



Soil Biodiversity Profile and Conservation Action Plan



Biodiversity Secretariat
Ministry of Mahaweli Development and Environment
2019



Soil Biodiversity Profile and Conservation Action Plan



Biodiversity Secretariat

Ministry of Mahaweli Development and Environment

2019

Soil Biodiversity Profile and Conservation Action Plan

Copyright:

© 2019 – Biodiversity Secretariat, Ministry of Mahaweli Development and Environment (MMD&E), All rights reserved

ISBN 978-955-8395-36-3

Supervision and Guidance

Mr. Anura Dissanayake
Secretary
Ministry of Mahaweli Development and Environment

Mr. M. G. W. M. W. T. B. Dissanayake
Additional Secretary (Environment Policy)
Ministry of Mahaweli Development and Environment

Ms. R. H. M. P. Abeykoon
Director (Biodiversity)
Ministry of Mahaweli Development and Environment

Ms. A. A. R. S. K. Bakmeedeniya
Assistant Director (Biodiversity)
Ministry of Mahaweli Development and Environment

Consultation

Dr. W. M. A. D. B. Wickramasinghe
Retired Additional Director General (Research) Department of Agriculture

Coordination

Ms. Samantha Kodithuwakku
Development Officer (Biodiversity)
Ministry of Mahaweli Development and Environment



Biodiversity Secretariat
Ministry of Mahaweli Development and Environment
No.416/C/1, Robert Gunawardana Mawatha, Battaramulla, Sri Lanka.

Tel : +94 (0)11 2034208

Fax : +94 (0)11 2879972

E-mail : biodiversitysl@gmail.com

Web : www.environmentmin.gov.lk

CONTENTS

	Page No.
List of Figures	VII
List of Tables	IX
List of Abbreviations	XI
Forward	XIII
1. Introduction	1
2. Physiography of Sri Lanka	1
2.1 Climate	2
2.2 Rainfall	2
2.3 Temperature	3
2.4 Humidity	3
3. Climate and agro-ecological zones	3
4. Land and Land use	4
5. Soil and Biological Activities	4
6. Role and functions of soil organisms	5
7. Soils of Sri Lanka	6
7.1 Soils in the mountain region	8
7.2 Soils in the mid country	9
7.3 Soil in the low country wet zone	9
7.4 Soil in the coastal plain	10
7.5 Soil in flood plain	10
7.6 Soil in the dry zone	11
8. Soil Biodiversity Programmes	11
8.1 Programme 1	11
8.2 Programme 2	12
8.3 Programme 3	13
8.4 Programme 4	13
8.5 Programme 5	14
8.6 Programme 6	14
8.7 Programme 7	15
8.8 Programme 8	16
List of Contributors	27

LIST OF FIGURES

		Page No.
Plate 1	: Horton Series	8
Plate 2	: Mattakele Series	8
Plate 3	: Hunugala Series	8
Plate 4	: MahaberitennaSeries	9
Plate 5	: Kiribathkumbura Series	9
Plate 6	: Wagura Series	9
Plate 7	: Gampaha Series	9
Plate 8	: Rathupasa Series	9
Plate 9	: Boralu Series	9
Plate 10	: Sandy Regosols	10
Plate 11	: Palatuwa Series	10
Plate 12	: SoladizedSolantez	10
Plate 13	: Madabokka Series	10
Plate 14	: Alluvial Soil	10
Plate 15	: Ranorawa Series	11
Plate 16	: Elayapattuwa Series	11

LIST OF TABLES

	Page No.
Table 1: Programme 1 Establishment of a national level platform on soil biodiversity for stakeholders	17
Table 2: Programme 2 Develop global linkage with the international Conventions	18
Table 3: Programme 3 Strengthen policies and legislative measures for the conservation of soil biodiversity	19
Table 4: Programme 4 Mainstreaming soil biodiversity into national Programmes and priorities	20
Table 5: Programme 5 Sustainable resource mobilization for implementing Soil Biodiversity Action Plan	21
Table 6: Programme 6 Research and development programme on soil biodiversity	22
Table 7: Programme 7 Development of data management and information system	24
Table 8: Programme 8 Capacity development and knowledge management	25

LIST OF ABBREVIATIONS

BDS	-	Biodiversity Secretariat
CARP	-	Council for Agricultural Research Policy
CBO	-	Community Based Organization
CEA	-	Central Environmental Authority
CRI	-	Coconut Research Institute
DAPH	-	Department of Animal Production and Health
DEA	-	Department of Export Agriculture
DOA	-	Department of Agriculture
DNBG	-	Department of National Botanical Garden
ERD	-	External Resources Department
FD	-	Forest Department
MMD&E	-	Ministry of Mahaweli Development and Environment
MOU	-	Memorandum of Understanding
MSL	-	Mean Sea Level
NAP	-	National action Program
NBSAP	-	National Biodiversity Strategic Action Plan
NFS	-	National Fertilizer Secretariat
NGO	-	Non Government Organization
NIFS	-	National Institute of Fundamental Studies
NPD	-	National Planning Department
NRC	-	National Research Council
NSF	-	National Science Foundation
RRI	-	Rubber Research Institute
SRI	-	Sugar Research Institute
TRI	-	Tea Research Institute
UNCBD	-	United Nations Convention on Biological Diversity
WMA	-	Waste Management Authority

FORWARD

“Living Soils and Our Lives”

Sri Lanka is considered as a country with rich biodiversity both of flora and fauna and is very unique compared to other countries. Its varied environmental and soils are the main sources for this diversity. Soil is an essential component of the terrestrial ecosystem which greatly influence in the conservation of biodiversity. It is not only a critical resource for agricultural production and food security but also to the maintenance of life on earth. Soil biodiversity reflects the variability among living organisms in soils ranging from micro-organisms to larger meso-fauna as well as the more familiar macro- fauna. Plant roots can also be considered as soil organisms in view of their role in different functions in the root environment and interactions with other soil components.

There are many constraints in conserving soil biodiversity in Sri Lanka. Environmental factors such as temperature, moisture and soil reaction, soil organic matter content, and different soil additives and anthropogenic actions in particular agricultural and forestry management practices affect to different extents of soil biodiversity. Further changing climate has significantly influenced the soil biodiversity.

