STRATEGIC REFORESTATION TO FIGHT AGAINST EROSION IN THE COLOMBIAN AMAZON

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ABSTRACT

The main objective of this research work is to determine the importance of reforestation on the banks of the Amazon River as an alternative for the mitigation of erosive processes in 36Km2 of humid tropical forests of the Ticuna indigenous territory, in Puerto Nariño-Amazonas; where an environmental problem of landslides in highly deteriorated forests is identified, generated by anthropogenic factors due to the felling of trees mainly for purposes of firewood and informal marketing (illegal timber trafficking). This has generated strong erosive processes on the riverbank, loss of soil, changes in use, expansion of the agricultural frontier and prolongation of periods of drought, disturbing the natural conditions of the basins, migration and extinction of fauna, loss of biodiversity and spatially-temporally changing the water resource, limiting its use, harming the quality of life of the inhabitants of the Ticuna indigenous populations: Soplaviento (K33), Calamar and the bifurcation of the Caño Correa (K82), the municipalities of Mahates, Arjona, María La Baja and San Estanislao among the most important. After identifying the importance of reforestation, we propose strategies that contribute to the conservation, prevention and protection of this ecoregion by formulating a reforestation proposal based on a methodology called "Priority actions for tree planting and environmental restoration." In view of the exposed environmental problems, we propose to carry out recovery processes of the soil's vegetal cover and implement erosion control and mitigation measures through the use of natural mechanisms that do not induce new environmental impacts. We document the alternatives that are being managed in bioengineering for erosion control.

Keywords: composting, erosion, geosynthetics; Ticuna indigenous community, Amazonas, fertile mixture, revegetation.

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INTRODUCTION

The degradation of the Amazonian Forest ecosystem, caused by deforestation, coca cultivation and drug production, had and still has negative impacts on the colombian amazon basin, reducing the productive potential of renewable natural resources, which need to be recovered through replenishment of forest biomass through reforestation.

The abandoned surfaces and those recently eradicated from coca crops must be rehabilitated to develop activities to recover degraded soils through reforestation and agroforestry, which will mean the recovery of forests with rich biodiversity, water, climate and mainly of the soil, which in short will offer greater possibilities for the social, economic, cultural and environmental development of the population. In addition, reforestation constitutes a prevention and mitigation mechanism against the negative effects of climate change, the same one that is supported by the environmental education activity, with which the population is being made aware of the environment, be interested in its components, operation and problems, and have the necessary motivation, knowledge, skills and desire to work individually and collectively in the search for solutions to current problems and to prevent future ones.

The cost of recovering the ecosystem of the colombian amazon basin, on the other hand, requires joining public-private efforts, given that the benefit granted by the environmental goods and services will reach the entire population. This proposal is based on the experiences of DEVIDA in coca-growing areas, which between 2003 and 2014, carried out 30 reforestation and agroforestry projects, managing to recover 50,000 hectares deforested and degraded by intensive coca cultivation. In the colombian amazon basin, 3,100 hectares were reforested with native species. 13 In this context, the fight against drugs assumes the defense and recovery of the environment as one of the approaches aimed at achieving the sustainability of alternative development, for which it raised this proposal, hoping to count on the contributions of the State, cooperating entities and above all of the population and its authorities, within the framework of the National Strategy for the Fight against Drugs

BASIC CONCEPTS OF EROSION

Erosion includes the detachment, transport and subsequent deposit of soil or rock materials by the force of a moving fluid; it can be generated by both water and wind (Suárez, 2018).

Erosion and desertification are phenomena linked to specific climatic conditions, generally dry seasons, and are additionally associated with physicochemical changes in the soil, induced by inappropriate human activities. Soil degradation affects the quality of vegetation cover and water quality, in addition to compromising the biological potential and sustainable development of associated geosystems. Soil erosion is a severe form of physical degradation; it is estimated that about 80% of the world's agricultural land suffers from moderate to severe erosion and 10% from light to moderate erosion (Lal and Stewart, 2015). 40% of the Colombian territory presents erosion from light to severe and the Andean zone is the most affected, with 88% of the area in a state of hydric erosion (Olmos and Montenegro, 2017). The intensity of erosion in the coastline is the annual extension measured in kilometers of the coastline that becomes unbalanced and begins to suffer processes of coastal erosion. This indicator represents the effects of natural and anthropic activity on the dynamic balance of the coastline, which, when altered, can trigger processes of erosion or accretion of the coastline, the advance or retreat of the coastline and variations of marine dynamics due to natural or induced changes ("Erosion intensity of the FOREST of the central sector of the Colombian Amazon basin", January 2016). The types of erosion and the characteristics of each of the erosive agents are shown in table 1.

