SECTOR GUIDELINE

CAF – GEF PROJECT ON DEGRADED LANDS

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Director Foreword

Directorate of Environment and Climate Change

For CAF of the axes of its policy is the economic, social and environmental sustainability. This implies that the financial transactions conform to the strict scrutiny develop an environmental and social assessment of each operation.

In CAF also understand the importance that the soil plays as a resource for development, sustainability of agricultural, livestock and agro-industrial activities as a platform for performance and growth is therefore always be considered as an increasingly strategic resource defendant.

Similarly, the institution is aware of the importance of play for the sustainability of the planet and of human life: water, air and soil resources. The important role of soil resources in mature forests where mature forest continues to accumulate soil carbon at that moment the ground becomes key part of that carbon sink.

In Latin America and the Caribbean reclamation of degraded primarily by the bad practices of men, mainly agricultural, livestock, industrial, mining, on the change in land use, such as loss of forest cover their recovery and / or restoration represents a cost remaining growth potential GDP.

These actions have led today that 14% of the region encounter degraded land, just as we are consistent with the increase in global food demand, implying an increase in demand for food production and consistently forced to improve yields on the same land and allocate new land for this activity, which is constrained by the occurrence of degraded lands.

Based on the foregoing, we express our interest because the CAF projects - GEF to be executed on land either productive or degraded meet at least the guidelines and technical fundamentals contained herein, which are a reflection of the commitment CAF forcefully promote the conservation of one of the valuable resources of the region, soil resource, without which it could not sustain you agricultural, forest productivity, as well as the different productive activities in the region, as the various ecosystems and valuable diversity biological contained therein, important for our region but in the same important way for the world and its balance.

Sincerely

Ligia Castro de Dones

Executive Summary

This document aims to establish the technical guidelines for the execution or implementation of CAF projects - GEF in which the use of soil resources directly and intensively is implicit, as in the case of projects related to rural areas, agricultural activities, livestock, forestry, such as those significant impacts on land use change and loss of forest cover.

The document provides for ease of use a list of keywords to facilitate the reader's understanding as to make clear the understanding that begs the institution about each concept.

A very general overview of the current of Latin America and the Caribbean in reference to soil loss, a topic studied shallow and lacking even bigger and better studies are presented.

Likewise, we present the Forest CAF Program and Restoration and Recovery of Forests, Lands Tired and Degraded Component, which reflects the operational perspective of some of the specific alternatives that promotes the institution as a mechanism to reverse the status of degraded lands in the region.

In the section on best practices for agriculture and animal husbandry topics ratio without exhausting the subject should be considered so too would when implementing projects related to agriculture and livestock sector are listed, all with the intention of reducing the impact directly and indirectly generated down to conserve the attributes that allow you to not only keep time as such, but also facilitate the maintenance of their performance.

Already in forestry alternatives that promote sustainable forest management within the best use of soil resources in order to improve it for preservation are presented.

The next section focuses on the prevention of soil contamination through an inclusive inventory of measures, mechanisms and strategies that allowed inside the building processes ensuring the preservation of the quality and quantity of soil resource by nature, was highly affected mainly by the movement of large land masses.

In the last section dictate the general to establish when the nature of the project warrants a basic outline of the process of monitoring soil protection, but are not exhausted the subject in full.

Acronyms

CAF	Corporación Andina de Fomento
CEPAL	Comisión Económica para América Latina y el Caribe
CIFOR	Center for International Forestry Research
CSFD	Comité Scientifi que Français de la Désertification
DEFRA	Department for Environment, Food and Rural Affairs
ELD	Economics of Land Degradation
EURE	Estudios Urbanos Regionales
FAO	Food and Agriculture Organization of the United Nations
FVL	Forestry Value Land
GEF	Global Environment Facility
GHG	Greenhouse Gas
ICRAF	International Centre for Research in Agroforestry
IDB	Interamerican Development Bank
IPPC	Integrated Pollution Preventionand Control
ITTO	International Tropical Timber Organization
LADA	Land Degradation Assessment Indicators
MAG	Ministerio de Agricultura y Ganadería de Costa Rica
PNUMA	Programa de Naciones Unida para el Medio Ambiente
SENARMAT	Secretaría de Medio Ambiente y Recursos Naturales de México
SLM	Sustainable Land Management
SPMP	Site Plan Monitoring Protection
UNCCC	United Nations Convention to Climate Change
UNCCD	United Nations Convention to Combat Desertification
UICN	World Conservation Union
WB	World Bank
WWF	World Wide Fund for Nature

Key Definitions

Arid Areas: are defined as areas falling within the rainfall zones of 0-300 mm, (FAO, 1987). Because of the short growing periods (1-74 growing days), these areas are not suitable for cultivation. Rainfall patterns are unpredictable and are subject to great fluctuations. One-year droughts are more frequent than multiyear droughts. The occurrence of drought is more frequent in the arid (lower rainfall).

Deforestation: The conversion of forest to another land use or the long-term reduction of the tree canopy cover below the minimum 10 percent threshold[1].

Degraded forest land: former forest land severely damaged by the excessive harvesting of wood and / or non-wood forest products, poor management, repeated fire, grazing or other disturbances or land-uses that damage soil and vegetation to a degree that inhibits or severely delays the re-establishment of forest after abandonment.

Desertification: "Land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities" (Article 1 of the Convention). Desertification is a subset of land degradation under dry climates. Combating desertification subsequently "includes activities which are part of the integrated development of land in arid, semi-arid and dry sub-humid areas for sustainable development and which are aimed at: the prevention and/or reduction of land degradation; the rehabilitation of partly degraded land; and the reclamation of decertified land" (Article 1 of the UNCCD).

Drought: "means the naturally occurring phenomenon that exists when precipitation has been significantly below normal recorded levels, causing serious hydrological imbalances that adversely affect land resource production systems" (Article 1 of the UNCCD).

Land: "The terrestrial bio-productive system that comprises soil, vegetation, other biota, and the ecological and hydrological processes that operate within the system" (Article 1 of the UNCCD).

Land degradation: Reduction or loss of the biological or economic productivity and complexity of rainfed cropland, irrigated cropland, or range, pasture, forest and woodlands resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns, such as: (i) soil erosion caused by wind and/or water; (ii) deterioration of the physical, chemical and biological or economic properties of soil; and (iii) long-term loss of natural vegetation.

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[1] 1. Deforestation implies the long-term or permanent loss of forest cover and implies transformation into another land use. Such a loss can only be caused and maintained by a continued human-induced or natural perturbation.

2. It includes areas of forest converted to agriculture, pasture, water reservoirs and urban areas.

3. The term specifically excludes areas where the trees have been removed as a result of harvesting or logging, and where the forest is expected to regenerate naturally or with the aid of silvicultural measures. Unless logging is followed by the clearing of the remaining logged-over forest for the introduction of alternative land uses, or the maintenance of the clearings through continued disturbance, forests commonly regenerate, although often to a different, secondary condition. In areas of shifting agriculture, forest, forest fallow and agricultural lands appear in a dynamic pattern where deforestation and the return of forest occur frequently in small patches. To simplify reporting of such areas, the net change over a larger area is typically used.

4. Deforestation also includes areas where, for example, the impact of disturbance, over-utilization or changing environmental conditions affects the forest to an extent that it cannot sustain a tree cover above the 10 percent threshold.

Land degradation neutrality: Land degradation neutrality is achieved when globally or in a given landscape or terrestrial ecosystem the area of productive land (and therefore sustainable land use) remains stable or increases.

Land restoration: Reversing land degradation processes by applying soil amendments to enhance land resilience and restoring soil functions and ecosystem services.

Mitigation: is intervention intended to reduce ongoing degradation. This comes in at a stage when degradation has already begun. The main aim here is to halt further degradation and to start improving resources and their functions. Mitigation impacts tend to be noticeable in the short to medium term: this then provides a strong incentive for further efforts. The word 'mitigation' is also sometimes used to describe the reductions of impacts of degradation.

Prevention: implies the use of conservation measures that maintain natural resources and their environmental and productive

Rehabilitation: is required when the land is already degraded to such an extent that the original use is no longer possible and the land has become practically unproductive. Here longer-term and often more costly investments are needed to show any impact.

Semi-Arid Areas: are defined as areas falling within the rainfall zones of 300-600 mm, respectively (FAO, 1987). Because of the short growing periods (75-119 growing days), these areas are not suitable for cultivation. Rainfall patterns are unpredictable and are subject to great fluctuations. One-year droughts are more frequent than multiyear droughts. The occurrence of drought is more frequent in the semi-arid zones.

Sustainable Agriculture: is the efficient production of safe, high quality agricultural products, in a way that protects and improves the natural environment, the social and economic conditions of farmers, their employees and local communities, and safeguards the health and welfare of all farmed species.

Sustainable Livestock: develop a livestock management system that 1) protects and enhances soil quality (physical and biological), 2) protects water quality, 3) enhances on-farm biodiversity, 4) provides a humane and healthy environment for the livestock, and 5) minimizes greenhouse gas emissions. Fortunately there are strong positive linkages between all these goals, so working toward any one of them usually helps with all the others.

Sustainable Land Management: SLM can be defined 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"

Soil Degradation: is defined as a change in the soil health status resulting in a diminished capacity of the ecosystem to provide goods and services for its beneficiaries. Degraded soils have a health status such, that they do not provide the normal goods and services of the particular soil in its ecosystem.

