealed that even though they used the word compost now, their grand mother's time, it was not a common word). This material is very rich in plant nutrients and makes a complete fertilizer. It improves the soil physical, chemical and biological properties and ensures healthy growth of plants

#### **Conclusions**

The traditional soil management practices seem to be very simple and sustainable and scientific. The traditional farmer did not depend on fossil fuel, for energy, instead, they used animal power and manual labour for tillage practices. The implements and practices were energy efficient. Mostly, the techniques were based on the natural phenomena and depended on what they found in their locality. Cattle and buffaloes were helpful in tillage as well as in fertility management. Principles of the traditional techniques are presently re-introduced by modern words such as "organic farming", "minimum tillage" and "bio-engineering techniques", etc.

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