

## Sustainable Use of Earth Resources

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A resource is some useful material that we can use to benefit our livelihood. The Earth has many resources that benefit us. Often we refer to these as “Natural Resources”. Some of the resources that we use for our benefit are water, air, sunlight, soil, plants, animals, rocks and minerals, as well as fossil fuels (coal, oil, natural gas etc.).

There are two broad categories of Earth’s resources namely, renewable resources and nonrenewable resources. Natural resources that can be replaced and reused by nature are termed renewable. Examples are air (wind), fresh water, soil, living organisms (trees) and sunlight. The resources that cannot be replaced are termed nonrenewable. Some examples of non-renewable resources are fossil fuels (coal, oil, and natural gas), diamonds and other precious gems, minerals and types of metals and ores.

Water resource available for the benefit of human beings is much lesser when compared to the total water volume of the globe. It is only 0.03% of the total volume of global water (Fig. 1).

Earth’s land surface is only 29%, and the rest comprise the ocean. Of this land surface, the fraction of habitable land surface is 71% (104 mil. km<sup>2</sup>), while the rest of it is glaciers and barren lands. Agriculture is practiced in almost half of these habitable lands. Crops are cultivated in a relatively small portion of land (11 mil. km<sup>2</sup>), and this is only 2.4% of the Earth surface. Fig. 2 illustrates this land resource distribution over the Earth surface.

The limited land resources is being degraded due to human activities. Land degradation is defined as a negative trend in land condition, caused by direct or indirect human-induced processes including anthropogenic climate change, expressed as long-term reduction or loss of at least one of the following: biological productivity, ecological integrity, or value to humans. It is the depletion of its physical, chemical and biological productivity.