Since 1994, Sri Lanka has been a party to the United Nations Convention on Biological Diversity (UNCBD). Considering the importance of the soil and its role in biodiversity, UNCBD has identified conservation and sustainable use of soil biodiversity as an area requiring particular attention under several work programmes. According to Article 6 of the UNCBD, Sri Lanka has developed a National Biodiversity Strategic Action Plan (NBSAP) in 2016. Conservation of soil biodiversity has been identified by the NBSAP and accordingly Soil Biodiversity Profile and Conservation Action Plan has been prepared. The objective of this Soil Biodiversity Profile and Conservation Action Plan is to address the issues pertaining to soil biodiversity and conservation of soil biodiversity systematically and take measures to conserve them.

This document is a product of collaborative work with the contribution by officials of numerous Government and Corporate Sector Institutions, Academics, Private Sector and Non-Government Organization (NGOs).

I take this opportunity to extend my thanks to all individuals and institutions who contributed for the successful completion of this task.

Anura Dissanayake

Secretary

Ministry of Mahaweli Development and Environment

Soil Biodiversity Profile and Conservation Action Plan

1. Introduction

Sri Lanka is an island located in the Indian Ocean at the southern tip of the Indian sub-continent. It has a land area of 65,610 km² with diverse climatic conditions, soil types and land use systems. The land use systems of the country have been evolved over the years under different agro-ecological conditions and this diversity is the main reason for the rich soil biodiversity exists in this country.

Soil biodiversity reflects the variability among living organisms including a myriad of organisms not visible with the naked eye, such as micro-organisms (e.g. bacteria, fungi, protozoa and nematodes) and meso-fauna (e.g. acari and springtails), as well as the more familiar macro-fauna (e.g. earthworms and termites). Plant roots can also be considered as soil organisms in view of their symbiotic relationships and interactions with other soil components. These diverse organisms interact with one another and with the various plants and animals in the ecosystem forming a complex web of biological activity. Soil organisms contribute a wide range of essential services to the sustainable function of all ecosystems. They act as the primary driving agents of nutrient cycling, regulating the dynamics of soil organic matter, soil carbon sequestration and greenhouse gas emission, modifying soil physical structure and water regimes, enhancing the amount and efficiency of nutrient acquisition by the vegetation and enhancing plant health. These services are not only essential to the functioning of natural ecosystems but constitute an important resource for the sustainable management of agricultural systems (FAO)."

In view of the above aspects, a national action plan for soil biodiversity have been developed and the objective of this action plan is to address the issues pertaining to soil biodiversity systematically and take measures to conserve the soil biodiversity of the country.

2. Physiography of Sri Lanka

The physiography of Sri Lanka is described by three zones based on the elevation patterns of the country. The area from the coastal belt extending up to 300 m elevation from MSL is referred to as the Lower peneplain while the area between 300m to 900m MSL is known as the Middle peneplain and the area above 900m MSL the High peneplain.

The lowest peneplain consists of almost flat terrain closer to the coast and becomes undulating towards the interior areas. The average slope in this area is 0 – 8%, but the presence of some occasional isolated hills with steep gradients disturb the monotony of this landscape. The middle peneplain rises from the inner edge of the lowest peneplain up to the highest peneplain, which is of 900m. This area consists more of a rolling and hilly landscape with an average slope in the range of 8% – 15%, but areas with steeper gradients are also evident occasionally. The high peneplain consists of a very complex system of plateaus, mountain chains, massifs and basins. The central part of the peneplain falls into the average slope category of 15% – 30%, while the outer skirt falls into the slope category of over 30%. The middle and highest peneplains form a mountain mass which is known as the Central highlands. The central highlands stretch from the middle of the country in a Southwest - Northeast direction. Different land forms and land systems are identified in each peneplain. In general terms, the lowest peneplain is referred to as the low country, while the middle peneplain and highest peneplain are known as mid country and up country respectively.

2.1 Climate

Sri Lanka is a tropical island because of its geographical location within the tropics between 5° 55' to 9° 51' North latitude and between 79° 42' to 81° 53' East longitude. The topographical features of the country strongly affect the spatial patterns of winds, seasonal rainfall, temperature, relative humidity and other climatic elements, particularly during the monsoon seasons.

2.2 Rainfall

The rainfall in Sri Lanka consisting of monsoonal rains and rains from convectional origin accounts for a major share of the annual rainfall. The mean annual rainfall varies from about 900mm in the driest parts to over 5000mm in the wettest parts of the country. The driest parts fall into the South eastern and Northwestern corners of the country while the wettest parts fall into the western slopes of the central highlands. The very unique temporal distribution of rainfall over the year results in four unique climate seasons in the country as indicated below :

First Inter-monsoon rain (March - April)
Southwest -monsoon (May - September)
Second Inter-monsoon Season (October-November)
Northeast – monsoon (November – January)

2.3 Temperature

The differences in temperature over and across Sri Lanka are mainly governed by the differences in altitude. The mean annual temperature in Sri Lanka remains largely homogeneous in the low lands and rapidly decreases towards the highlands. The mean monthly temperatures differ slightly over the year and is due to seasonal movement of the sun with some influence caused by rainfall. In the lowlands, up to an altitude of 100 m to 150 m, the mean annual temperature varies between 26.5 °C to 28.5 °C with an annual mean temperature of 27.5 °C. In the central highlands, the temperature falls quickly as the altitude increases. Generally, the coldest month of the country is January, and the warmest months are April and August.

2.4 Humidity

Humidity is typically higher in the southwest and mountainous areas and amounts depend on the seasonal rainfall. In the coastal areas, the daytime humidity remains above 70 % year round, rising to almost 90 % during the monsoon season in June. However, the drier areas experience a daytime low of 60 % during the inter-monsoonal month of March, but a high value of 79 % during the rainy months of November and December. In the highlands, the daytime humidity usually ranges between 70% to 80 %.

3. Climatic and agro-ecological zones

Depending on the total annual rainfall, the island has been divided into 3 climatic zones, namely the Wet zone, Intermediate zone and the Dry zone. The Wet zone is the area which receives a mean annual rainfall of above 2500mm. The Intermediate zone receives a mean annual rainfall varying from 1750mm-2500 mm. The mean annual rainfall of the Dry zone is below 1750 mm. In most parts of the country, particularly in the dry zone, the rainfall within the year shows a bimodal pattern while in the rest of the area an uni-modal distribution pattern is evident. The bimodal distribution pattern shows two rainy periods and two dry periods within the year. One dry period falls during February to March while the other falls during July to September. Based on the three climate zones and three elevation classes, namely, up country (>900m), mid country (300-900m) and low country (<300m), seven agro-climatic zones have been delineated. These 07 agro-climatic zones have been further delineated into 46 agro-ecological zones based on the rainfall distribution within the year.