Soil Erosion: is a common term that is often confused with soil degradation as a whole, but in fact refers only to absolute soil losses in terms of topsoil and nutrients. This is indeed the most visible effect of soil degradation, but does not cover all of its aspects. Soil erosion is a natural process in mountainous areas, but is often made much worse by poor management practices.

Introductions

To CAF soils play a key role in the conservation and development of all resources associated with this from conservation of water resources in support of different ecosystems, including soils of agricultural and forestry purposes as those for all types of development associated with human activities.

Soil plays an important role in the fight against climate change, in fact, soils contain about twice as much carbon as the atmosphere and three times the amount of that element found in vegetation. The soils are an enormous carbon reservoir, so its poor management can have catastrophic consequences, so the proper management of soil resources can help significantly to managing the impacts of climate change so.

The soils of urban areas will be assessed during the development and construction practices vital functions of soil can be kept secure; while soil pollution of the cities in the region, and historical legacy to the ground to ensure the mechanisms to prevent at all costs the contamination of these is avoided.

Soil is a fundamental natural resource which life depends. It provides many essential services in which we support, including for food production, water management, biodiversity support, valuable ecosystems and efficient mechanism when well managed for securing the performance of the agricultural, livestock and forestry. As fulfill the function of acting as carbon storage but also play a vital role in the fight against climate change.

The soils of the region have deteriorated in the last 200 years due to intensive agricultural production, loss of forest cover and industrial pollution among others. The soils of the region continue to face three main threats:

1. Soil erosion by wind and rain. The erosion affects the productivity of the soil, but also water quality and aquatic ecosystems.
2. Soil compaction reduces agricultural productivity and water infiltration and increases flood risk through higher levels of runoff.
3. Loss of organic matter. The loss of soil organic matter reduces soil quality, affecting the supply of nutrients and making it difficult for plants to grow and generate increased emissions to the atmosphere.

All these threats can be magnified by climate change. Safeguarding our soil for future generations means managing them in a timely and efficient manner, reducing degradation and building resilience to increased pressures to provide a sustainable supply of food and raw materials such as tackling climate change.

The soil is changed slowly, and our understanding of these changes is incomplete. In addition, the impacts of our actions today cannot be seen for many years. To avoid degradation need to develop knowledge and start taking action now to build the necessary strength to face future challenges.

This tool highlights those areas in which we will prioritize and focus our attention on combating the threats of degradation. As the fundamentals and technical guidelines to influence the improvement of active soil management and procurement of mechanisms to promote new measures.

However, CAF alone cannot protect soil resources for future generations. It is for all managers CAF projects - GEF, whether they farmers, ranchers, land managers, developers, planners and builders and others who must perform appropriate and timely management of soils sustainably and protecting functions that this provides us. Users of products associated with the soil should also require the conservation of this resource given the information they need to make responsible decisions when buying products from the.

Latin American and Caribbean Land Degradation

According to project estimates, arising Global Assessment of Land Degradation (GLADA, for its acronym in English), 5.4 million km^2 of the territory of the region in which they live about 150 million people, are degraded. Other studies have reported similar figures, although variations between countries.

Studies compiling data for Latin America and the Caribbean from 1996 to 2011 are estimated losses in economic terms waste product of the soil resource about 41,707,740,000 dollars representing up to 8% of GDP in some countries. This fact is very bleak if we consider that any production system depends directly or indirectly soil is compromised in the immediate term, which has a direct impact on reducing the productive capacities of the countries of the region.

According to FAO, healthy soils are the basis of agriculture, food production and hunger, and also play a role as reservoirs of biodiversity. In addition, part of the carbon cycle, so care is required if you want to mitigate and adapt to climate change.

It is essential to maintain a careful balance between the need to preserve our natural resources and expand our food production.

Dangerous degradation

Despite its importance, the health of soils and growing challenges facing constant. 33 percent of the Earth's land are degraded, either by physical, chemical or biological reasons, as evidenced by a reduction in vegetation cover, decreasing fertility, soil contamination and water, and because Therefore, the impoverishment of crops.

The fact that soil is not renewable resource preservation makes it an even more urgent challenge: one inch of soil can take a thousand years to form and this same centimeter can be destroyed in only a few minutes because of degradation due to mismanagement.

Fourteen percent of the global degradation occurs in Latin America and the Caribbean. This situation is most severe in Mesoamerica, which affects 26 percent of the land while this phenomenon affects 14 percent of the land in South America. Four countries in the region have more than 40% of degraded lands and in 14 countries degradation affects between 20% and 40% of the national territory.

The degradation has a negative impact on many of its critical food production functions and the provision of ecosystem services and their main causes include water erosion, intensive application of agrochemicals and deforestation.

The degradation is also associated with poverty: 40% of the world's degraded lands are in areas with high poverty rates. Poor farmers have less access to land and water, working poor soils and high vulnerability to degradation.

Growth of agriculture

From 1961-2011, the agricultural land in Latin America and the Caribbean increased from 561 to 741,000,000 hectares, with the greatest expansion occurring in South America, where he grew 441-607000000 hectares. About 47% of arable lands in the region are covered by forests, but this figure is shrinking resulting from the expansion of the agricultural frontier.

Globally, 12% of the land is used for agricultural crops (1.6 billion acres); 28% (3.7 billion ha) is forest forestry; and 35% (4.6 billion ha) corresponds to grasslands and other forest systems.

During 2015, FAO will work with governments, civil society, the private sector and all stakeholders to achieve full recognition of the important contributions of soils for food security, adaptation to climate change, essential services of ecosystems, poverty alleviation and sustainable development.

Forest CAF Program and Restoration and Recovery of Forests, Tired and Degraded Lands Component

A conditioning series for countries of Latin America is the item on the tired and degraded land, in the case of tired lands; these are linked to the processes generated by intensive farming and ranching, accompanied by malpractice agricultural. These malpractices under high rainfall and high temperatures of the tropics itself can trigger processes that lead to degraded lands.

Depending on the availability of productive land or the lack thereof, in countries could be the case much pressure on productive land available occurs, this makes transcendental drive recovery mechanisms to enhance the future availability of productive land and increase the productive capacity of countries.

In the case of Latin America and the Caribbean, the two main triggers or degraded land generators are mining and infrastructure, the latter if they are not provided with mechanisms to ensure the conservation of the environment.

A third activity that impacts to soil resources immediately is the expansion of the urban boundary and increased mining activities, which mainly affects soil through the physical and chemical contamination.

The main damage caused degraded soils is the removal of large areas that are generally aimed at the conservation of forest cover or supporting productive forests, and the best in reference to soils tired reduce productive lands countries. If I compared the volumes and wooded areas of the region it might seem that this decrease or loss of productive land is futile, we cannot forget that the cost to reinstate these soils productivity of countries has a cost that is generally not considered when determining the opportunity cost of land use and mainly Forest Vocation Land (FVL).

Another analysis that is obvious is the conditions imposed degraded populations and communities that are supported on these floors because these types of soils consistently have very low or no productive capacity which negatively impacts the quality of life of its inhabitants. Creating social repressed areas and economically, an example is the one in the Ngöbe Indigenous - Buglé in Panama, which has the highest rates of poverty and extreme poverty in the country, the result of being in the area with the most degraded soils and less forest cover of that country.

1. **Biofuel Production for the Recovery of Degraded Areas**

Exist in the region experiences that have more than twenty years in reference to the issue of recovery of degraded areas using native species, mainly in the case of Brazil, through the efforts of aware mining companies committed to good practice abandoned mined areas have conducted various investigations supported by higher educational establishments which have completed degraded areas recovered and preserved.

Another practice more widespread mainly in the northern part of South America is the use of bamboo for the restoration of degraded areas including gallery forests or even making its use by the pulp and paper industry for the manufacture of paper bags of cement by along its fiber which gives a high resistance to paper.

Recently developed experience in recovery of degraded areas with the use of bioenergy species such as *Jatropha curcas* which is being used in countries like Mexico, Guatemala, Chile and Brazil for this purpose well as a byproduct and not least biofuel production, which may become an option that merits serious consideration if we recognize that large companies in the air transport sector in the region are already establishing plantations and conducting trials to test the quality of biofuels produced, as is the case some airlines such as AeroMéxico and Interject Mexico, Chile for LanChile and Brazil TAM and BLUE, which have been tested by green flight using biofuels produced in their respective countries. This species already available in Brazil of improved varieties that generate high returns which represents one of the alternatives for the production of biofuels in the region, reinstating degraded to productive land without competing with forest lands or agricultural vocation.

It is currently in the process of establishment in Latin America several plants for the generation of biofuels using bamboo as raw material in terms of this cultivar can be established on degraded soils representing an alternative for the reinstatement of these soils to economies of their countries. Further that Argentina is occurring and varieties of fast-growing bamboo which has another alternative to this emerging sector which has three fundamental reasons to grow, the first rising oil prices, the second pressure from passengers to reduce their emission of CO_2 (carbon footprint) and the third race of the air carriers to reduce its dependence on oil and to market their flights as green flights. Bamboo enables the production of ethanol from cellulose, one of its advantages is the production of a suitable high octane fuel to blend with gasoline, with regard to the energy balance is 16.0 and reduces between 80 and 100% GHGs, and are available in the region with the technique to cultivate and technology to produce it.

Given this scenario degraded areas of the region are presented as an opportunity to promote the reinstatement of degraded areas and the possibility of adding value by processing the same for the aviation industry not only in Latin America but of American, European companies and Asian making use of airspace in the region and maintain flights to Latin American cities as in the case of American Continental Airlines KLM and Air France Europe and the JAL Japan have also already implemented test flights using these biofuels.