It is widely accepted that land degradation is one of the most

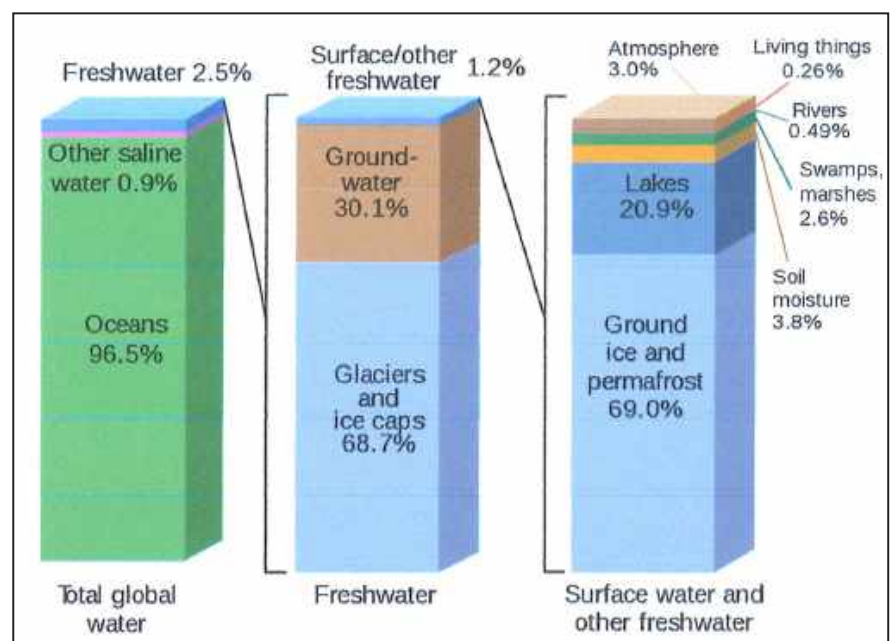
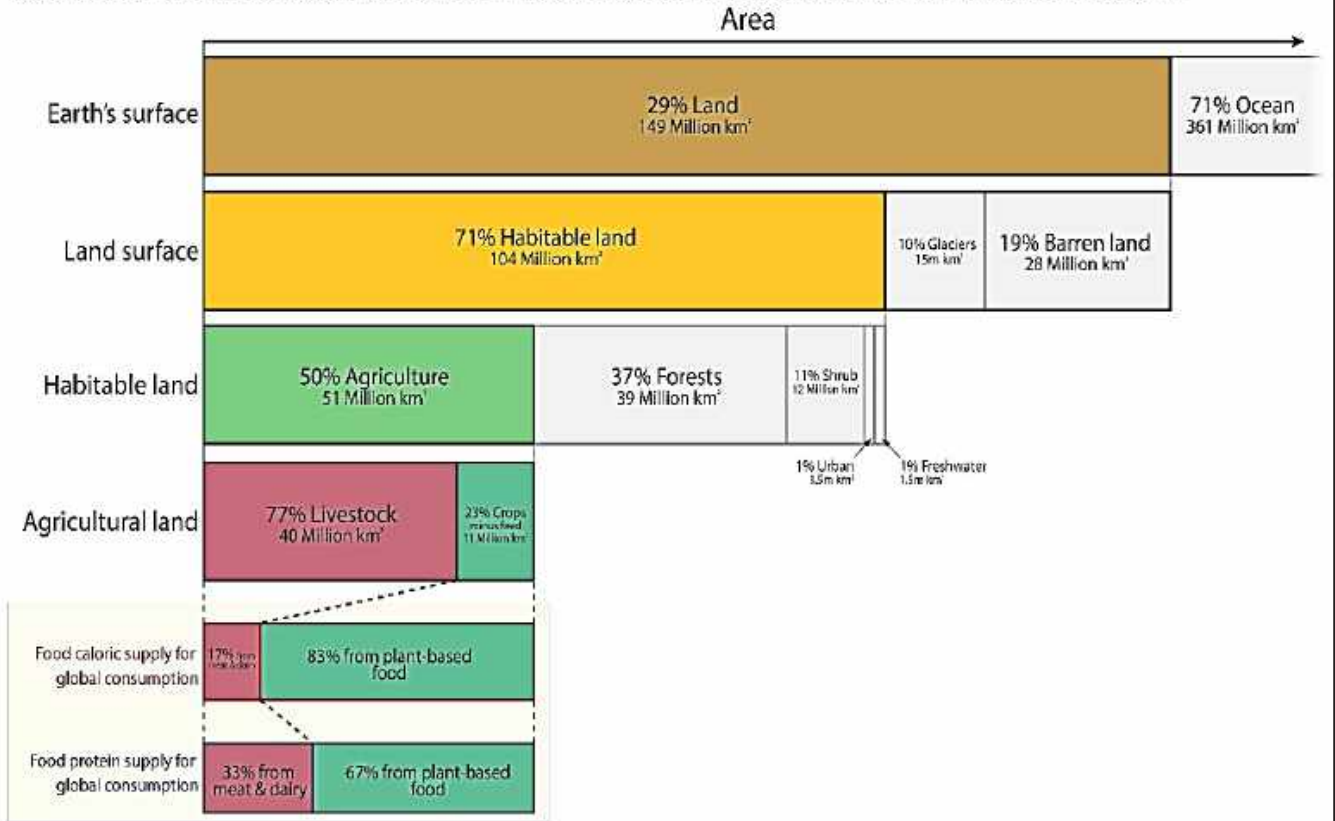


Fig 1 : Distribution of Earth’s water resources

# Global surface area allocation for food production

The breakdown of Earth surface area by functional and allocated uses, down to agricultural land allocation for livestock and food crop production, measured in millions of square kilometres. Area for livestock farming includes grazing land for animals, and arable land used for animal feed production. The relative production of food calories and protein for final consumption from livestock versus plant-based commodities is also shown.



Data source: based on UN Food and Agricultural Organization (FAO) Statistics. The data visualization is available at OurWorldinData.org. There you find research and more visualizations on this topic. Licensed under CC-BY-SA by the authors Hannah Ritchie and Max Roser.

**Fig 2 : Distribution of Earth's land resources**

critical problems affecting the future economic development in Sri Lanka. The demands of a rapidly expanding population has set up pressures on the island's natural resources, and these in turn have resulted in a high level of environmental degradation. In Sri Lanka most apparent evidence to land degradation is shown in manifestations such as heavy soil losses, high sediment yields, soil fertility decline and reduction in crop yields, marginalization of agricultural land, salinization, landslides and deforestation, as well as forest degradation. Severe soil erosion takes place in the hill

country on sloping lands under market gardens (vegetable and potato cultivation), tobacco cultivation, poorly managed seedling tea and chena cultivation. We need to maintain long-term productivity of land, while we use it for our benefit. Sustainable Land management (SLM) has been introduced to cater for this need.