4. Land and land use

The total land area of Sri Lanka is 6.56 million ha. About 4.6 % of this area is covered by water bodies. The land is used for wide range of agricultural and non-agricultural practices. The extents of agricultural land has increased from 45% in 1956 to 60% in 2007 while land extent under various forest types has decreased from 51% to 28.8% during the period. The dense and open forest area of the country during this period decreased from 44% to 23%. The sparsely used crop lands, homesteads and paddy occupy the highest land area in the agriculture sector. The paddy lands include both irrigated and rain-fed lands. The homestead lands are the home gardens where agricultural crops are grown. The sparsely used crop lands are the lands where agricultural crops are grown but not properly managed and maintained. The sparsely used crop lands have been increased during this period indicating poor management of agricultural lands in the country. Among the plantation crops the land extents under tea and rubber plantations have decreased since 1956. It is these lands that have become sparsely used lands. There is nearly 2% increase of mixed and perennial crop lands and 1% increase in the coconut plantations (NAP, 2014).

5. Soils and biological activities

The formation of soils depend on factors such as parent material, environmental conditions, topography (slope), organisms, time and management practices. Biological activity is a primary factor in the physical and chemical processes of soil formation. Biological activities in a soil mainly depend on environmental and drainage conditions which ultimately decide the types of flora and fauna that could live in the soil and types of soil formed. Hence, soils and biodiversity are strongly linked as the soil is the medium for a large variety of flora and fauna living in soils and biosphere, and they interact closely with the wider biosphere. Soil provides a vital habitat for organisms ranging from large plants to microbes, including bacteria and fungi; for microfauna such as aprotozoa and nematodes; mesofauna such as microarthropods and enchtraeids; and macrofauna such as earthworms, termites and millipedes (Bardgett, 2005). According to the preferred living environment, aboveground and belowground specialists can be distinguished.

Soil is therefore, one of the most diverse habitats on earth and contains the most diverse assemblages of living organisms. Generally, biological activity in soils is largely concentrated in the topsoil. The biological components occupy a tiny fraction (<0.5%) of the total soil volume and make less than 10% of the total soil organic matter. This living component consists of plant roots and soil organisms. Soil microorganisms are responsible for a large part of biological activity (60-80%) which is associated with processes regulating nutrient cycles and decomposition of organic residues. Earthworms often form a major part of the soil fauna biomass and can represent up to 50% of the soil fauna biomass in some temperate grasslands, and up to 60% in some temperate forests. High levels of biodiversity, particularly at the microbial scale accompany the huge numbers of soil organisms and about hundred different bacterial species per gram of soil is not an extreme number. Other than bacteria, hundreds of other species are present in the soil.

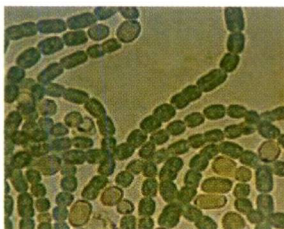
The primary role of soil biota is to recycle organic matter that is primarily derived from the above ground plant biomass. Soil is in close cooperation with the wider biosphere and maintenance of soil fertility is one of the most vital ecological services the living world performs. The mineral and organic contents of soil must be replenished constantly as plants consume soil elements and pass them up the food chain (Baskin, 1997). The correlation of soil and biodiversity can be observed spatially, for example, both natural and agricultural vegetation boundaries correspond closely to soil boundaries, even at continental and global scales (Young & Young, 2001). A study, published in *Vadose Zone Journal*, found that the number of soil types in an area (called the "Pedodiversity") and the biodiversity of that area i.e. the number of species of vascular plants, amphibians, reptiles, birds, and mammals are strongly correlated on a global scale. Additionally, the findings show that pedodiversity could be used as an indicator of biodiversity, which can often be difficult to measure (Juan José Ibáñez and Enrico Feolib, 2013).

6. Role and functions of soil organisms

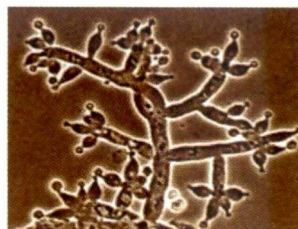
Soil organisms interact in a soil food web, where each trophic layer is food for the next trophic layer. In general, a soil food web is based on the degradation of roots and dead organic material. The stability of the performance of an ecological function is dependent on the stability of the soil food web. The soil food web stability increases with an increasing number of interactions between the organisms.



Nessia hickanala



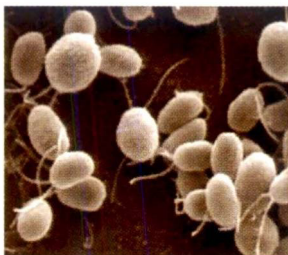
Anabaena



Trichoderma harzianum



Dung Beetles



Chlamydomonas



Penicillium

When predators have an increasing choice in their food, the chance that they will predate on a specific species until its extinction decreases. This is an important fact relating to the biodiversity of soil organisms. Earthworms can improve the incorporation of organic matter below the soil surface, increase the numbers of water stable soil aggregates, improve water infiltration, aeration and root penetration and increase microbial activity. Soil microorganisms also degrade toxic residues, form symbiotic associations with plant roots, act as antagonists to pathogens, influence the weathering and solubilisation of minerals and contribute to soil structure and aggregation. The majority of vascular plants is associated with arbuscular mycorrhizal or ectomycorrhizal fungi and benefits from an increased capacity to extract phosphorus and other nutrients from the soil. Mycorrhizal fungi thus have an important role in plant community development, nutrient cycling and the maintenance of soil structure.