Another species that occurs with great potential for the recovery of degraded lands is the *Moringa oleifera*, which is one of the plant species with higher oil content (35%), making it an important resource for manufacturing quality biodiesel. The crop has a yield of 2500 kg / ha, producing nearly 1500 liters of oil and more than 1400 liters of biodiesel / ha, which has led to its cultivation is investigated in several parts of the world. In Paraguay, in the town of Cerrito Benjamin Aceval is a very interesting experimental cultivation of *Moringa oleifera* for research of this plant.

In addition the plant is good purifying water, 37 contain a cationic polyelectrolyte 38 has demonstrated efficacy in water treatment (removal of turbidity), in place of aluminum sulfate or other flocculants. The advantage of using these seeds is twofold: one local replace imported easily accessible and, unlike aluminum sulfate, is completely biodegradable products.

It is worth considering the recovery of degraded areas with the use of biofuels producing species as an alternative to the economy of developing countries, but fundamentally as a mechanism for generating processes of employment in the rural setting favoring labor to rural areas and reduce migration to cities in the region very marked process.

2. Agroforestry and Pasture Systems for Ecological Regulation of Agricultural Property.

Due to the impact of traditional farming systems on natural resources; today, the need to implement sustainable production systems arises. Agroforestry can contribute efficiently in the creation of integrated production systems that help keep productivity, protect natural resources, minimize environmental impacts and meet the economic and social needs of the producer.

Agroforestry and silvopastoral systems are one of the schemes has been well accepted in Latin America by small farmers interested in diversifying their production along the agricultural calendar. It is the implementation of agroforestry or silvopastoral as a mechanism for incorporating a complementary economic alternative to traditional productive activities in rural areas by facilitating the wood resource and wood, as well as the establishment of short barriers wind, which also serve as phytosanitary barrier within the property as well as the benefits for livestock such as generating shade and fodder.

Better protection for agricultural and livestock soils

Farmers, ranchers, foresters and other land managers handle most soils, without ignoring all the productive activities of man physically occupy this, which involves replacing the direct use of the productive capacity of the soil. Therefore whatever the use of the CAF is essential for the implementation of good practices and encourage the best possible management of soils in the region.

CAF promotes the prevention of land degradation through environmental monitoring carried out systematically and with appropriate frequency, depending on the underlying risk of each operation, as conditionality available to plans for environmental and social management of each project.

The challenge is to improve the effectiveness of these tools in the light of the evidence on the causes of land degradation and best ways to prevent it from planning environmental project management. This involves considering new threats to soil and ensure they do not become significant to future problems.

Deforestation, over-farming and ranching, excessive use of chemical inputs in agricultural crops and growing urban expansion marked adverse conditions for soils of Latin America and the Caribbean, is reflected in two strong mechanisms that undermine the conservation of the quantity and quality of the soil: the erosion and desertification.

Currently are costly investments needed in the region to implement appropriate soil management and research that this demands critical to improving our understanding of how degradation affects soil functions and the best way to make face up. We will build on existing information and guidance for land users running CAF resource projects - GEF can ensure that the implementation of these, available skills and knowledge needed to address land degradation.

Accordingly be promoted for agricultural and livestock activities using best practice guides that include the SLM. In the case of agricultural farms to ensure soil conservation will be promoted using:

Land use according to its usability

Much of the land has been used without previous studies that show which type most appropriate use and what the environmental impact of different uses is. Many types of land use, agricultural or otherwise, are made in form and in inappropriate places, which has resulted in poverty, environmental degradation, economically inefficient exploitation and loss of natural resources such as soil and water. The best way to land use depends on the economic, social, political and cultural conditions, and soil characteristics and response to use.

The land, in an economic sense, have many other attributes such as farm size, proximity to water and other land transport facilities and market (FAO, 1967). According to FAO (1993), land is a segment of the surface of the globe defined in space and in terms of features and properties covered by the attributes of the biosphere, which are reasonably stable or cyclically foreseeable, including those of the atmosphere, soil, geological substrate, hydrology and the outcome of current and future human activities to the extent that these attributes have significant influence on the current or future use of the land by man.

The system was structured by the Soil Conservation Service of the United States, developed by Klingebiel and Montgomery (1961) and adapted and disseminated in Brazil by Marques (1971). Were made after other approaches, such as made by Lepsch (1983) and Lepsch (1991).

The use of this system is recommended for planning purposes of soil conservation practices, the level of properties or farms, or small watersheds. Its use for other purposes, as in the case of regional studies must be done with adaptations and accompanying studies that consider economic conditions and agroclimatic suitability of crops (Lepsch, 1991).

Conceptually, the system is based on the interpretation of the characteristics and intrinsic soil properties, the physical environment and the technological level of farmers, in order to obtain homogeneous classes of land, and define its maximum capacity degradation safe use soil, especially in relation to accelerated erosion. Thus, the system takes into account the specific constraints of land, relating to the possibilities and limitations of using it. Consider, however, socioeconomic and agricultural policy (Lepsch, 1991) aspects.

Besides this system also exists This system was initially proposed by Bennema et al Evaluation system of agricultural land suitability. (1964), reformulated by Beek (1975), by Ramalho Filho et al. (1977), Ramalho Filho et al. (1978) and by Ramalho Filho and Beek (1995). Also known as "FAO System / Brazilian". As is also the parametric method for classifying usability of the land. The key is to identify the land use capability to thereby identify and adapt the or crop (s) to be established.

Ground cover

Land Cover and. Soil and Water Loss

Ground cover has a protective action by intercepting and absorbing the direct impact of raindrop, thus preventing sealing surface and preserving the soil structure immediately below it (Adams, 1966) .In this way, water infiltration can be maintained along the rain (Musgrave and Nichols, 1942). Therefore, increasing the coverage of soil and soil movement breakdown are reduced by splashing rain (Singer et al., 1981), average speed and transport capacity of the surface flow (Lattanzi et al. 1974; Meyer et al, 1970; Mannering and Meyer, 1963). The volume of runoff, according to Singer and Blackard (1978), is affected by the quality and quantity of waste through the delay in the onset of runoff; the increase in time between the initiation thereof and the first liter of water lost; and decreasing the time between the end of the rain and the end of runoff

Growing contour

The crop outline or contour is one of the simplest practical and highly efficient in controlling erosion; involves planting crops according to the contour of the ground, ie perpendicularly to its slope (Sobral Filho et al., 1980).

The contour plowing requires the application of systematic tillage practices and soil preparation before execution. Thus, terracing and tillage, scarification and other must be carried at all; therefore, the terraces serve as general guidance for planting.

Isolated as practical for erosion control, the contour plowing is recommended only for limited areas, with a slope up to 3%, and an area of not very long slope. With regard to the other conditions of tillage, contour plowing should always be associated with other conservation practices.

Green manures

The use of green manure as an agricultural practice, known since before the Christian era, consisted of soil incorporation of undecomposed plant mass, in order to preserve and / or restore the productivity of farmland. For this purpose even then you were basically used legumes, such as lupine.

Currently it is conceptualized as a green manure to the use of plants in rotation, following or associated with commercial crops incorporated into the soil or left on the surface, providing protection, either as maintenance and / or restoration of physical, chemical and biological properties soil (Costa et al., 1992). Eventually, part of the green manure can be used for human or animal consumption and / or production of fibers or forage production (Miyasaka, 1984). This is an important aspect adoption of this practice, since the higher your profit on the property, the greater its potential benefits. In this new approach, plus legumes that are most used for this purpose plants, also grasses, cruciferous and *cariophilaceous* used, among others.

Green fertilization Functions

- Protects the topsoil against high intensity rains, the sun and wind.
- Maintains high rates of water infiltration through the combined effect of root system and vegetation cover. Roots after decomposition, leave pores in the soil and the cover prevents the breakdown and surface sealing and reduces the velocity of runoff.
- Promotes a considerable and continuous supply of biomass to the soil, so maintaining and even raising, over the years, the content of organic matter.
- Reduces the temperature range and decreases soil evaporation, increasing water availability for cash crops.
- Through the root system breaks hard layers and promotes aeration and soil structure, inducing biological soil preparation.
- Promotes nutrient recycling; well-developed root system of many green manure, has the ability to translocate nutrients found in deeper layers to the surface layers of soil, making them available for future crops.
- Reduces nutrient leaching; the occurrence of heavy rainfall and high rainfall usually cause intense leaching of nutrients. Green manure, to retain nutrients in the biomass and gradually release during decomposition of plant tissue, reduces this problem.
- Promotes the addition of nitrogen to the soil through biological fixation of legumes; this may represent a significant saving of this element in the fertilization of cash crops, as well as improving soil nitrogen balance.
- Reduce the weed population through the suppressive effect and / or allopathic caused by the rapid initial growth and exuberant development of biomass.
- The growth of green manure and its decomposition activate the cycle of many species of macro-and especially soil microorganisms, whose activity improves physical dynamics and soil chemistry.
- Multiple uses on agricultural property; some green manure have a high nutritional quality and can be used in animal feed (oats, peas, pigeon peas and lablab), in food (lupine and pigeon pea) or, to be used as a source of timber and fuel wood (*Leucaena sp*).