Table 1. Types of erosion and their characteristics. Source: elaboration own; information: Suarez, J., 2018.

TYPE OF EROSION	CHARACTERISTICS
Wind erosion	Wind movement exerts frictional forces and lift on soil particles, detaching and transporting them to be deposited in other places
Rainfall erosion	The force of rain drops falling on bare soil can release and move particles to truly amazing distances away
Laminar erosion	Surface water flows may cause the detachment of soil upper layers and form an erosion system in which layers become progressively deepened
Rill erosion	Concentration of flow in small channels or ridges causes them to deepen; such small channels form a semi-par all el series of grooves
Groundwater upwelling erosion	Groundwater rising to the surface can dislodge soil particles, forming gullies or subsurface caverns
Internal erosion	Water flow through soil transports particles, forming internal caverns within the earth
Gully erosion	Grooves can become deepened, forming deep channels or water concentration at a given site in a major stream, forming long, deep channels (so-called gullies). Once a gully has started, it is very difficult to stop the erosion
Waterway erosion	Lateral erosion and deepening. The tractive force o water in streams and rivers produces channels' lateral extension, depth and overall dynamics concerning a particular stream
Wave Erosion	The forces inherent in wave motion produce particle detachment and transport
Mass Erosion	Landslides. The term erosion or landslide is related to the mass movement of soil

Erosion control and soil stabilization alternatives are being sought after nowadays. It is known that revegetation controls gully erosion by increasing infiltration and reducing run-off. The vegetation physically protects soil from the impact of rainfall and run-off and reduces water flow speed by increasing the ground's hydraulic resistance, thereby decreasing water's erosive effect. If flow speed can be reduced enough, it leads to the settling of some of the material being carried away; natural vegetation can then become regenerated (Hudson, 2012). Growing grass slows run-off from 50% to 60% and soil loss by erosion from 60% to 80% (Morgan, 2016).

EROSION CONTROL SYSTEMS

Bioengineering erosion control would include the use of grasses, vetiver grass, bamboo or guadua and trees, run-off management, circuit breakers, stone-lined and concrete channels, gullies, vegetation barriers, revegetation with sisal fibre cloth (fique), using bamboo with metal mesh, organic soil placement, forks, slopes reinforced with geofabrics, stone gabions and sandbags, bags of concrete and reinforced concrete hexapods. Most technologies used in Colombia are local adaptations. The principles of engineering erosion control are basic; vegetation is one of the best natural materials for erosion control but geomanufactured and marketed synthetic applications for erosion control have significantly changed the concept during the last decade. The problem of soil conservation, protection, revegetation and turf reinforcement can be resolved by using many organic and synthetic materials having specific properties which must be met for achieving suitable performance (Carroll et al.,2012).

Geosynthetics are defined as, "permeable fabric used in connection with the ground, foundation, rock, soil or geotechnical engineering" (John, 1987). The geosynthetics used in erosion con-trol are made of natural or synthetic materials, including coco-nut, sisal, cereal straw, nylon, palm leaves, polypropylene, poly-ester and polyethylene (Rickson, 2006). Geotextiles' longevity depends on several external facts such as the effect of ultra-violet (UV) degradation due to water temperature. Photon energy can thus be greater than or equal to the strength of chemical bonds between polymers and therefore can break fibres or result in degradation (Khanna, 2005).

Changes in seasonal and daytime temperatures, the atmosphere and dramatic temperature changes affect the characteristics of geotextiles strains and reduce their efficiency by inducing fibre wear. High temperatures accelerate all polymer degradation mechanisms according to Hsuan and Koerner (1993). High tension can cause mechanical wear on the surface during heavy rains; however, the effect of water is less than UV light and cyclic temperature changes (Khanna, 2005).