7. Soils of Sri Lanka

There are 12 soil orders in the world, of which 7 soil orders have been identified in Sri Lanka, which is mainly due to variation of the agro ecological conditions of the country. At the local level, these soils are further classified into 14 Great Soil Groups (Panabokke and Alwis, 1963). The natural vegetation exists covering these soils as ecosystems, namely forest, grasslands, coastal and marine vegetation, and inland wetlands. All these ecological factors collectively create a greater soil

biodiversity in Sri Lanka. Ten Great Soil Groups out of 14 Great Soil Groups are located in the dry and semi dry areas in the country. They are the Reddish Brown Earths, Low Humic Gley Soils, Noncalcic Brown soils, Red-Yellow Latosols, Alluvial Soils, Solodized Solonetz, Regosols, Soils on Old Alluvium, Grumusols, Immature Brown Loams. In the wet and semi wet areas in the country, 5 Great Soil Groups have been identified. These soils are Red-Yellow Podzolic Soils, Reddish Brown Latosolic Soils, Immature Brown Loams, Bog and Half Bog Soils and Latosols and Regosols on Old Red and Yellow sands. In addition, some other great soil groups and miscellaneous land units occur scattered throughout the country which are considered as minor with respect to their extent. The great soil groups of minor extent are Rendzinas, Meadow Podzolic Soils, Wet Mountain Regosols and Lithosols. The miscellaneous land units include rock knob plains and eroded lands, erosional remnants, and steep rockland and lithosols. Low Humic Gley Soils, Alluvial Soils, Grumusols, Bog and Half Bog Soils occur in the flat and lower aspect of undulating landscape. Solodized Solonetz Soils on Old Alluvium are located in the coastal plains of the country and has unique ecosystems for those conditions.

In this group of soils, rice is cultivated in human influenced lands and the biodiversity of these lands is narrow due to mono crop cultivation and control of other species of plants.

Soil flora and fauna are also greatly affected by intensive cultivation and application of various kinds of agro chemicals. Aquatic plant species are dominant on virgin lands in villus, mangroves, salt marshes, mudflats, sea grass beds, flood plains, and

Swamp forests and the flora and fauna found in these ecosystems are unique to those systems. Soils in the flood plains in major rivers consist of villus. Basically Bog and Half bog soils are inundated with either fresh water or brackish water and the ecosystem changes accordingly.

The soils that occur on higher aspect of undulating landscape in dry and semi dry areas include Reddish Brown Earths, Non-Calcic Brown soils, Red-Yellow Latosols and Immature Brown Loams. The soils have a fairly a good drainage condition and aeration. Therefore, soil micro-organisms in these soils are completely different to those of poorly drained soils. In this group of soils, other field crops, vegetables, seasonal fruits, sugarcane, tobacco, planted forest etc. are grown. Soils on virgin lands support tropical dry mixed evergreen forests, tropical thorn forests, savannas and dry patanas.

The soils that occur on rolling, hilly and mountainous topographic land classes in wet and semi wet areas are Red-Yellow Podzolic Soils, Reddish Brown Latosolic Soils and Immature Brown Loams. In this group of soils, plantation crops such as tea, rubber, coconut, spices, tree fruits, tobacco, exotic vegetables are grown on human influenced lands. Soils on virgin lands support tropical wet ever green forests, tropical moist semi evergreen forests, tropical lower montane forests, tropical upper montane forests and wet patanas. High soil organic matter content in top soils of these virgin soils is a common factor and therefore greater soil biodiversity can be found in these soils than in the dry zone.

The soils and miscellaneous land units that occur in other topographic positions scattered in the country are Regosols, Latosols, Regosols on Old Red and Yellow sands, Rendzinas, Meadow Podzolic Soils, Wet Mountain Regosols, Lithosols, rock knob plains, eroded lands, erosional remnants, and steep rockland. Regosols in human encroached lands are used to grow seasonal vegetables, fruits, coconut etc. Lands having other soils in this group are not fully utilized for human use and are occupied by different species of grasses, shrubs and trees under virgin situation.

Recently, the Sri Lankan soils have been classified into soil series and altogether 102 different soil series have been identified and recorded (Soil profile of some of the series are shown in Plate 1- 16). Their physical and chemical characters were measured, but biological characters need to be studied.

7.1 Soils in the mountain region



Plate 1.
Horton Series



Plate 2.
Mattakele Series



Plate 3.
Hunugala Series

7.2 Soils in the mid country



Plate 4.
Mahaberitenna Series



Plate 5.
Kiribathkumbura Series

7.3 Soils in the low country wet zone



Plate 6.
Wagura Series



Plate 7.
Gampaha Series



Plate 8.
Rathupasa Series



Plate 9.
Boralu Series

7.4 Soils in the coastal plain



Plate 10.
Sandy Regosols Series



Plate 11.
Palatuwa Series



Plate 12.
Soladized Series



Plate 13.
Madabokka Series

7.5 Soils in flood plain

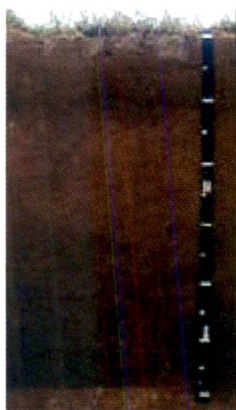


Plate 14.
Alluvial Soil

7.6 Soils in the dry zone

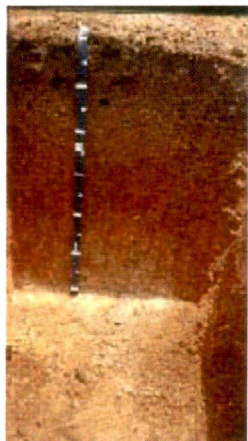


Plate 15.
Ranorawa Series



Plate 16.
Elayapattuwa Series

8. Soilbiodiversity programmes

Considering the mission to conserve the soil biodiversity, seven programmes have been identified and an Action Plan was developedfor each programme as indicated below.

8.1 Establishment of a national level platform on soil biodiversity for Stakeholders – Programme 1

In Sri Lanka, very little attention has been paid tothe conservation of soil biodiversityresulting in the destruction of soil biodiversity due to various reasons. One of the main reasons for the negligence is the absence of a National Forum to raise the issues relating to soil biodiversity and to discuss them at the national level by the stakeholders. Hence, the objective of this programme is to coordinate all matters related to soil biodiversity at national level.

The expected outcomes of the programme are as follows:

- Soil biodiversity issues are addressed & discussed in various for a
- Information is documented & communicated among key stakeholders
- Programmes and activities of soil biodiversity are coordinated and implemented
- Scientific community & CBOs are increasingly engaged in conservation process.

The key performance Indicators are as follows;

- The number of issues addressed by the National Coordinating Committee
- Matters discussed in various fora, media, journals, research organizations etc.
- The number of CBOs and Scientific Community engaged in the conservation process
- Minutes of the regular meetings of the committees.

8.2 Develop Global linkages with the international Conventions – Programme 2

Conservation of biodiversity is a global issue and soil biodiversity is part of the global biodiversity conservation programmes. Hence, it is very important to develop global partnerships and align the local programmes on soil biodiversity with international treaties and conventions. The objective of this programme is to ensure that Sri Lanka becomes an active partner of international conventions on biodiversity / soil biodiversity and synergize local priorities with global priorities.