Features that must be observed to select green manures

According Amado and Wildner (1991) the main characteristics that should be observed for

Selection of green manures are:

1. Present rapid initial growth (initial aggressiveness) and efficient soil cover;
2. Production of large amounts of biomass (green and dry matter);
3. Ability to nutrient recycling;
4. Ease of implementation and management in the field;
5. Present low level of pests and diseases and not act as host plant;
6. Submit a deep root system and well developed;
7. Being easy to use for subsequent incorporation in soil and crop establishment.
8. Present potential for multiple use on the farm;
9. Present tolerance or resistance to drought and / or frost;
10. Present tolerance to low fertility and adaptability to degraded soils
11. Possibility of seed production sufficient to increase their cropland amounts;
12. Not invading plant, preventing successive crops and / or rotation.

Malavolta (1967), cited by Muzilli et al. (1980) also suggests:

13. Belonging to the family of legumes;
14. Possessing medium sized seeds (1000-1500 seeds/kg.), Are able to germinate in soil prepared conventionally;
15. Species that produce robust, able to withstand inclement weather seedlings;
16. Seeds that is permeable to water, which facilitates germination;
17. Do not be climbing, particularly if they were perennial cycle.

Also can be added:

18. Note ease of adaptation to cropping systems in the region;
19. Have good regrowth capacity in cases of cutting the aerial part;
20. Have good capacity for natural reseeding.

Despite require so many features, this does not mean that each species must meet all these prerequisites. In fact, depending on the kind of green (winter or summer, shrub or creeping, short or long cycle) payment, cropping system and the condition of the farmer, some points can be neglected. Amado and Wildner (1991) remark that hardly a species would satisfy at the same time with all the prerequisites mentioned above. For this reason, in the field of agricultural property, only some of these features will be of paramount importance, thus being used as

Physical barriers for the control and channeling runoff

The total water that reaches the ground in the form of heavy rains, part infiltrates and the remainder becomes runoff, focusing on natural depressions, draining to find areas of natural deposition (plains, slopes, network drainage). As runoff progresses, increases in speed and volume. The greater the runoff, the greater its ability to cause erosion. According Rufino (1989), the critical velocity of runoff runoff in which the particles disaggregated drag begins is 5 m / sec in sandy soils and 8 m / sec in clay soils.

The efficient control of the erosive action of rainfall can be obtained through the implementation of a set of soil conservation practices. These practices include:

- The systematization and protection of the area to control surface runoff;
- Soil preparation;
- Planting of crops; and
- The soil cover.

Systematization practices and protection of the area are aimed at rational implementation of obstacles, drainage or roadways against the action of runoff. The practical implementation of these morphological alterations promotes the soil surface.

Traditional practices implemented for this purpose are: drainers channels, individual sidewalks, curbs permanent vegetation and windbreaks (Sobral Filho et al., 1980).

Terracing

The draft agricultural terracing should include the entire property, or property group to the same river watershed, in which are located the farms, so that the construction of terraces anywhere, can be integrated into the overall system, without problems or unnecessary expenses. In this aspect should not exclude the possibility of a redistribution of agricultural areas, fences and roads to bring its precepts under appropriate land use and agricultural management.

Gully control

"Gully" It is called the most advanced stage of rill erosion. Rill erosion is the way to more easily perceptible erosion, originated because of runoff water that focuses on uneven places or surface depressions unprotected or inadequately worked soil. Depending on the slope and length of the slope of the terrain, the concentrated water flow causes an increase in the dimensions of the grooves initially formed up into large ditches called gullies.

In general, gully control is difficult and expensive. The restoration of an area requires time, labor and capital, which is economically advisable to establish a prevention plan gullies.

Moreover, the highly eroded lands have a small immediate value, justifying containment measures, to at least protect the surrounding land and avoid its consequences outside the eroded area.

When you opt for control, it is desirable to determine which is the most economical and suitable for each area protection. The cost of correcting a gully and type of protection to be applied, should always be considered in relation to the destination that can be given to them.

Water harvesting methods

Of course, the shortage also affects many productive activities of man, among which agricultural and livestock production (Alfaro 2009 and Casanova et al 2000) .In this context, exploring options for management and use of water is needed, to be used both as domestic production purposes.

One of the options that we have is the harvesting of rainwater. The use of Aguade rain has been present for many generations, as a way to meet the needs of water for different uses such as agriculture, animal care and domestic use.

Although it has long been neglected as a source of water for various activities, in recent years this practice has been regaining strength. Nasr (1999) defines water harvesting and collection of runoff water for productive use, while according to FAO (2000) capturing rainwater is defined as the collection of surface runoff for productive use, and can achieved roof surface, as well as intermittent or transient currents water.

There are several ways of classifying what is considered harvest water (Desrochers2004). The variations usually depend on the author, and often there is disagreement about what is or is not water harvesting. It is also important to note that there are differences between what is considered rain water harvesting, water conservation and between capturing rainwater and irrigation. Hudson (1987) cited by FAO (2000), distinguishes between soil conservation (tillage, terraces, edges and grooves), water conservancy, defined as capture and store water where (furrows, terraces and branch water and floods) and falls capturing rainwater, described with emphasis on water storage for use elsewhere. An important and obvious difference is that water conservation is required to prevent runoff, while technical water needed to capture an area with high runoff (FAO 2000).

Several authors describe methods and different concepts of how to capture rainwater for harvesting (Martínez 1998 Middle East Peace Process2005, Mongil and Martínez de Azagra 2007, Narayan et al. 2008) is conceived. Oweis et al. (1999), Oweis and Hachum (2004), for example, indicate that water harvesting is divided into two main branches: one that refers to runoff and another that talks about water harvesting for supplemental irrigation. Prinz (1994), Prinz and Malik (Sf) make a broader breakdown where the following categories defined by the ratio between the area of collection and water storage area include:

1. Water harvesting ceilings, 2 Water harvesting for animal consumption, 3 Harvest inter-linear water, 4 Microcatchment 5 Attracting medianaescala or Macrocaptación, 6 Attracting large scale (catchments with many square kilometers, require structures very complex and large distribution networks).

To summarize, Fox (2001) summarizes the catch possibilities considering the possible duration of storage and the source from which water was captured. Fox (2001) states that if the storage time of the water in the soil is short, the main structures are those that are within crops as crescents, hedgerows; among others. Meanwhile, if the storage period is long (weeks or months), you can use structures such as tanks, dams and reservoirs.

According to Bocek (Sf), the criteria for determining what is the best method for storing rainwater and / or runoff include:

- The purpose for which it is collected.
- The slope.
- Soil characteristics.
- Construction costs.
- The amount, intensity and seasonal distribution of rainfall.

Social factors such as land tenure and traditional practices of water use. It should also be noted that the physical conditions of a catchment area are not homogeneous. Even at the micro level there are a variety of different slopes, soil types, vegetation cover, etc. Each catchment has therefore its own response surface runoff and responds differently to different rainfall events (FAO, 2000).

Minimum components

Most authors (eg, FAO (2000); Anaya and Martinez (2007); Bocek (Sf) and Cajina (2006), among others, refer to the existence of three components in water harvesting systems:

1. The capture area, where water is collected to be transported to the reservoir.
2. The storage area or reservoir (artificial reservoir, soil profile, groundwater).
3. The target area or water use (agriculture, industrial household).

Selection of alternative technologies

There are several sources where you can get information about new technologies on soil management. It is certainly advisable to seek published information on technologies that have been investigated in the same issue of the recommendation that one is working, which were then validated by farmers on their properties and then evaluated by themselves. This way, you can trust the suitability of these technologies for conditions where they were tested and evaluated.

Often, information on technologies that are still in the experimental phase without being validated by farmers on their own terms. Unable to recommend these technologies without further evidence regarding their suitability for the areas and conditions of farmers. However, if there is apparently a good chance that these technologies are fit, instead of waiting to be finished the entire sequence of research that could be time consuming, it is recommended to conduct participatory research with some farmers who are interested in adopting these technologies. Farmers will test new technology within a small portion of your property and compare the results with their current practices. Tests will be no replications in plots, and where possible, should be an adequate number of tests in order to use the sites as replicates in statistical analysis.

Technicians often have information from the literature or their own visits to other regions or countries, technologies that work well in these conditions, but these technologies have not been tested or validated in the country or region where the technician works. In this case it is important to compare the agroecological and socioeconomic conditions of farmers where technology has worked well with local conditions to assess the likelihood of successful transfer of technology. If the odds of success are good, it is suggested that as a first step some participatory trials with one or two farmers are made. If the results are encouraging, you can increase the number of participatory for more information on fitness testing technology, and for farmers to properly assess the adequacy of technology in their particular situations. Do not push a technology before having found that really works.

The selection of technologies based on the current status of the farmer

When new technologies are introduced is very important to be consistent with the resources and conditions of the farmer. New technologies must fit within the framework of the production systems of the farmer. A production system consists of several components, p. eg., the land preparation, tillage, crop and rotation, planting, application of herbicides and pesticides, fertilization, harvesting, grain storage, handling stubble, machinery, implements and equipment and drainage systems, irrigation and soil conservation. If the introduction of a new technology requires changes in some of the components of the production system, that may mean changes in other components. For example, in the system of tillage crop rotation is more important because the residues remain on the surface. This may stimulate the survival and proliferation of certain diseases and soil insects.

It is expected that a farmer will completely change from one day to another, their production systems and soil management that has been practiced for many years. The process of change must be gradual, in stages, and an acceptable rate for the farmer.