Geosynthetics can play a vital role in the protection, mitigation and rehabilitation of affected coastal areas. Geosynthetics have been widely used in hydraulic and geotechnical engineering during the last two or three decades. Its use has been well-established for the purpose of material separation and erosion control filters (Faure et al., 2006; Liu and Chu, 2006).

Analysis must involve using different types of materials to control erosion because it is considered that revegetation is a slow process which may last hundreds of years; natural revegetation is thus not considered acceptable as a restoration strategy (Cullen et al., 1998). Regarding artificial revegetation, several methods have been widely used to rehabilitate the landscape of rocky slopes (Petersen et al., 2004). Many restoration projects have been undertaken to date; however, they have usually lacked the proper scientific contribution due to a lack of information and knowledge regarding plant species, growth and the natural conditions of a particular soil slope to be treated (Shu et al., 2003).

Current practices, materials and solutions seek to control or recuperate soil erosion caused by rain, wind, run-off and/ or gravity; rolled erosion control products (RECP) is one such solution. The recovery of vegetation on slopes having with little organic material requires the use of products protecting the fertile soil and providing favourable conditions for new vegetation to become established.

Many traditional erosion control applications have been based on straw and organic material; many designs seek to capture and hold soil in place and facilitate revegetation. Other product categories have been introduced today for specific erosion control, making such products more affordable, technically feasible and environmentally harmonious. Some reports regarding extremely degraded steep slopes have dealt with ecosystem revegetation where natural colonisation of plant species has been a difficult and slow process and has proved to be a complicated and expensive matter (Yuan et al., 2006).

The following control systems for erosion control may be mentioned. Organic conventional and non-conventional coverage different types of mulch have been used for thousands of years to protect seeds and soil from erosive forces and accelerate vegetation establishment. Their benefits would include:

-Assisting in stabilising the soil, immediately reducing erosion produced by wind and water;

-Reducing fluctuations in soil temperatures to promote rapid seed germination and lower temperature stress on seedlings;

-Retaining moisture in a seedbed for rapid seed germination and plant growth; and

-Transforming such cover into valuable organic matter incorpo-rated in the soil to provide long-term moisture and good nutrient retention for plants.

The following could be noted regarding conventional organic coverage:

DISSOLVED ORGANIC COATING

Straw and hay are the most widely used organic coating materi-als. Loose straw and hay fibres however must have sufficient length (10 to 20 centimetres) to be woven and offer the maxi-mum desired effect; the longer the organic residue fibre length, the more effective it is in providing benefits. A dry mulch is usu-ally machine spread on fields ranging from plains to gently slop-ing land at of 3,370 to 4,490 kg /ha (1.5-2.0 tons/acre); it is ploughed into the soil using dull crimped-centre disc blades.

Clamps (tackifiers)

As slope angle increases, disk techniques are replaced by using viscous sprays to bind organic residues, fibres and soil together. These sprays, which are called binders (tackifiers) usually consist of asphalt emulsions, water distillates, psyllium and sodium algi-nate. The amount of binder applied varies according to the kind of product, the severity of site conditions, climate and desired application duration.

The following could be noted concerning non-conventional coverage:

Rolled erosion control products (RECP)

When manufacturers were faced by limited conventional or-ganic coating techniques in the late 1960s, then they began developing what has become a diverse group of products known as rolled erosion control products (RECP). This category consists of preformed products, such as organic waste retention net-works, open-mesh geotextiles, erosion control coatings and vegetation reinforcement mats. Using this growing family of ma-terials made from woodchips, straw, jute, coir, polyolefins, PVC and nylon has led to designers incorporating long-staple organic coatings' superiority with meshes and dimensionally-stable geo-textiles' tensile strength. The US Erosion Control and Technology Council (ECTC) has developed standard terminology for these products, which is presented below:

1) Mulch-control netting (MCN)

The ECTC's official definition is, "a flat-woven fiber, natural or extruded geosynthetic mesh used as temporary and degradable RECP to anchor loose mulches." This product consists of two woven or mesh dimensional fibres having been submitted to a biaxial geosynthetic process used to fasten loose fibre mulch on the type of straw or hay. MCN networks for controlling organic coatings are spread over the sown area, covered with organic waste and then secured with staples or stakes. Because they are not glued or sewn to the organic waste, these belts do not pro-vide the same degree of structural integrity offered by prefabricated coatings for erosion control.