The expected outcomes and key performance indicators of the programme are as follows:

- Local priorities and programmes on soil biodiversity are in par with the international Conventions and reflect the international programmes.
- The key performance Indicators are:
 - * Initiatives taken to develop the local priorities on soil biodiversity
 - * Establish global linkages such as number of conventions and MOUs signed.

8.3 Strengthen legislative measures for the conservation of Soil biodiversity – Programme 3

Policies and legislations play an important role in conserving soil biodiversity. Although there is no specific Act or regulations to cover the aspects of soil biodiversity conservation, other existing Acts address the needs of conserving soil biodiversity. However, it is noted that these Acts are implemented separately by the responsible agencies and there is no link among those Acts and regulations. In this programme, it is expected to review the existing policies, Acts and regulations and identify the gaps in relation to issues related to soil biodiversity, strengthen them with necessary amendments, and strengthen the implementation process of those acts.

Expected outcome of this programme is,

- The successful implementation of policies, acts and regulations leading to soil biodiversity conservation

The Key Performance Indicators are,

- The approved policies, acts & regulations
- Implementing processes.

8.4 Mainstreaming soil biodiversity into national programmes and Priorities – Programme 4

At present, soil biodiversity and its conservation has been given less importance in the development activities of the country. Therefore, a considerable destruction of soil biodiversity occurs during the activities related to the various development programmes of the country. Under this programme, it is expected to include conservation of soil biodiversity as a main component of the national development programme and activities.

The expected outcome of the programme is,

- Soil biodiversity is included and implemented in national policies and programmes
- Aspects of soil biodiversity are covered by all relevant agencies in their development activities.

The key performance indicators are,

- Implemented policies and programmes that include soil biodiversity
- Reports indicating efforts by each agency in handling the soil biodiversity issues.

8.5 Sustainable resource mobilization for implementing of Soil Biodiversity Action Plan – Programme 5

With the finalization of the Soil Biodiversity Action Plan, all the necessary resources should be in order to implement it successfully. The resources include human resources, infrastructure facilities and necessary financial allocation. The objective of this programme is to create innovative resources generating mechanism and allocate necessary resources for successful implementation of activities in Soil Biodiversity Action Plan.

The expected outcome of the programme is,

- The Soil Biodiversity Action Plan is successfully implemented with adequate Resources mobilized.

The key performance Indicators are,

- The amounts of funds, manpower and other resources disbursed to implement the action plan.

8.6 Research and development programme on soil biodiversity – Programme 6

The present knowledge among researchers and other stakeholders on soil biodiversity in the country is limited, the main reason being the lack of attention paid to generate research information. In addition, this area can be developed to harness the national development programme. For example, apart from conservation of soil biodiversity, soil microbes can be utilized particularly in the agriculture sector to improve productivity and reduce chemical fertilizer cost. Therefore, a national research and development programme is timely needed to generate research information, identification and characterization of soil microbes and to harness the benefits of the soil biodiversity. It is expected to develop and implement national research and development programmes to explore the beneficial effects of soil microorganisms and conserve soil biodiversity.

The expected outcome are,

- Sustainable agricultural development through improved soil health
- Utilizing beneficial soil microorganisms
- Conserved soil microbial diversity.
- Soil biodiversity identified, documented and used for socio economic development of the nation.

The Key performance Indicators are,

- Established and operational soil microbe data bank
- Documented microbial diversity in soil
- Number of products and technologies generated to capture the beneficial effects of soil microorganisms
- Number of patents obtained.

8.7 Development of data management and information system – Programme 7

Available data and information on soil biodiversity are scattered and are mostly lying in personal information systems at present. These data and information are necessary to monitor the changes of soil biodiversity and to conserve them. Hence, it is important to gather all the data and information into a central portal and make them available to all the stakeholders. In addition, data and information related to soil biodiversity and their conservation are necessary for reporting purposes according to the international conventions. The objective of this programme is to collect and store data and information on soil biodiversity to conserve soil biodiversity and share data and information among stakeholders.

The expected outcome of the programme is,

- Establish data / information platform for planning and dissemination of information.

The Key Indicator is,

- Data / information management system available and operational (as indicated by the number of users of the site).

8.8 Capacity building and knowledge management – Programme 8

Along with the action plan, it is vital to enhance the capacities of all the stakeholders, which include human and other infrastructure capacities. In addition, information related to soil biodiversity and conservation are to be disseminated timely to relevant stakeholders and the general public should be made aware of the conservation aspects of soil biodiversity. This programme plans to develop the institutional and human capacities of all the stakeholders to carry out their functions in relation to soil biodiversity conservation and development.

The expected outcome is,

- Assured soil biodiversity conservation and utilization through improved institutional and human capacities of relevant stakeholders and dissemination of knowledge through improved knowledge management.

The key Indicators are,

- Implementation mechanism developed
- Improved infrastructure facilities and trained officers of stakeholders
- Public awareness of soil biodiversity conservation and soil biodiversity related programs conducted by each agency with their results.

Programme 1 – Establishment of a national level platform on soil biodiversity for stakeholders

Objective : To coordinate all matters related to soil biodiversity at national level

Expected outcomes : Expected outcome of the programme are that soil biodiversity issues are addressed & discussed in various fora, information is documented & Communicated among key stakeholders, programmes and activities of soil biodiversity are coordinated and implemented, and scientific community & CBOs are increasingly engaged in conservation process.

Key Performance : Number of issues addressed in national coordinating committee, information discussed in various fora, media,

Indicators : journals, research organizations etc.,
number of CBOs and Scientific Community engaged in the conservation process, minutes of the regular meetings of the committee.