In the case of cattle properties to ensure soil conservation will be promoted:

Alternative production system

In the tropics solar radiation allows the incorporation of different strata (herbaceous, shrub and tree) within farmers and farming systems. Both silvopastoral agroforestry systems as possible to maximize biomass production to be consumed by animals.

Silvopastoral systems also increase the beneficial effects generated by interactions between trees and shrubs, grasses and animals, stimulating nutrient cycling, exploring deeper layers and improving soil conditions. Similarly greater water retention with increasing organic matter and decreased evapotranspiration, ie occurs, there is a water balance within these systems.

As a result, you can earn income that transform the traditional livestock to supplement it with other like forestry. Profitability for livestock improvement because it has fodder, fuelwood, shade, crop protection and soil fertility improvement in crop and animal production, and sustainability of the system increases.

Arrangements or spatial distribution of trees and / or shrubs of the system can be varied, depending on the biophysical, socio-economic and cultural aspects of the environment which are to be established.

Association pasture legumes

Most farmers think that the best pasture is one which is predominantly one type of grass and other species is considered undesirable or weeds. When you have monoculture of grass upright growth, there are always spaces between each plant, even when pastures are taken with very good coverage; in real terms, only between 50 and 80% of the area of the paddock is producing fodder, the remaining area will always be empty and these spaces shall be capable of being colonized by the "weeds".

For this reason we must associate two or more species of erect and creeping growth (grasses and legumes), to raise productivity of pastures. The recommended option is to mix improved technique, natural or naturalized grasses with some kind of creeping legume

In parallel, the conservation of native legume species in pastures should be a priority for all livestock. Legumes associated with soil bacteria through the process of biological nitrogen fixation, improve the fertility of the pasture to which they are associated, increasing the protein content in the diet of grazing animals.

The combination of forage crops can have positive effects on biodiversity (native plants and less associated fauna) in soil protection, recycling of nutrients from deeper soil layers due to the absorption capacity of the roots and protection water sources. In this way contribute to reducing the negative impacts associated with livestock for forage crops like erosion, soil compaction and water pollution by herbicides and synthetic fertilizers. They also promote the growth of the fauna (micro and macro) soil, indispensable for the decomposition of organic matter assimilable forms for plants (Moreno & al, 2008).

This mixture of different species in pastures increases production and nutritional quality of forage biomass. With greater availability of food for the animals, the capacity of farms increases and maintenance costs prairie to decrease the occurrence of undesirable weeds are reduced also the incidence of insect pests is reduced.

Use of green manures and cover crops

Other good practice conservation and land reclamation is the use of green manures and cover crops some. Both high and low tropical tropics there is a large number of species that can be used for this purpose in agriculture and the establishment, recovery and renewal of grassland. Often it has been used in crop rotation (potatoes, peas, corn, and rice) and as a tool in reducing fertilizer use through incorporation into the soil.

Rotational grazing

There is talk of rotational grazing when it has a sufficient physical space, so that the rest time between two grazing in each pasture is sufficient for the grass to recover and is in its optimal nutritional status. The best use of a prairie farm is achieved by dividing the paddocks and proper management of forages. Grazing areas should be split into as many paddocks or stables, allowing you to easily control the cattle and pastures are consumed when they have the best nutritional quality. This is when the plant is in its ideal growing season, which in the case of pastures is before flowering spikes (Zuluaga & al, 2010) appear.

The rotational grazing reduces the trampling of pastures for animals and soil compaction. The rest time between each grazing allows pastures to recover and grow roots. When nutritional reserves in the roots, the regrowth of grasses, legumes and fodder shrubs is stronger, thicker roots grow and deepen further, reducing the chances of soil erosion and rapid runoff of water during the rains, plus there greater penetration of air and greater capacity for water infiltration into the soil (Moreno & al, 2008).

The most appropriate to divide pastures option is the electric fence, as it is more expensive than fences with barbed wire. One of the most important advantages of this technology is that it can easily resize pastures depending on forage availability. It is also important that the poles divisions fences are gradually replaced by hedgerows and avoid over exploitation of natural forests for the purpose.

As a general rule, a maximum group of animals should remain two or three days in each paddock. The ideal time occupation of each pasture is 12-24 hours. According to the author of rotational grazing, André Voisin, 1962, the occupation time of a parcel should be short enough so that the grass cut by the animal is not cut twice in the same period.

Using the Level "A"

The "A" level is a useful tool for soil conservation practices such as bends different level, hedgerows, ditches, canals, terraces, balconies and mini water pipe lines for water systems, etc. are performed. Its origins date back to the times of the construction of the pyramids of Egypt. Used to build simple engineering works which is controlled and prevents soil erosion caused by farming and by runoff (control of water velocity that drags the ground during rains).

Its use allows to preserve the productivity of land through soil conservation, water facilitates driving through channels and hoses on long journeys in a controlled manner on slopes, it is easy to build and inexpensive.

Degraded forest land

Rehabilitation of degraded forest land

The rehabilitation of degraded forest land is required at sites where mismanagement has led to the total replacement of forest ecosystems by grassland, bushland or barren soil. Characteristics of degraded forest lands include low soil fertility and poor soil structure (soil compaction, waterlogging, salinization or other physical and chemical limitations), soil erosion, recurrent fire and increased susceptibility to fire, the absence of fungal or root symbionts, a lack of suitable micro-habitants for seed germination and establishment, and severe competition with other plant forms, especially grasses and ferns. The rehabilitation of such degraded land aims to re-establish the production and protection functions of a forest or woodland ecosystem.

The first consideration in attempting any recovery of degraded forest land is to understand the processes and underlying causes leading to degradation (the 'stress' factors) and then to try to remove or correct them. Since the causes of degradation often involve socioeconomic factors, local needs and the value systems of local actors need to be considered. The nature of tenure and access rights to resources by different sectors of society will also be important.

The rehabilitation of degraded forest land can be done by facilitating natural regeneration through measures such as protection from chronic disturbance, site stabilization or water management. Ecological stability may be regained more rapidly through the planting of nurse or framework species that help to provide basic protective functions.

Silviculture on degraded forest land

The decision on what to do about degraded forest lands and which strategies or approaches to adopt is necessarily guided by the ecological, social, cultural, economic and institutional context. Initial efforts should focus on strategies for facilitating succession rather than trying to either plant or seed a wide variety of species. In this regard, one possible option for degraded forest lands is to allow the ecosystem to recover naturally (depending on the ecology and disturbance history of the area). In many situations, however, the high pressure on land by an increasing population may mean that this approach is not viable. Alternative approaches for ecosystem rehabilitation aim to facilitate, accelerate and direct natural successional processes so as to increase biological productivity, reduce rates of soil erosion, increase soil fertility (including soil organic matter), and increase biotic control over biogeochemical fluxes within the recovering ecosystem.

Attempts to plant trees to accelerate regeneration or influence its direction should be based on a thorough understanding of the likely pathways of regeneration without interventions. For this it will be important to establish plots to determine how the vegetation will recover without significant management interventions.

There are several strategies for accelerating recovery. The planting of native tree seedlings is most commonly used. Others include the planting of native and non-native tree seedlings as nurse trees or framework trees, the retention of remnant trees, the planting of patches of trees and seeding shrubs, etc.

The choice of plantation species can influence both the rate and trajectory of rehabilitation processes. The species to be used should have a traditional economic value or be suitable for existing or potential markets. Multi-purpose trees may have an especially important role for local communities. In addition, these species should tolerate unfavorable conditions, and they should be easy to rise in large numbers in nurseries, fast-growing, and able to shade out grasses or other unwanted plant species. Species capable of coppicing and soil improvement (ie organic matter development, nitrogen fixation, etc), tolerant of heavy pruning or pollarding, and resistant to fire, pests and diseases are all to be preferred.

In some highly degraded sites a nurse crop might be necessary to improve the site so that target species can become established (for example, by shading out weeds, fixing nitrogen, improving soil organic matter or changing the microclimate to prevent insect attack and facilitate natural regeneration). An alternative to using temporary mixtures such as target trees beneath a short-lived nurse crop might be to use permanent plantation mixtures.

Prioritizing restoration, management and rehabilitation within tropical landscapes

Many modified and degraded tropical landscapes do not possess the critical complement of forest goods and services that are necessary to sustain rural livelihoods and ecosystem integrity; well-targeted restoration, management and rehabilitation activities can make a significant contribution to addressing such deficits. However, not all site-based actions are capable of making the same contribution to improving the functionality of the degraded tropical landscape.

The selection of priority areas in which to promote forest restoration, secondary forest management and the rehabilitation of degraded forest land, as well as the configuration of restored and rehabilitated forest resources, will depend on the broad social and ecological context that exists within the landscape. For example:

a) Where the opportunity exists to improve landscape-level biodiversity, activities should target those sites within and between protected areas or other forests of high conservation value, such as habitats of endangered, vulnerable or rare species, relatively undisturbed forest remnants, etc.;

b) Where degradation has brought about failures in ecosystem functioning, activities should be targeted along riparian strips, steep slopes, field boundaries, etc.; and

c) Where the opportunity exists to enhance human well-being, and in particular to support income-generating activities, priority areas should be those sites that are suited to the production of high-value species and are close to existing infrastructure.