2. Open-weave textile (OWT)

The ECTC's official definition is, "A temporary and degradable RECP composed of processed natural yarns or polymers, intertwined with a binder that is used in erosion control and facilitates the rooting of the vegetation." Open-weave fabrics are processed polyolefin wire moulded into a 2-D matrix. These materials' tight weave allows

them to provide erosion control with or without using an underlying layer of organic coating. Moreover, these screens typically display greater tensile strength than most of the above. OWT are usually used in places where greater traction is required, such as steep slopes or as a reinforcing layer for grass. OWT also represent a protective coating on slopes reinforced with geosynthetics in bioengineering facilities, especially where hard stem plants are used as natural stabilising material.

3. Erosion-control blankets (ECB)

The ECTC's official definition is, "A temporary and degradable RECP consisting of natural fibres or processed polymers, linked mechanically, structurally or chemically to form a continuous bond for erosion control and streamlining the process of fix-ing vegetation." The coatings for erosion control fibres consist of multiple organic / biodegradable synthetic woven material, glued or structurally bonded with mesh. The coatings most used for erosion control are made of straw, wood chips, coconut, poly-propylene or a combination sewn or glued inside or through the processed biaxially-orientated nets or natural woven fibre net-ting. The ECB functional duration may be modified and adapted to a place's specific requirements. Some ECB are designed to last less than three months in places requiring a lot of maintenance to be cut immediately after the grass has taken root, while oth-ers are designed to provide longer-lasting protection in applica-tions requiring protection against erosion as long as three years.

4. Turf reinforcement mat (TRM)

The ECTC's official definition is, "A permanent RECP composed of non-degradable synthetic fibres, filaments, nets and / or mesh processed in a continuous three-dimensional matrix. The TRMs can be supplemented with degradable components and are designed to provide immediate protection against erosion, pro-mote the establishment of vegetation and provide long life, rein-forcing vegetation during and after maturation.

TRMs are typically used in hydraulic applications such as high flow channels, on steep slopes, embankments and coasts where erosive forces may exceed natural vegetation limits or where the establishment of vegetation is limited. Although some TRMs also contain biodegradable components to supplement their perma-nent structure, all TRMs must have a permanent three-dimensional structure featuring high-tensile strength to function as a binder having elastic qualities for the roots, stems and plant floor entanglement. Together they form a continuous composite: a living, unified blanket.

A TRM is often used in situations where the "green" alternative is preferred to more rigid structures. A TRM is generally installed to optimise plant stem and/or root interaction with the blanket structure. Traditional installations involve TRM deployment and support in close contact with soil surface. There are two placement methods and their use depends on the type of blanket being used. One method is to place a newly seeded TRM directly on a surface to allow vegetation to grow through the blanket's structure.

In this scenario, the TRM initially acts to prevent the washing away of soil and plant root fixing structures and plants becoming released from the soil surface. This type of installation usually results in strengthening vegetation stems and the natural process of sedimentation filling the blanket and layers of vegetation growing in and through its structure. The second method is to deploy TRM, install the product, then fill it with good quality soil and seed mixture prescribed for this purpose. Vegetation is immediately rooted inside and/or through the structure of the blanket in this type of installation, producing initial, permanent strengthening reinforcement.

Revegetation

Environmental facts affecting the restoration of vegetation. Plants depend closely on the medium in which they operate; it provides the energy, raw materials and space needed and used to grow in. Soil, air and water are its constituent elements. Plants' living conditions arise from their immediate environment resulting from the interaction of various factors which can be grouped as follows:

Climate factors: solar radiation, rainfall, temperature and wind act directly on plants; Edaphic factors: soil is a physical-biological system that acts in complex ways on vegetation. It is the source and pantry for nu-trients and water and it contains the necessary oxygen for roots and microorganism respiration; Topographic factors: altitude, slope, exposure, guidance and forms of relief exert a modifying action on other environmental factors; and Physical factors: in turn, divided into:

Temperature: ambient temperature should be taken into account when choosing species for sowing or plant ing. There are certain temperature thresholds for each species, within which their life-cycle un folds; however, the temperature of the atmosphere is not regarded as providing specific data because it does not pinpoint the conditions found in the topsoil, where plant life develops; Moisture: soil moisture and humidity influence both the time of planting and subsequent plant development. Regarding soil moisture, water availability is the amount of liquid that can be used by plants. It depends on water supply (rainfall or irrigation) and infiltration capacity and soil retention; and Soil aeration: the soil's atmosphere affects all the proc esses taking place within it, the life of soil microorgan isms and the roots of taller plants depend on it. This also involves the chemical changes taking place in the ground: the absence of O2 inhibits root growth, O2 and CO2 concentration also affects germination, microorgan isms are necessary from the time of germination, the amount of O2 y CO2 is involved in nutrient absorption and oxydoreduction of soil; Chemical factors: Three factors can affect or even severely limit vegetation development; all of them are edaphic factors arising from the disappearance of surface soil horizons below a crop, resulting from excavation:

Nutrient presence and availability: plants need to have essential elements for their development. Some macro nutrients are required in large amounts: nitrogen, phos phor, sulphur, calcium, magnesium and potas s i u m . Micronutrients are needed in very small doses: i r o n , manganese, boron, zinc and molybdenum. Others may only be essential for particular species: sodium, chlorine, cobalt and vanadium; Acidity and alkalinity of the soil: the importance of pH as an environmental factor affecting revegetation is due to direct (an environment's acidifying or basifying influ ence can affect plant development conditions) and indirect reasons because of its intervention regard ing other soil characteristics: influencing the speed and quality of humification and mineralisation through its influence on soil microorganisms, influencing the status of certain nutrients characterised by its degree of plant assimilation and soil structure conditions and, therefore, all soil properties derived from that; and Toxicity: toxicity problems in area neighbouring waste collection and dams are mainly due to the presence of heavy metals (copper, zinc, lead, nickel) and other me-tals (aluminium, manganese).

Fertile blends

Fertilisers are products for feeding plants. Therefore, fertilising means providing substances of plants or their nutritional substrate. The law contains this definition, "Fertilisers are sub-stances directly or indirectly applied to plants to promote their growth, increase production or improve their quality."7 Certain matters must be considered when using and applying fertilisers: soil characteristics (content and nutrients availability for fertilising, pH and texture), conditions (temperature, amount and distribution of rainfall) and plant characteristics (needs, the root system, crop rotation, farming systems and production measures). Another important basic point regards evaluating the characteristics of fertiliser content and nutrients' chemical form, dissolution process, granule size and their reactions with soil8.

Compost used as fertiliser

Preference in using compost as a nutrient source for crops rather than fresh waste is usually due to the desire to reduce offensive odour (Miller, 1993), toxic effects on crops, reduced water use and the elimination of pathogens and weed seeds in compost (Rink, 1992). However, it is clear that the rate at which nutrients deliver fresh residues is faster than a compost matures (Castellanos and Pratt, 1981). Incomplete composting products such as bokashi provide more nutrients in the short-term than finished compost, as well as incorporating a diverse microbial population to continue decomposition in the field, with the inherent risk of warming on the ground (which must obviously be managed) (Soto, 2001)

The carbon: nitrogen (C:N) ratio in bulk compost decreases during composting, regardless of the composting technique used. A 10:15 ratio is considered stable; however, it can be stabilised long before the compound becomes stabilised (Namkoong et al., 2019, Chefetz et al., 2016) and the final ratio depends on the source material and the method used for measuring N (Hueand Liu, 2015). The proportion of NH4-N NO3-N in the water ex-tract has been suggested as a maturity index.

The long-term intensive influence of NPK fertilisation on soil properties has special characteristics. Potassium fertilisation leads to an accumulation of potassium-exchangeable K, but infiltration is also large and leads to changes in ion coverage of soil colloids and possible imbalance between K, Ca and Mg9.

William Albrecht (1888 to 1974) ensured that the key to fertilisation was balance; he advised ensuring a soil nutrient balance lacking excess or deficiency. The Albrecht theory (also called base saturation theory) is used to guide lime and fertiliser appli-cation by measuring and evaluating the proportions of positively-charged nutrients (bases) held in the soil.