	Action	Main Agency	Supporting agencies	Short Term		Medium Term		Long Term	Performance Indicators	Remarks
				Y1	Y2	Y3	Y4	Y5<		
1	Establish a national level committee on soil biodiversity and assure a representation of this committee in the Biodiversity Expert Committee.	MMD&E	DOA, Universities, DEA, TRI, FD, RRI, CRI, NIFS, SRI, RBG, AP&H (VRI)	*					Decisions taken at the meetings	
2	Establish a Technical Coordinating Committee(TCC) representing each institute to build inter-institutional linkages.	MMD&E	All the stakeholders and funding sources NSF, CARP, NRC	*					Decisions taken at the meeting and technical matters addressed	
3	Develop Terms of Reference (TR) for above two committees	MMD&E	Relevant Committees	*					Developed ToR	
4	Facilitate the generation of funds and other resources for soil biodiversity programmes	MMD&E	Expert committee	*	*	*	*	*	Number of projects successfully secured funds	
5	Coordinate research and development programmes on soil biodiversity	MMD&E	Technical committee	*	*	*	*	*	Successfully implemented coordinated programmes	
6	Documentation and sharing of data / information.	BDS/ MMD&E	Technical committee	*	*	*	*	*	Data and information collected, documented and shared	
7	Implement and monitor the National Action Programme on soil biodiversity	BDS/ MMD&E		*	*	*	*	*	Monitoring reports	
8	Arrange workshops and conferences at national level with relevant stakeholders to discuss the issues and share the information on soil biodiversity.	BDS/ MMD&E		*	*	*	*	*	Conferences and workshops reports	

Programme 2 – Develop global linkage with the international conventions

- Objective** : To be an active partner of international convention of biodiversity / soil biodiversity and synergize local priorities with global priorities.
- Expected outcomes** : Local priorities and programmes on soil biodiversity are in par with the international conventions and those programmes reflect the international Programmes.
- Key Performance Indicators** : Initiatives taken to develop the local priorities on soil biodiversity and establish global linkages such as number of conventions and MOUs signed.

	Action	Main Agency	Supporting agencies	Short Term		Medium Term		Long Term	Performance Indicators	Remarks
				Y1	Y2	Y3	Y4	Y5<		
1	Establish and promote Sri Lanka as a country with important and wide soil biodiversity.	BDS/ MMD&E		*					Gazette notification	
2	Prioritize and align the soil biodiversity programmes in Sri Lanka on par with international treaties/ conventions.	BDS/ MMD&E		*					Aligned Action Programme	
3	Develop links with international experts and local soil biodiversity working groups	BDS/ MMD&E	ERD,NPD	*	*	*	*	*	MOU signed, experts visits and their visit reports	
4	Performance of national requirements of Biodiversity convention	BDS/ MMD&E		*	*	*	*	*	Requirements addressed	
5	Active participation in international soil biodiversity conservation forums and link with national focal point	BDS/ MMD&E	Expert/ Tech Committee						Participation reports	

Programme 3 – Strengthen policies and legislative measures for the conservation of soil biodiversity

Objective : to review the existing policies, Acts. & regulations and identify the gaps in relation to issues of soil biodiversity, strengthen them with necessary Amendments, and strengthen the implementation process of those acts.

Expected outcome : Successful implementation of policies, acts and regulations leading to soil biodiversity conservation.

Key Performance : Approved policies, acts & regulations and implementing processes.

Indicators

	Action	Main Agency	Supporting Agencies	Short Term		Medium Term		Long Term	Performance Indicators	Remarks
				Y1	Y2	Y3	Y4	Y5<		
1	Review and Identify the gaps in the present policies and legal framework, and propose suitable provisions	BDS/ MMD&E	Expert committee	*					Reports	Task of National Committee
2	Strengthen the implementation of Biodiversity Conservation Act. Soil Conservation Act, Pastureland (Reservation and Development) Act. Environment Act. Plant Protection Act. Pesticide Act. Fertilizer Act. and other relevant Acts.	MMD&E, BDS, DOA, DAP&H, NFS, CEA, Waste Management Authority, Local Authorities		*	*	*	*	*	Actions taken	
3	Implement existing laws, rules and regulations to prevent or minimize disturbances to Soil Biodiversity	MMD&E, BDS, DOA, DAP&H, NFS, CEA, WMA Authority, Local Govt. Authority		*	*	*	*	*	Actions taken	
4	Identify the programmes in National Action Programme (2014) on Land Degradation in relation to soil biodiversity and implement them	BDS/ MMD&E	Expert committee and TCC	*	*	*	*	*	No. of successful programmes	Task of the TCC
5	Enforce strict control and quarantine measures to regulate importation of soil organisms and soil organisms containing materials from overseas	DOA		*	*	*	*	*	No off cases and reports	
6	Introduce necessary policies to involve Corporate sector in SBD and define their role	BDS/ MMD&E	Stakeholders	*					Policy document and ToRs	
7	Policy on sharing soil organisms with international communities / organizations	BDS/ MMD&E		*					Policy Documents	
8	Introduce incentive programmes which promote soil biodiversity conservation and utilization	MMD&E	Treasury, DOA, DEA, TRI	*	*	*	*	*	No. of programmes	

Programme 4 – Mainstreaming soil biodiversity into national programmes and priorities

Objective	: Include and give due consideration of soil biodiversity issues as a main component in national development programmes
Expected outcome	: Soil biodiversity is included in national policies and programmes and implemented. Aspects of soil biodiversity is covered by all relevant agencies in their development activities
Key Performance Indicators	: Implemented policies and programmes that include soil biodiversity. Reports indicating efforts by each agency in handling the SBD issues

	Action	Main Agency	Supporting Agencies	Short Term		Medium Term		Long Term	Performance Indicators	Remarks
				Y1	Y2	Y3	Y4	Y5<		
1	Include soil biodiversity as an essential part of the EIA process	CEA	BDS/MMD&E	*					EIA ToR	
2	Enhancing awareness of officials of the planning and finance ministries at national & provincial, and other development agencies dealing with land on the importance of soil biodiversity on the economy and need for conservation..	BDS/ MMD&E		*					Minuets of the meetings	
3	Include the importance of Soil biodiversity conservation into NVQ 3,4 and 5 programmes and University curricula	BDS/ MMD&E	Ministry of Higher Education, Universities, Ministry of Vocational Training,	*	*				Curricular	
4	Frame and provide guidelines to each implementing agency on how to handle SBD issues	BDS/ MMD&E		*					Framework/ Guidelines	

Programme 5 – Sustainable resource mobilization for implementing soil biodiversity action plan

Objective : Create innovative resources generating mechanism and allocate necessary resources for successful implementation of activities in Biodiversity Action Plan

Expected outcome : Soil Biodiversity Action Plan is successfully implemented with adequate resources mobilized.

Key Performance Indicators : Amount of funds, manpower and other resources disbursed to implement the action plan.