Strategies for accelerating the rehabilitation of degraded forest lands

- Planting native tree seedlings: the most commonly used strategy for accelerating tropical forest succession is planting seedlings of a few native tree species that are fast-growing, drought resistant, and able to grow in low-nutrient soils. Direct seeding may be a viable option, but weed invasion and predation rates are often sufficiently high to preclude this option.
- Planting non-native tree seedlings as nurse trees: tree plantations may help to shade out aggressive pasture grasses, increase nutrient levels and enhance seed dispersal while also providing a source of income to landowners. The use of non-native trees as nurse species should be considered carefully with regards to their aggressiveness, and their potential to spread and to alter soil chemistry.
- Remnant trees and planting patches of trees: remnant trees play a critical role in natural forest recovery by increasing seed dispersal, ameliorating microclimatic conditions, and

increasing soil nutrients. Leaving some seed trees in areas that are logged and planting or maintaining trees in agricultural lands should be encouraged both to improve the quality of the habitat while the land is used for agriculture and to facilitate recovery if the land is abandoned. The importance of isolated trees and patches of trees for facilitating seed dispersal and seedling establishment suggests that planting patches of trees may be a cost-efficient method of facilitating recovery. It may also provide a level of spatial diversity characteristic of the ecosystem.

- Seeding shrubs: naturally colonizing shrubs may play a critical role in improving adverse conditions and aiding succession in abandoned tropical pastures. Seeding early-successional shrubs may be an inexpensive strategy to accelerate recovery in regions where shrubs facilitate tree seedling establishment; unlike most tree species, many shrubs produce copious, easily-collected seeds all year round (eg Lantana spp., Solanum spp., Grevillea banksii, etc). Care is required, as these species can easily become dominant and can hamper the establishment of other desired species. It is better to avoid introducing seeding shrubs that have little socioeconomic value.
- Clearing existing vegetation: establishing vegetation that shades out grasses has generally proven to be the most economically and ecologically effective strategy. The initial clearing of vegetation to facilitate establishment during the first year of seedling growth may be important. This is effective only if followed by other silvicultural treatments (planting or direct seeding).
- Fire prevention: an essential component of any tropical forest restoration effort in areas with extended dry seasons is fire prevention. This can be done by patrolling areas susceptible to burns and educating landowners on the risk of burning at dry times of the year.

In reality, any one landscape will provide a range of opportunities and challenges. Policy-makers, resource managers, civil society organizations and local communities will need to ensure that the benefits of restoration, management and rehabilitation are realized at the landscape scale and are not only limited to producing immediate site-level benefits.

Additionally, together with kidnapping by the vegetation, the carbon is sequestered by the soil. Carbon is part of the composition of the soil, usually by decomposing vegetation (humus) in surface soils and adjacent layers to the surface, also by bodies decomposed vegetation (degrading) and also in the roots fine. The amount of carbon in soil can vary significantly, depending on the environment and history of the site. The accumulation of soil carbon is added to the surface as dead vegetation and incorporated it as degrading activity. Carbon is also "injects" the soil as root growth (biomass increase). The soil carbon to the atmosphere is returned too slowly decomposing vegetation. Scientific knowledge about accumulation rates of soil carbon and its decomposition, is still insufficient to predict changes in the amount of carbon sequestered by forest soils.Prevent soil pollution.

Prevent Soil Pollution

Effective soil protection during construction and development

Benefits of managing soil in the built environment

Construction and landscaping can have an enormous impact on soil quality within the urban environment. Using techniques that maintain soil quality and function will help you ensure that soils can continue to maintain drainage characteristics, support vegetation and provide the basis for green spaces, while minimizing the risk of causing flooding or erosion. In addition to these environmental benefits, such sustainable business practices can help you reduce your costs and enhance your reputation among clients.

We can cut your soil management costs, with effective forward planning and management before and during construction activities. If possible, you should aim to reduce the need to double handle your soils. This will help prevent problems such as compaction and poor drainage and, in some cases help avoid unnecessary importing of soils for landscaping. Finding a sustainable use for any surplus soils could also mean further savings – as well as making it easier to comply with waste legislation.

Pressures on soil in the built environmentSoils provide various important functions and services for society, including water infiltration, flood mitigation and the protection of valuable biodiversity. They need to be protected and managed to optimize these functions. Construction and development activities can damage the soil, preventing it from carrying out these natural functions.

If soil is permanently removed and not reused, this could result in the loss of an irreplaceable natural resource. Topsoil is particularly valuable because of its fertility. You should find a sustainable use for any waste topsoil rather than send it to landfill. See the page in this guide on uses for surplus topsoil.

When soil is stockpiled there is a risk of it being mixed with subsoil components and other construction materials, which reduces its quality. There's also a risk of the stockpiled soil becoming compacted and eroded by the weather. If you keep too large a stockpile of topsoil, it can result in a loss of quality through lack of oxygen. For more information on soil stockpiling techniques, see the page in this guide on how to manage soil during construction.

Compaction is a common problem during construction projects. Poor soil handling techniques, inappropriate on-site storage of materials and trafficking - particularly by heavy machinery - can all contribute. Lack of oxygen and poor drainage in compacted soil restrict its ability to support vegetation.

If soil is sealed - ie covered with an impermeable material - it's prevented from functioning properly. As well as removing an area that could support vegetation, this also damages natural drainage characteristics. As sealing will occur as a result of development, you and your client should consider how to minimize the footprint of any building and try to reduce the loss of soil function. For information on protecting soil function and sustainable drainage systems, see the page in this guide: consider soil protection before construction begins.

There are many types of soil pollution and contamination - including chemical spills and building rubble. These can all contribute to a loss of soil function.

Importing soil is common practice for landscaping projects. Unfortunately, this is often accompanied by a poor understanding of soil management. This can result in unsuitable soil materials being imported or some of the problems described above - such as compaction or contamination.

We can improve the reputation with regulators, customers and other stakeholders by showing that you consider environmental issues to be a priority.

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Consider soil protection before construction begins

Are necessary be arranged for a soil resources survey to take place before any earthmoving operations start. This should be carried out by a suitably qualified and experienced soil scientist or practitioner - eg a member of the Institute of Professional Soil Scientists (IPSS). You should not rely on a geotechnical or geo-environmental survey for this - the soil resources information won't be detailed enough.

You should use the results of your survey to help you manage your soil more sustainably - for example, by developing a soil management plan and budget (and identifying deficiencies or surplus requirements), which can be updated as site planning progresses.

You could also consider using new technologies which can return some of the lost soil management plan and functions to the built environment. Examples of techniques used by these sustainable drainage systems (SUDS) to replicate natural systems include:

- Permeable paving – porous materials or voids within areas of solid paving to allow water to drain through, reducing flooding
- .green roofs – roofs covered with vegetation, which reduce the volume and rate of rainwater run-off and provide good design and compatibility for the local area.

Manage soil during construction

Having a soil management plan is an important part of ensuring soil sustainability. It doesn't matter if the soil will be retained for future landscaping on-site, or used or sold off-site – without a plan there is a risk of losing, damaging or contaminating valuable soil resources.

Your plan should include:

- Maps showing topsoil and subsoil types and areas to be stripped
- Methods for stripping, stockpiling, respreading and improving the soils
- Haul routes
- Location and content of each soil stockpile
- Schedules of volumes for each material
- Expected after-use for each material
- Who is responsible for supervising soil management

If your site doesn't have room to stockpile soil, it might make sense to find a sustainable off-site use for the temporary surplus and then import suitable soil later. However, you should consider the costs that this may involve.

You should ensure that any areas of soil that need to be protected from construction activities are clearly marked out by barrier tape and exclusion signs. Any haul routes should be stripped down to a firm base and be no wider than necessary to accommodate two passing vehicles.

Topsoil and subsoil stripping

Topsoil is a finite and valuable resource due to its fertility. Before beginning work on site, you should strip the topsoil from all areas that will be disturbed by construction activities or driven over by vehicles.

Subsoil isn't as fertile as topsoil, but – because of the vital role it plays in storing and transmitting water - you should still minimize any damage during stripping. Subsoil in areas designated for landscape plantings often just needs to be protected from damage rather than stripped. However, you should remove subsoil from all areas that will be disturbed by construction activities or to make way for haul roads.

There are a number of best practice measures you should follow when stripping topsoil or subsoil to avoid soil damage as much as possible, such as:

- Using Tracked Machinery
- Carrying The Work Out In The Driest Conditions Possible
- Soil Stockpiling Techniques

To enable soil to be reused on site at a later stage, it needs to be stored in temporary stockpiles to minimize any damage or loss of function. There are a number of important considerations when creating stockpiles - including soil erosion, pollution to watercourses and the risk of flooding. These will be affected by the size, height and method of forming your stockpiles, and how they are protected and maintained.

Create landscapes, habitats or gardens

If you are creating landscapes, habitats or gardens, there are a number of issues you should consider. For example, if you re-spread a large volume of soil that's been stockpiled or imported - particularly using heavy machinery - this can cause loss of soil structure and over-compaction.

Such damage to the soil's structure can cause a number of problems that will restrict its ability to support new vegetation. For example, if plant roots are unable to penetrate the soil and take up water or nutrients, they will be susceptible to drought.

Good soil spreading and cultivation techniques can help to reduce compaction and help restore lost soil function. You should consider:

- Decompascting The Soil Before Soil Spreading Begins
- Using Appropriate Machinery
- Minimizing Any Handling Of The Soil
- Suspending Work In Wet Conditions

You will also need to consider a number of issues when you are spreading topsoil. For example, it needs to be at least 150 millimeters deep for grass or a thicker layer for shrubs and trees as these have deeper roots.