SLM is defined by the World Bank as a knowledge-based procedure that helps to integrate land, water, biodiversity, and environmental management (including input and output externalities) to meet the rising food and fiber demands while sustaining ecosystem services

and livelihoods. SLM is necessary to meet the requirements of a growing population. Improper land management can lead to land degradation and a significant reduction in productive and the service functions (biodiversity niches, hydrology, carbon sequestration) of watersheds and landscapes.

The World Overview of Conservation Approaches and Technologies (WOCAT) defines SLM as the use of land resources, including soils, water, animals and plants, for the production of goods to meet the changing human needs, while simultaneously ensuring the long-term productive potential



**Fig 3 : Tropical rainforest – Sinharaja in Sri Lanka**

of these resources, as well as the maintenance of their environmental functions.

FAO used the definition in UN Earth Summit 1992 as “the use of land resources, including soils, water, animals and plants, for the production of goods to meet changing human needs, while simultaneously ensuring the long-term productive potential of these resources and the maintenance of their environmental functions”.

One similarity among all these definitions is that the land resource includes soil, water, flora and fauna. Therefore, land means the entire ecosystem in a more practical way. It means that ‘land degradation is the long-term depletion of the production potential and function of the ecosystem’. Accordingly, sustainable land management is the maintenance of the production potential and functions of an ecosystem.

There are four types of ecosystems in Sri Lanka.

1. Forest and related ecosystems - tropical forest types (Fig. 3), riverine dry forest, grasslands etc.
2. Inland wetland ecosystems - flood plains, swamps, reservoirs, wet villus (Fig. 4)
3. Coastal and marine ecosystems - mangroves (Fig. 5), salt marshes, sand dunes and beaches, lagoons and estuaries, coral reefs
4. Agricultural ecosystems - paddy lands (Fig. 6), fruit cultivations, small crop holdings or other field crops, vegetables, export crop plantations, home gardens, chena lands

Ecosystems provide ample benefits to human beings. In addition to their environmental value, Sri Lanka’s varied ecosystems provide many services that are of significant economic value. Despite the fact that all ecosystem services are not marketable, and many pass unrecognized, they play a crucial role in providing goods

and services to meet local and national needs.

The most crucial ecosystem services are:

1. Supporting services (that help maintain the conditions for life on earth): Soil formation and retention; nutrient cycling; primary production; pollination; seed disposal; production of O<sub>2</sub>; provision of habitats.
2. Regulatory services (i.e. benefits from regulation of ecosystem processes): Air quality maintenance; climate and water regulation; flood and erosion control; water purification; waste treatment; detoxification; human disease control; biological control of agricultural and livestock pests and disease; storm protection.
3. Provisioning processes (i.e. products obtained from ecosystems): Food; wood fuel; fiber; biochemicals; pharmaceuticals and natural medicines; genetic resources; ornamental resources; freshwater; minerals, sand and other non-living resources.
4. Cultural services (i.e. non-material benefits obtained from ecosystems): Cultural diversity and identity; spiritual and religious



**Fig 4 : Wet Villu ecosystem in Sri Lanka**

values; knowledge systems; educational and aesthetic values; social relations; sense of place; cultural heritage; recreation and ecotourism; communal; symbolic. (Source: Millenium Ecosystem Assessment 2003 Report “People and Ecosystems: A framework for assessment” cited in SCBD, 2003).

Most of the soils in Sri Lanka are highly erodible. Although the problem of soil erosion has been well recognized in Sri Lanka and effective conservation measures have been clearly identified, yet severe land degradation has been taking place in most of the cultivated lands due to absence of attention to soil erosion. There are 3 recommended SLM practices that could be adopted in Sri Lanka.

### 1. Agronomic practices

- Mulching - conserving moisture, improving the fertility and health of the soil and reducing the weed growth
- Contour planting - decreases negative effects associated with soil erosion such as reducing crop productivity, worsening water quality, flooding, and habitat destruction.
- Zero tillage - increasing the amount of water that infiltrates into the soil, increasing organic matter retention, cycling of nutrients in the soil, reducing or eliminating soil erosion, improving soil biological fertility and making soils more resilient.
- Application of organic fertilizer – made through the natural process of decomposition of organic materials by microorganisms under



**Fig 5 : Mangroves in Sri Lanka**

controlled conditions. Raw organic materials such as crop residues, animal wastes, green manures, aquatic plants, industrial wastes, city wastes, food garbage etc. enhance their suitability for application to the soil as a fertilizing resource, after composting.