	Action	Main Agency	Supporting Agencies	Short Term		Medium Term		Long Term	Performance Indicators	Remarks
				Y1	Y2	Y3	Y4	Y5<		
1	Establish sustainable resource mobilization programmes for implementing Soil Biodiversity Action Plan	BDS/ MMD&E		*	*	*	*	*	Document showing methodology. Innovative funds received	
2	Allocation of funds for studies on Soil Biodiversity and its utilization	MMD&E	DOA,DEA, TRI, Universities, CARP, NRC, NSF. NIFS	*	*	*	*	*	Amount funds allocated	
3	Develop joint programmes with corporate sector and NGO for SBD	MMD&E	All stakeholders	*	*	*	*	*		
4	Preparation and submission of project proposal for treasury funding and international donors	MMD&E	Treasury,All stakeholders	*	*	*	*	*	Successful Project proposals	

Programme 6 – Research and development programme on soil biodiversity

Objective : Develop national research and development programme to generate research information, identification and characterization of soil microbes, harness the benefits of the soil biodiversity, to explore the beneficial effect of soil microorganism and conserve soil biodiversity.

Expected outcome : Sustainable agricultural development through improved soil health and utilizing beneficial soil microorganisms, conserved soil microbial diversity. Soil biodiversity identified, documented and used for socio-economic development of the nation.

Key Performance Indicators : Documented soil microbial diversity in different ecosystems. Number of products and technologies generated to capture the beneficial effects of soil microorganisms and number of patents obtained, number of conservation sites.

	Action	Main Agency	Supporting Agencies	Short Term		Medium Term		Long Term	Performance Indicators	Remarks
				Y1	Y2	Y3	Y4	Y5<		
1	Gap analysis on the knowledge of soil biodiversity in different soil types, land uses and farming systems and on bio-fertilizers	BDS/MMD&E	All stakeholders	*					Report indicating gaps	Task of Technical Committee
2	Identify Research Thematic areas and develop a research programme for identification, characterization & conservation of Soil Biodiversity in different land uses & farming systems, and development of biological agents	BDS/MMD&E	All stakeholders	*					Research Programme Report	Task of Technical Committee
3	Carry out the research and development programmes identified.	BDS/MMD&E	All stakeholders	*	*	*	*	*	Reports indicating Steps taken to strengthen and actions	
4	Identification and characterization of soil flora and fauna	BDS/MMD&E	DOA, DEA, TRI, RRI, CRI, SRI, NIFS, Universities	*	*	*	*	*	No of identified and characterized soil flora and fauna	Task of the TCC
5	Research on soil health of different ecosystems and farming systems	BDS/MMD&E	DOA, DEA, TRI, RRI, CRI, SRI, NIFS, Universities	*	*	*	*	*	Research publication and database	
6	Initiate soil biodiversity monitoring programme in different important eco systems.	BDS/MMD&E	DOA, DEA, TRI, RRI, CRI, SRI, FD	*	*	*	*	*	Data base and reports	Coordinate by Technical Committee

	Action	Main Agency	Supporting Agencies	Short Term		Medium Term		Long Term	Performance Indicators	Remarks
				Y1	Y2	Y3	Y4	Y5<		
7	Promote or develop a programme to collect local level type culture collection of soil microorganisms.	BDS/MMD&E	All stakeholders	*	*	*	*	*	Collected and conserved cultures	
8	Develop commercially viable effective microorganism/ bio fertilizer products.		DOA, DEA, TRI, RRI, CRI, SRI,NIFS, Universities and private sector	*	*	*	*	*	Commercially available products	
9	Identify and promote use of suitable crops and technologies which promote soil biodiversity and crop productivity		DOA, DEA, TRI, RRI, CRI, SRI,FD	*	*	*	*	*	Data base and reports	

Programme 7 – Development of data management and Information system

Objective : Collect and store data and information on soil biodiversity to conserve soil biodiversity and share data and information among stakeholders.

Expected outcomes : Data / information platform is available for planning and dissemination of information.

Key Performance : Data / information management system available and operational (As indicated by number of users of the site)

Indicators

	Action	Main Agency	Supporting Agencies	Short Term		Medium Term		Long Term	Performance Indicators	Remarks
				Y1	Y2	Y3	Y4	Y5<		
1	Develop a meta data / information sharing platform(web based)	BDS/ MMD&E	All stakeholders	*	*	*	*	*	Operational data / information sharing mechanism and platform	Technical Committee to coordinate
2	Develop soil biodiversity profile data base	MMD&E	All stakeholders	*	*	*	*	*	Operational data base	Technical Committee to coordinate
3	Setting up a Task Force to document the information on soil biodiversity in Sri Lanka	MMD&E	Technical Committee	*	*				Collected data and information	
4	Collect, documents and promote local knowledge on soil biodiversity conservation and sustainable use	MMD&E	All stakeholders						Steps taken to promote	

Programme 8 – Capacity development and knowledge management

Objective : Develop the institutional and human capacities of all the stakeholders to carry out their functions in relation to soil biodiversity conservation and Utilization.

Expected outcome : Conserved soil biodiversity assured through improved Institutional and human capacity development and dissemination of information.

Key Performance : Developed mechanism, improved infrastructure facilities, trained officers of stakeholders and public awareness

Indicators of soil biodiversity conservation. SBD
Related programs conducted by each agency with their results

	Action	Main Agency	Supporting Agencies	Short Term		Medium Term		Long Term	Performance Indicators	Remarks
				Y1	Y2	Y3	Y4	Y5<		
1	Strengthening the capacity of the existing regulatory bodies to regulate the inflow of soil organisms into the country.	DOA	Custom	*	*	*	*	*	Number of violated cases	
2	Strengthen the capacity of all institutions engaged in research and development on Soil Biodiversity	DOA, DEA, TRI, RRI, CRI, SRI, FD NIFS, Universities		*	*	*	*	*	Improved infrastructure	
3	Develop capacity of officers involved in planning, financing, regulating and management (including focal point, provincial councils) of Soil Biodiversity programs by providing them with scientific knowledge.	BDS/ MMD&E	All stakeholders	*	*	*	*	*	No of training Programmes conducted and number of participants. Quality of duties performed.	
4	Implement joint programmes with media to campaign for motivating people on soil biodiversity conservation	BDS/ MMD&E	All stakeholders	*	*	*	*	*	Media campaign conducted and knowledge products prepared and distributed (both print and electronic) Percentage of individuals/ agencies fulfil training / awareness	Need follow up survey.
5	Awareness programmes for school children, teachers, government officials, NGOs, CBOs etc.,	All stakeholders		*	*	*	*	*	Number of programmes conducted and attendance	