Make sure that you remove any undesirable materials such as stones, fill materials or vegetation larger than 50 millimeters in any dimension. You should cultivate re-spread topsoil using appropriate equipment and techniques, and ensure that you break down any compacted lumps.

Familiarize with best practice for re-spreading soil for landscaping, and using and cultivating topsoil.

If you do not have the in-house expertise to carry out this work effectively, you should get a suitably qualified person or organization to do it for you.

Sourcing, importing and manufacturing topsoil

Before you consider importing topsoil, your soil resources survey should have fully investigated the suitability of all on-site resources for your project. If a shortfall in topsoil is identified, the survey should consider the potential to manufacture topsoil from surplus subsoil. However, you should consider the cost implications. For more information on surveys, see the page in this guide: consider soil protection before construction begins.

If you need to obtain topsoil from an off-site source, there are a broad range of soil-based materials sold as topsoil, but not all of these are suitable for the intended purpose.

Natural topsoil

Natural topsoil comes from the development of greenfield sites and, sometimes, undisturbed and uncontaminated areas of brownfield sites. As a result, its availability often depends on such a site being developed simultaneously nearby.

Whilst many topsoils are suitable for general landscaping, those with more extreme characteristics are not. For example, a silty soil is excellent for agriculture, but its weak structure may mean it isn't appropriate for landscaping. Temporary storage can also make topsoil unsuitable for its intended use without appropriate improvement – see the page in this guide on how to manage soil during construction.

Manufactured topsoil

Manufactured topsoil can be produced by mixing appropriate mineral and organic materials to create a rooting medium. Blends can include components such as natural topsoil, sand, overburden, subsoil, green compost and treated bio solids.

If the correct components have been selected and blended to the appropriate ratios, this can offer an excellent alternative to natural topsoil. But you should beware of manufactured topsoil that uses unsuitable additives or without the necessary quality control measures.

Skip waste soil

Skip waste soil is derived from screening materials from 'muck away' site clearance operations. The coarse element is screened out and used as recycled aggregate, whilst the fines are often sold to an unsuspecting buyer as 'general purpose topsoil' or 'turfing soil'. It's generally a mixture of:

- Topsoil
- Subsoil
- Clay
- Building Waste - Eg Fragments Of Brick, Concrete, Mortar, Ash, Clinker, Asbestos, Glass, Metal, Wood And Plastic

It's usually extremely alkaline, saline and infertile – and often contains high levels of chemical contaminants such as heavy metals and hydrocarbons.

Topsoil assessment

Don't accept non-documented or unverified topsoil. You should always use a reputable supplier, establish its source and analyses whether it is appropriate for your intended purpose.

It's wise to have the soil independently sampled and tested by someone suitably qualified, preferably an independent qualified professional.

Your requirements will depend on the required performance of the topsoil - so may differ for different planting plans.

Manufacture your own topsoil

Manufacturing your own topsoil can offer many benefits, including:

- Cost Savings
- Reduced Transport Movements
- Reusing Surplus Subsoil
- Recycling Materials
- Reduced Landfill Costs
- Allowing You To Alter Mixing Ratios To Suit Planting Requirements

Topsoil manufacture can be carried out on site or off site.

On site methods involve spreading out and incorporating the organic and mineral components directly at the soil's final location. Although efficient, this approach is better suited to large, open areas that are accessible to tractor-drawn machinery.

Offsite methods involve blending the components using mobile quarrying and civil engineering machinery before transporting the soil to its final location. This approach is better suited to manufacturing topsoil for smaller areas that are inaccessible to larger equipment.

Waste legislation

In reference to the disposal of contaminated soils is mandatory compliance with national legislation and in his absence ensure proper end and if possible decontamination of this provision.

Soil aftercare

Structurally-weakened soil tends to settle and self-compact after it's been spread - leading to anaerobism (lack of oxygen) and waterlogging. These are the most common soil-related causes of plant failure on landscaped areas.

Even when the soil isn't compacted, it can take up to three years for the soil structure to stabilize and offer the necessary aeration and drainage for plants to grow properly.

Where a landscape contractor is used, it's common to retain their service for up to five years after installation on a 'defects liability' arrangement. Such a maintenance programme should include monitoring soil conditions to identify unsatisfactory growing conditions.

Amenity grass

Tractor-drawn or self-propelled equipment can be used to verti-drain, slit or spike the turf and topsoil. This will break-up any panning and compaction - improving drainage, aeration and root function.

Other effective treatments include:

- Applying Fertilizer
- Applying Herbicide
- Top Dressing With Sand, Soil Or Compost
- Over-Seeding To Improve Grass Cover
- Tree pits and planting beds

For trees and shrubs, it's essential to monitor conditions to identify any problems as early as possible.

Tree pits can act as sumps for draining water - this leads to anaerobic conditions, root rot and can ultimately completely kill the tree. Possible remedies include drying out the soil by opening up the pit or pumping the stagnant water out.

Applying wood mulches to planting beds can cause compaction. You can usually relieve this by spiking the soil with a hand fork between the plants. Where compaction is deeper, or on larger areas, mechanized treatment may be necessary.

You should also include fertilizer application as part of your maintenance programme – particularly for the first few years. Compound, slow-release or controlled-release fertilizers are best for tree and shrub topsoil.

Uses for surplus topsoil

Uncontaminated topsoil is in short supply in many places - particularly urban areas. So it's important that this vital and valuable resource isn't wasted.

Your soil resources survey and subsequent soil management plan may identify a surplus of topsoil - once the required quantity has been set aside for on-site landscaping. If this is the case, you should contact your local authority to try to identify nearby land reclamation or brownfield development sites lacking soil resources.

Waste permitting and exemptions

Soil discarded from a site – rather than being moved off it temporarily – is normally classed as waste. It only ceases being waste once it has been fully recovered - eg spread back onto land as soil.

Such soil waste is subject to landfill tax – unless it's recycled or recovered under relevant waste exemptions. The main exemptions relevant to soil reuse concern the treatment of agricultural land and the reclamation or improvement of non-agricultural land.

Alternatively, the soil should be taken to an appropriately permitted treatment facility for recovery or, as a last resort, be disposed of at landfill. If the surplus soil is sent to landfill it will be subject to landfill tax.

Monitoring the soil protection process

Designing an Infrastructure Environmental Monitoring

It is suggested that environmental monitoring infrastructure will be installed during investigations to collect baseline data.

After every round of research, will have met additional information that should be used to refine and possibly modify the design, location or number of points environmental monitoring.

The following should be considered in designing environmental monitoring infrastructure:

- The suitability of any existing environmental monitoring infrastructure;
- The location of the sources and nature of any possible loss of containment;
- The nature of the contaminant, especially the (liquid, dissolved, emulsified, etc. vapor) phase is;
- The fate and transport of contaminants (when selecting the design and location of infrastructure, for example, preferential in the sub-surface for contaminant migration pathways, the partition between the soil / water / steam, etc.).

The design of schedules and Environmental Monitoring Protocols The environmental monitoring program should include schedules and protocols covering the following topics:

- The frequency and timing of monitoring;
- A monitoring plan must identify emergency pollution;
- Sampling protocols (including collection, storage, handling and storage);
- Analytical Suites; analytical protocols (including preparation and analysis of samples);
- Quality Control and Quality Assurance process sampling and analysis of coverage:
    - Functions and responsibilities of staff
    - Training of staff
    - Sampling and analysis and validation using duplicate samples and analytical sample blanks, etc.
    - Programs for inspection and maintenance of surveillance infrastructure

Designing the Infrastructure Monitoring Program

The purpose of the monitoring program of infrastructure is to demonstrate the effectiveness of measures to prevent pollution at the site during the lifetime of the building permit. This occurs through a planning process inspection, testing and maintenance of infrastructure.

The monitoring program of infrastructure must also include a system of regular assessment, recording and reporting of monitoring results. This shall contain such checklists, records of inspection, maintenance and repair of infrastructure.

The systems that may already be in place in a facility that covers part or all of the requirements of a SPMP. These may include:

- An ISO SGA: 14001 (or schema credited similar);
- A Preventive Measures Planning and Maintenance Program;

- A program of inspection and testing meet the appropriate industry standards;
- An inspection, testing and maintenance program in accordance with the manufacturer's recommendations infrastructure;
- A program of inspection, testing and maintenance to comply with Health and Safety Regulations.

If a condition that requires the collection of baseline data is not included in the permit then a case has been made that the test procedures, maintenance and monitoring existing or proposed are sufficient to ensure that there is little likelihood of contamination, or leakage land will occur during the future life of the installation.

In this case the design Site Plan Monitoring Protection SPMP shall contain a statement to the effect that:

1 Such procedures will continue during the life of the Permit, and

2 that procedures must be reviewed and amended after the modification of the infrastructure, work practices or any requirement guidance / legal procedure is based on.

3 SPMP should also include systems for the regular assessment, records and reporting of monitoring results for the purposes of demonstrating compliance with permit conditions and for the purposes of being required extending the term of the permit authorized.