RESULTS AND RESULTS ANALYSIS

The climate favors the reforestation of degraded soils, this hypothesis was affirmed by 45% of the farmers interviewed in the Monzón micro-basin; there are 4% of residents who do not think about it. What remains clear is that new conditions are created to populate these degraded areas with native forest species and, furthermore, farmers recognize climate as the state of time made up of temperature, rain, and humidity; which in this area is suitable for reforestation. With a good climate, favorable conditions are created for the growth of the plantation and generate its own permanent microclimate. Reason why the Spearman's Rho correlation test with 0.867, which indicates that there is a high degree of association between the climate variables and soil recovery, so it is concluded that the climate favors reforestation for soil recovery gradients. The application of the land classification by capacity for major use is vital to technically define, based on experience, if the land intervened by the study is appropriate for reforestation. In this sense, 33% of the farmers surveyed indicated that the use of the classifying document favors reforestation.

The lands studied in the Monzón river micro-basin, through the development of the monzón forestry project, determined that 45% are soils with forestry capacity and constitute permanent production forests, in the case of recovery. Likewise, the result of the Spearman's Rho test is 0.917, indicating that the population affirmed that said classification document favored the location and prioritization of the areas to be reforested to recover the soils degraded by the illicit cultivation of coca.

Water, the main element for life, is closely related to reforestation, which provides the necessary water for forest growth. In the case of Monzón, 39% of the farmers surveyed are aware that water favors reforestation. This resource is precious in the area, where it has already suffered a very strong impact, the flow of the Monzón River and its tributaries having decreased in recent years, due to increasing deforestation, and it is necessary for the population to continue to be aware of regard. Likewise, from the Rho Spearman test, 0.929 was obtained, which indicates the existence of a high degree of association of the variables water and recovery of degraded soils, with the confidence value being less than 0.01%, with which it is concluded and corroborates that water favors reforestation for the recovery of degraded soils.

The trees planted in the Monzón River micro-basin play an important role in ensuring reforestation for the purpose of recovering degraded soils. It is an inclusive process that fosters collaboration between a wide range of stakeholders, including the local population, authorities, institutions, among others. In this sense, whose results of the survey show that 43% of beneficiaries manifest themselves favorably and in response to the Espearman test, the correlations show that 0.945, indicates that there is a high degree of association between the trees and the recovery of soils, therefore it is concluded that the planted trees directly favor the recovery of degraded soils. When farmers are asked: How does the population collaborate in the reforestation of degraded soils? 44% of those surveyed responded that the population collaborates favorably in reforestation, concluding that the environmentally educated population constitutes an agent of sustainable development to transform realities and build a better society, based on the recovery of degraded soils.

Likewise, with the correlation test, it is corroborated that with 0.854, it indicates the degree of associativity between the population and the recovery of soils, concluding that the population collaborates with its workforce in reforestation to recover its degraded soils.

RECOMMENDATION

The results obtained have made it possible to determine that reforestation has a favorable impact on the recovery of degraded soils in the Colombian Amazon basin, as is the case of the Monzón forestry project (UNODC, 2013), which was a living example of the study, which fulfilled the clear principles and criteria in forestry, environmental, social and economic matters, in addition to applying technical criteria and giving way to guarantee sustainability, in replacement of the illegal economy of coca cultivation. The Colombian Amazon basin presents a diversity of climates due to the Andean-Amazonian relief, which allow benign conditions for the development of reforestation and recovery of degraded soils, therefore it is concluded that the climate is quite good and favors the reforestation of soils. degraded in the Colombian Amazon basin, whose potential can allow productive diversification and the natural balance of the ecosystem. Currently, the Land Classification is taking possession of its capacity for Major Use, as an important tool used for the territorial ordering of farmers' plots, for the purpose of land use planning and the production of goods and services. In the Colombian Amazon basin, the lands that predominate are those of protection and forestry, both of which occupy 98.8%, whose soil pH fluctuates between 3.5 - 4.5 (extremely acid and of low fertility). Therefore, it is concluded that the Classification of Lands due to their capacity for Major Use is a tool that favors the sustainable use of natural resources, as evidenced by the reforestation of areas degraded by coca cultivation.