	Action	Main Agency	Supporting Agencies	Short Term		Medium Term		Long Term	Performance Indicators	Remarks
				Y1	Y2	Y3	Y4	Y5<		
6	Education & awareness programmes on the impact of the use of chemicals on soil biodiversity & how to diminish their deleterious effects	BDS/ MMD&E	All stakeholders	*	*	*	*	*	Programmes conducted	
7	Promote student participation in conservation by conducting art and essay competitions	BDS/ MMD&E	All stakeholders	*	*	*	*	*	Number of competitions.	
8	Engaging corporate sector and non-governmental institutions that can promote Soil Biodiversity Conservation and strengthen them	BDS/ MMD&E		*	*	*	*	*	Number of CBOs and NGOs strengthened and programs conducted by them	

References:

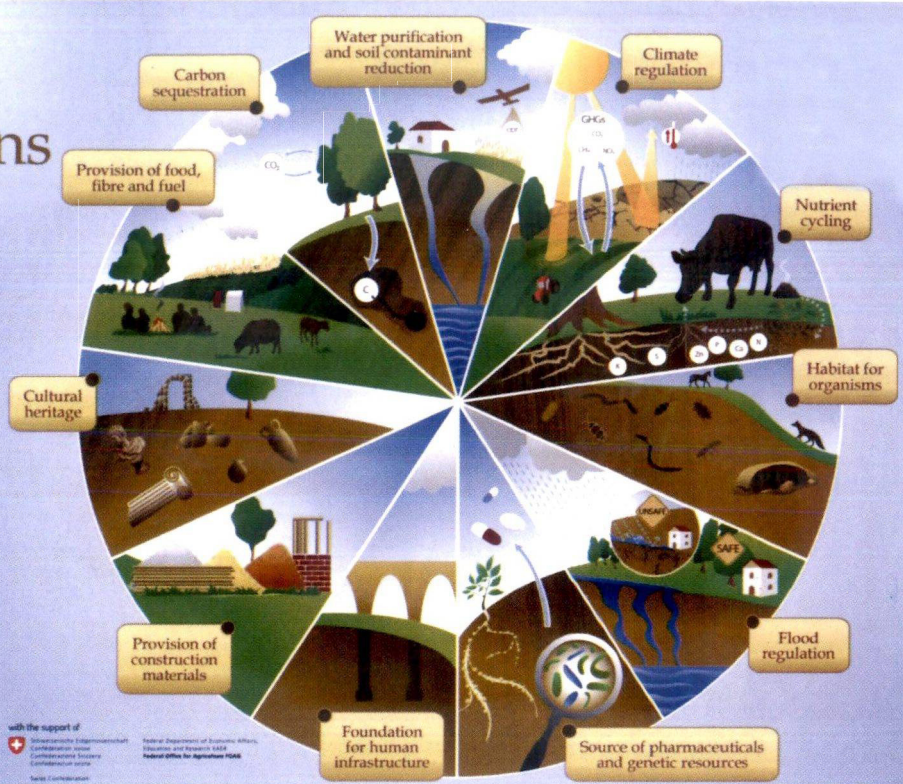
1. Juan José Ibáñez and Enrico Feolib (2013), Vadose Zone Journal , Vol. 12 ,3.
2. Conservation and Sustainable use of Soil Biodiversity in Sri Lanka, National Symposium on Soil Biodiversity (2013), Symposium Proceedings, Biodiversity Secretariat, Ministry of Environment and Renewable Energy.
3. National Action Programme for Land Degradation (2014), Ministry of Environment and Renewable Energy.
4. Soil Biodiversity (2014), Ed Rajapaksha, R M C P, Biodiversity Secretariat, Ministry of Environment and Renewable Energy.

LIST OF CONTRIBUTORS

Prof. S. Ananda Kulasooriya	Research Professor, Institute of Fundamental Studies
Prof. Gamini Seneviratne	Professor, Institute of Fundamental Studies
Prof. Chandi Rajapaksha	Professor, Department of Soil Science, University of Peradeniya
Prof. G. Mikunthan	Professor, University of Jaffna
Prof. P. Mangala de Silva	Professor, University of Ruhuna
Prof. Jinadasa Katupotha	Professor, University of Sri Jayawardanapura
Prof. Athula Perera	Emeritus Professor, University of Peradeniya
Mr. Jagath Gunawardena	Attorney- at-law (Environment)
Dr. W. M. A. D. B. Wickramasinghe	Retired Additional Director General (Research), Department of Agriculture
Dr. K. M. Mohotti	Senior Research Officer, Tea Research Institute
Dr. Warshi S Dandeniya	Senior Lecture, Department of Soil Science, University of Peradeniya
Dr. Chammi Attanayake	Senior Lecture, University of Peradeniya
Dr. Saman Dharmakeerthi	Senior Lecture, University of Peradeniya
Dr. Kapila Munasinghe	Deputy Director, Natural Resource Management Centre
Dr. Priyantha Weerasinghe	Director, Horticulture Research and Development Institute, Gannoruwa
Dr. Ajantha de Silva	Director, Natural Resource Management Centre
Dr. Prasadi demekorala	Deputy Director, Department of Export Agriculture
Dr. H. K. Kadupitiya	Deputy Director, Natural Resource Management Centre
Dr. Jayantha Senanayake	Director, Rice Research Institute
Dr. W. A. R. T. Wicramarachchi	Additional Director, National Plant Quarantine Service
Dr. Chandi Dangalla	Senior Lecture, University of Colombo
Dr. S. R. Krishnaraja	Senior Lecture, Open University of Sri Lanka
Dr. T. K. Weerasinghe	Senior Lecture, Open University of Sri Lanka
Dr. H. M. V. G. Herath	Senior Lecture, University of Peradeniya
Dr. P. Mangala	Senior Lecture, University of Ruhuna
Mr. Ajith Silva	Director (Land Resources), Ministry of Mahaweli Development and Environment
Mr. K. M. A. Kendaragama	Deputy Director, Natural Resource Management Centre
Mr. P. R. Idamekorala	Deputy Director, Department of Export Agriculture

Soil functions

Soils deliver
ecosystem
services
that enable
life on Earth



Food and Agriculture
Organization of the
United Nations

with the support of

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Federal Department of Economic Affairs,
Education and Research MEd
Federal Office for Agriculture FOAG

Swiss Contribution



Biodiversity Secretariat
Ministry of Mahaweli Development and Environment
No.416/C/1, Robert Gunawardana Mawatha, Battaramulla, Sri Lanka.

Tel. : +94-0112034208
Fax : +94-0112879972
E-mail : biodiversitysl@gmail.com
Web : www.environmentmin.gov.lk