If a condition that requires the collection of baseline data is included in the permit (ie there is a reasonable possibility of current or future contamination of land from the installation), then the following needs to be taken into account in the design SPMP:

A written plan describing how reliable the land protection techniques must be monitored and maintained shall be prepared and must contain:

Identification of elements of plant or equipment within the facility that can contain and / or transport substances that if released, can lead to contamination of the land. (Primary containment) Examples:

- Vessels fixed storage
- Conduit pipe and associated pumps, valves, flanges and fittings
- Facilities and process equipment
- Drainage systems
- Raw materials and packaging of finished products

Identification of facilities, equipment or infrastructure within the facility that are intended to prevent pollutants from being released into the earth when there has been a loss of containment. (Secondary containment)

Examples:

- Containers (Bunds)
- Traps catch (Catch pits)
- Surface hard permeable and containment curbs (Waterproof hard-standing and curbs)
- Interceptors

Identification of protective devices designed to carry a failure of pollution prevention techniques to the attention of the operator to stop the equipment in case of failure or to alleviate the impact of abnormal operations.

Examples:

- Level measurement devices
- Alarms
- Automatic shutdown
- The leak detection systems
- The corrosion detection systems

Identification of other techniques relied to prevent a loss of containment of substances which can lead to soil contamination.

Examples:

- Security measures
- Loading Procedures
- Responses to Accidents
- Inventory
- Environmental Management Systems

Identification of appropriate standards used to ensure technical identified to protect the earth are designed, installed, monitored and maintained to ensure technical maintains its functional capacity.

Examples:

- ISO Standards
- Recommendations Manufacturers
- Pollution Prevention Guidelines

Details of any required examination, including inspection and testing, to ensure technical, facilities, equipment or infrastructure remains an appropriate standard.

Examples:

- Preventive maintenance plans
- Plans for Statutory Inspection
- The manufacturer's recommendations

Details of the maximum interval between examinations techniques.

Examples:

- Statutory Intervals
- The manufacturer's recommendations
- Recognized standards
- Requirements EMS / QMS

The details of the studies to identify the fundamental techniques if modified or repaired should be examined by a suitably trained before being invoked to protect the earth person.

Examples:

- Risk / Environmental and operability studies
- Failure Mode Analysis
- Fault / event tree analysis

Design and survey data, information management and reporting

Monitoring results will form an important part of the evaluation must be submitted with an application to surrender a permit. Operating a robust SPMP necessary when large amounts of data are generated as a routine monitoring and analytical records infrastructure.

The purpose of the System Information Management and Data and Reports is to keep track of this data, or to summarize data summaries.

The system must be designed to record data so that:

- The data are not easy to understand and it is obvious that the recorded data relating to means;
- Easy consultation (taking into account data queries are likely to run during operations and for purposes of applying for delivery);
- Easy to maintain and update (data entry);
- When possible, the quality controls automatic data produced and nonconforming data raise flags for quality control and proper action.
- Procedures covering the following topics should be established:
- Management and storage of reports or summaries of relevant data reports the life of the facility;
- Clearly documented procedures and management responsibilities for reporting and acting on test failures and inspection;
- Periodic reviews of the monitoring program;
- Periodic supply of information both internally and to the public body responsible;
- Periodic evaluation of monitoring data to cover the following:
    - Determine trends in pollutant concentrations
    - Concentrations or triggers for further assessment and action
- The responsibility of the owner of the data.

Reports

The design document SPMP must be submitted to the relevant environmental authority on the basis that it set permissions and should provide a framework for investigations to collect baseline data.

Templates for preparing the report design SPMP shall be designed and available. These templates will be designed to help the operator, highlighting the data required for the submission of reports.

When required baseline data to collect this should be reported to the competent authority at least within six months from the date of issuance of the permit. So is the design document should include a timetable and a program for implementation and reporting.

Generic Term of References for Environmental and Social Impact Assessment

Soil conservation of human activities that may trigger degradation processes of soil resources, the risk of contamination of this, or failing to establish mechanisms to ensure the protection of natural phenomena is needed against which it is possible to protect.

It is important to recognize long-time path required for the genesis; why training and physical structure of the soil is important to ensure the occurrence of biotic processes, hence also the importance in ensuring the protection of soil chemistry of potentially polluting products, as proper and appropriate use of chemicals improving yields soil for agricultural and forestry activities in order to avoid contamination by chemicals and agrochemicals understood fertilizers and pesticides. We must remember that the chemical contamination of soil is possible due to the very alteration mineral that gives rise to soils due to natural processes.

The process and procedures for the preparation of ESIA that impact on the appeal are to ensure that projects adhere to the following guiding principles: Management of agricultural and forestry chemical pesticides; Management of Biological Biodiversity of the Soil and Management of Land Degradation, including activities involving physical and chemical risks to soil.

The suggested structure which should be adjusted to the legal requirements of the country where the project is the minimum content expected in the preparation of an Environmental and Social Impact for any project developed within a degraded area or be held any development activity that involves directly or indirectly in anthropogenic impacts or natural origin in terms of physical or chemical impacts to soil type; is detailed below.

General Resources Description

- Identification of the presence of areas with degraded soils within or on the boundaries of the project.
- Identifying the presence of areas or soil degradation prone areas.

Abiotic Environment

- Climate and Atmospherics Conditions
- Temperature
- Winds
- Hydrography
- Geology and Geomorphology
- Flood Vulnerability

Biotic Environment

- Biological Soil Diversity

Legal Aspects

- Compliance with local legislation and policy applicable in protection and soil conservation.
- Local good practices on using soil resources for productive activities (agricultural, forestry, construction, among other they become available).
- Or adopt similar guidelines for international character in the absence of local.

Socioeconomics Aspects

Sensitivity of the productive sectors and local people, potential impacts about the project's on soil resources.

Institutional Aspect

- Local institution involved in soil protection and conservancy.

Impacts Projects

- Assessment of anthropogenic and natural impacts, on biological, chemical and physical soil characteristics.

Environment Protection Criteria Application

- Strategies and measures for ensuring the protection of soil processes put affect into biological, chemical and physical soil quality.
- Mechanisms approach for soil protection in the event of occurrence of incidents or accidents that endanger the biological quality physics, chemistry and soil.
- Mechanisms and means for correcting processes and activities for occurrence of incidents or accidents that endanger the physical biological quality, and soil chemistry.
- For pollution procedures for handling accidents.
- If necessary in the case of contamination of large proportions a plan for soil remediation.

Impacts Projects Analyze

- Evaluation of all processes and activities project that impact directly or indirectly in the management of soil resources.

- Comparison of physical, chemical and biological parameters against the permissible ranges of local laws and in the absence of these implementing international standards.

Environmental and Social Management Plan

Scope

Project Scope; specifying the project boundaries and areas under direct or indirect actions outside this.

Scope – Description

Project scope is specifying the project boundary and the descriptive detail areas of ecological or natural areas and unnatural adjacent areas that may be subject to direct or indirect damages including upcoming project or surrounding communities.

Scope – Location

Preferably where the project is projected on a map, with local and regional location with the detail of ecosystems, communities and soil types within and / or surrounding the project.

Scope – Management Plan Framework

Compliance with environmental legal mandates for the theme, and the conditions, mechanisms and proposals for the implementation of environmental and social management of the impacts of the project to minimize these activities.

Environmental and Social Responsibility Policy

Manifesto of the social and environmental policy under which the project will lead the management to minimize impacts and defining the mechanisms for managing potential claims.

Environmental Objectives

Clear definition of the overall purpose of the environmental management of the management plan; and the definition of the specific purposes of the management plan.

Roles and Responsibility

Defining roles and responsibilities in order to be able to assess management performance management plan, in order to go to the specific activity responsible and this is clear. Defining any liability involved in the / processes and / or activities.

Condition Manager

Definition of responsible management plan and their roles and responsibilities.

Environmental and Social Management

Definition and description of the processes and activities required for the realization of environmental and social management of mitigation measures and conflict resolution proposed in the environmental and social impact of the project and budget definition for execution, work plan and defining goals and outcomes of this.

Implementation and Operation

Definition of responsible planning of activities and definition of performance indicators to ensure compliance with the management and implementation of environmental management plan.

Environmental Aspect Management Plans and Maps

Definition of mitigation and compensation measures in order to minimize the impacts identified in the Environmental and Social Impact, including planning this and spatial definition of it on maps that will facilitate its location and conduct field and monitoring this.

Operating Procedures

Defining the specific procedures for ensuring the effective and efficient implementation of the management plan, specifically focusing on issues related to the conservation, protection and management of soil resources.

Emergency Procedures

Detailed description of the procedures and activities necessary to the occurrence of incidents, accidents or unforeseen emergencies processes that affect the chemical, physical and biological soil quality, the definition of roles and schemes of work to contain and manage the occurrence of these.

Training

Survey and identification of training and refreshes needed to ensure adequate and timely handling of the occurrence of incidents, accidents or emergencies affecting the chemical, physical and biological soil quality, to maintain a standard procedure to ensure the effectiveness compliance with previously established procedures.

Monitoring and Review

Establishing and defining the periodicity and those responsible for the review of the management plan as well as monitoring arising from the activities and processes of the project.

Monitoring

Defining mechanisms for ensuring effective monitoring of maintenance and / or conservation of physical, chemical and biological quality of the soil, and water in and project boundaries. Mainly based on the nature of the potential risks implicit in processes and own project activities that might affect or influence the soil resource.

Audits

Definition of periodicity and compliance with third party audits in accordance with local legislation and in the absence of this assurance at least conducting a yearly basis.

Corrective and Preventive Action

Establishment of the mechanism for corrective actions required, and the development of a plan of preventive measures to ensure compliance with activities aimed at the prevention of incidents, accidents and emergency actions and mechanisms to channel any of these not considered to above.

Management Review

Defining the periodic review and updating of the plan for environmental and social management and communication updating this with the relevant environmental authorities.

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