- Mixed cropping - growing of two or more crops simultaneously on the same piece of land. It is also known as multiple cropping. This type of cropping leads to an improvement in the fertility of the soil and increases in crop yield.

### 2. Vegetative methods

- Biological hedges - Hedges are placed across the slope to slow down the overland flow. These can consist of live or dead materials of biological origin. Alley cropping, graded hedgerows, SALT hedges fall under this category.
- Grass hedges – Here a Grass hedge is established across

the slope. Species recommended are Vetiver (*Vetiveria zizanioides*), Citronella (*Cymbopogon nardus*) and Sera (*Cymbopogon citratus*). Pruning has to be done 2-3 times a year and the biomass can be placed as a mulch to the crop.

- Cover crops - Recommended cover crops are *Calopogonium mucunoides* and *Desmodium* species. Maintaining a vegetative ground cover is reported to be beneficial to reduce the incidence of Phtophthora foot rot disease. Growing cover crops is also not widely practiced in Sri Lanka except in rubber and coconut lands



**Fig 6 : Paddy ecosystem in Sri Lanka**

### 3. Structural methods

•Lock and Spill drains - This is a hill side ditch unique to Sri Lanka, practiced for soil conservation on sloping lands exceeding 40% slope. The ditch is about 0.6 m wide, 45 cm deep and square in shape, placed across the slope with a slight gradient. Low cross walls of about 45 cm long and 30 cm high are left in the bed of the drain so that it is divided into separate basins of about 4-5 m in length in order to encourage infiltration, and to trap sediment

•Stone bunds – These are used on steep slopes, where soil is not stable enough to keep as risers in terraced lands and where stone is available for such work. The foundation for the stone bund is laid down to 22.5 cm and the bund is raised about 45 cm from the upper side. Generally these bunds are constructed for width of 60 cm.

•Soil bunds and drains – These are adopted on lands with slopes less than 10 %. Bunds are demarcated on sloping lands with simple tools mostly by field extension workers or trained farmers, and the land user is asked to do soil work with or without incentives. This system will reduce the surface flow rate of water.

•Terracing - Converting a steep slope into a series of steps with horizontal or nearly horizontal ledges (shelves), and vertical or almost vertical walls (risers) between the ledges. The wall is vulnerable to erosion and is protected by a vegetation cover and sometimes faced with stones or concrete. There is no channel as such but a storage area is created by sloping the shelf into the hillside.

The basic bench system can be modified according to the nature and value of the crops grown.

•Gully control structures - There are varieties of gully control structures from brushwood dams to cement structures. Sometimes you do not find much difference among these structures. The brushwood dam uses small tree branches, packed as tightly as possible across the direction of flow. They can be anchored by packing them between rows of vertical stakes, or by tying down with wire, or stick, laid across the top and fasten down.

Traditional management of natural resources in Sri Lanka has been incorporated into their culture. In ancient times soil, water, animals and plants were their resources which were conserved as an entity for sustainable living. Traditionally they considered 4 resources (sathara sampath) to protect namely forest, water, cattle and child. They followed 10 commandments to secure their lives. It illustrates how they ensured water security, food security, environmental protection, preservation of the knowledge and maintenance of the spiritual strength of their minds. The Ten Commandments, that ensures their whole culture and life are given below.

1. *Diya paththayam thabanchiya* – Regulations for water security during drought
2. *Niyama kanneta govithen bath* – Correct time of cultivation to reduce the risk of crop failure
3. *Gaba kola satha seepawa, Binkare wathurai aubowa* – Sustainability is ensured by plants, animals, land and water
4. *Hithe ispasuwata dan pin karannata*

*peti pas parane badapan wadapan* – Make your mind free to attend religious events through raising 5 types of babies (child, calf, kitten, pup and chick)

5. *Akabe webi keten wev amunu puropan* – harvest rainwater and store for future use

6. *Ekatbu paadaa nowi hari haman wedak nokaran* – Work as a team

7. *Wee kuraban sambhare atu kotu purawan rale* – Store excess grains for future use (food security)

8. *Theh peni atthiban kewumda pangnan* – What is impossible if everything is with you?

9. *Kem paban denagan sanuhare rekagan* – Gain knowledge to protect all

10. *Kavi sindu ragan hithata kawaddapan* – Preserve the cultural arts



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