The primary resource for the location of population settlements is water, which is scarce in the Colombian Amazon basin, due to the high rate of deforestation that has brought more poverty than development, while illicit crops persist. The conscious recognition of the importance of water by the farmers of the Ticuna indigenous community is very high, which favors reforestation and they are determined to continue reforestation and avoid future droughts. The formation of a forest mass or reforested forest, made up of trees and shrubs, favor the recovery of soils degraded by the deforestation process in the Colombian Amazon basin, faced with this problem, farmers today are more environmentally aware and are concerned about the remoteness and scarce firewood on their plot and they are concerned to recover degraded soils through reforestation and simulate a natural forest with important goods and services for the local legal economy. The participation of the population is very important and decisive and this is achieved through a change in the attitude of the people, and especially of the farmers of the Colombian Amazon basin, who have strategically become involved in training and awareness-raising actions or Education Environmental, as part of the educational community (teachers, students and parents) executed by the Regional

Directorate of Education of the Regional Government of Ticuna, sphere of influence of the PIRDAIS Comprehensive and Sustainable Alternative Development Program, which was promoted by DEVIDA , within the framework of the National Strategy to Fight Drugs and the National Environmental Education Policy. In short, to reduce the natural and anthropic attacks, the organized population has been betting favorably on the reforestation of its soils degraded by the illicit cultivation of coca.

It is worth mentioning that all activities carried out by man generate positive and negative impacts, zero impact does not exist; therefore, the tasks generated by reforestation, be it for any modality, must imply the substantial reduction of negative impacts, also promoting the practice of optimal activities, under an orderly scheme that improves the administration of resources with the objective of generating goods and services ensuring environmental balance. It is recommended to prioritize reforestation projects and/or programs, for production purposes, agroforestry systems, protection and/or recovery of degraded soils. These reforestation modalities can contribute to the mitigation of global warming, as storage or "carbon sink" (tree biomass above the ground in accessible high forest: 172.53 t C/ha, in difficult access high forest: 200.11 t C/ ha) and/or conservation in the headwaters of the Monzón River micro-basin, for the recovery of the water supply, production and management of agroforestry systems, the destruction and recovery of natural resources may be an alternative solution, mainly for reasons ecological, since the association of forest species with permanent agricultural species resembles the original ecological reality based on principles of diversity of species in a unit area, permanent protection of soils, recycling of nutrients and restoration of their fertility. As well as, a great economic potential, to reduce the vicious circle of extreme poverty and strengthen environmental management. In the same way, it is appropriate to evaluate and incorporate different data on the soil and land use data to determine the carbon stocks in the flight and soil. There is a direct relationship between the recovery of degraded soils and the carbon content in the flight and soil. The key to monitoring lies in having a reliable baseline, or reference level.

Promote comparative and interdisciplinary research, basic and applied, disinterested and functional, on the subject of recovery of soils degraded by the cultivation of illicit coca. The development of reforestation in the recovery of degraded soils in the Monzón River micro-basin implies participation, coordination, agreement and a special effort by the authorities, local governments, public and private institutions and civil society. Thus, the result will not only be reforestation, but create environmental awareness and recover environmental goods and services, such as the creation of habitat for wildlife, create ecotourism and above all create forest governance, in which government is governed taking into account the participation of the actors of society at the time of making public decisions. The forms of soil degradation, both natural and anthropic, must be recognized, studied and analyzed in order to apply forestry techniques that minimize the impact on the soil and allow the recovery of its natural functions. When soil degradation processes are especially severe, it is necessary to act to recover the lost components or functions of the original forest and prevent negative effects from spreading to the waters or to the affected ecosystems as a whole. • It is recommended to replicate this experience of executing the first pilot forestry project of the Monzón, in other areas with similar social, economic and environmental problems, in order to massify the task of recovering and conscientiously managing soils degraded by illicit coca cultivation.

CONCLUSIONS

The consequences of soil erosion are manifest both in the place that it occurs and outside it (diffuse erosion). Site effects are particularly important concerning agricultural land where soil redistribution and loss, degradation of its structure and entrainment of organic matter and nutrients leads to loss of topsoil thickness and a decline in fertility. Erosion also reduces the moisture available in the soil, stressing arid conditions.

The current trend is to make erosion control less aggressive for the environment, meaning that the idea is to use natural, mainly fibre based, prefabricated materials (organic blankets or screens and bio-rolls or organic fascines), many of them forestry-based (Contreras, V. 2011). Environmental solutions become integrated in soil fertilisation and revegetation to resolve soil erosion is-sues.

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