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RESEARCH ARTICLE

# SOIL CONSERVATION PRACTICES IN FOREST OF NEPAL

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#### **ARTICLE DETAILS**

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#### **ABSTRACT**

Forests play a vital role in Nepalese rural communities, which rely on them for firewood, employment, additional meals, and good health to sustain and improve their lifestyles. It has contributed to the Nepalese farming system. Soil helps in regulating ecological processes like nutrient uptake, decomposition, and water availability in the forest. Nepal's annual soil loss ranges from 2-105 t ha-1 with 34% water-induced erosion, 60% mass wasting (geological erosion), and 3 % by wind erosion. Forest soil requires various management and conservation practices to minimize the exploitation of forest lands. Hence, this article explains the ongoing soil conservation approaches like Afforestation, Agroforestry, and community forest management in Nepal. This article can also be the roadmap for the formulation of appropriate policies in soil conservation, and indirectly in maintaining sustainability in the ecology.

## **KEYWORDS**

Afforestation, Agroforestry, Degradation, Ecology, Watershed

# 1. Introduction

Forest is an integral part of the troposphere. Forests are responsible for the majority of food, water, shelter, livelihood, and fuel that humans consume. All these activities directly or indirectly involve forests. Fruits, paper, and wood from trees are seen as the obvious and direct production of the forest ecosystem. Others remain less obvious, such as by-products that go into everyday items like medicines, cosmetics, detergents, and the various geochemical cycle harboring in this ecosystem. Despite our reliance on trees, we continue to allow them to go (WWF, 2020).

Forests play a vital role in Nepalese rural communities, which rely on them for assets such as electricity, employment, additional meals, safe drinking water, and good health to sustain and improve their lifestyles. In these communities, forests are also an essential component of the farming system (Acharya et al., 2021). One of the leading causes of the degeneration of forests other than deforestation is the degradation and loss (drift) of the top layer of fertile soil. This is mainly due to the lack of soil conservation practices in the forests of Nepal. Over millions of years, soils have given the basis for plants and entire forests. Forest and woodland ecosystems rely on soil for their existence because it aids in regulating important ecological processes like nutrient intake, decomposition, and water availability. Soils offer anchorage, water, and nutrients to trees. As leaves and other vegetation die and disintegrate, trees and other plants, and vegetation play a crucial role in forming new soil (FAO, 2015). Soils and forests are inextricably intertwined, with enormous consequences for one another and the wider environment. The interactions between forests and forest soils aid in maintaining the environmental conditions required for agricultural production (FAO, 2015). Forest ecosystems are built on the foundation of soils as they aid in the regulation of essential ecosystem processes like nutrient uptake, organic matter decomposition, water storage, and providing tree anchorage. In turn, trees and other plants, and vegetation play a vital role in forming new soil as leaves and other vegetation rot and decay (FAO, 2015). The preview literature shows that the degrading top layer of the soil, haphazard construction of roads without proper surveys, forests fire, concentrated rainfall events in the monsoon, weak soil structure, fragile geology, and undulating land topography are the major issues for the degradation of soil in the forests in Himalayan countries like Nepal, but there is no paper regarding the collective discussion on the way for integrated management and conservation of the soil and forest in a sustainable way. So this current review will be focused on the collective and integrative approaches, especially for the developing and forest-dependent population country like Nepal. The major way forwards for the concerned authorities in policies building, working at the grass-roots level, as well the general consumers.

#### 2. METHODS AND METHODOLOGY

This article is based on reviewing the information gathered and produced from several secondary sources. The published and unpublished papers, documents, brochures, leaflets, newspapers, proceedings, official documents, and other sources of information were used to present and discuss the results and shape the paper.

### 3. SOIL AND SOIL CONSERVATION

Soils are a large reservoir of organic carbon and play a significant role in their accumulation and storage (Osipov et al., 2021). Soil functions are numerous, and many of them have yet to be fully explored. Soil functions are divided into seven categories (European Commission, 2006a; JRC,2011); i) Contribute to biomass production through Agriculture and forestry; ii) Storing, filtering, and transforming nutrients, substances, and water; iii) Biodiversity pool, such as habitats, species, and genes; iv)

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Physical and cultural environment for humans and human activities; v) Source of raw materials; vi) Acting as a carbon pool; vii) Archive of geological and archaeological heritage. Soil function might be affected by several factors. The European Union has recognized eight challenges to soil functions or degradation processes: i) Water and wind erosion; ii) Organic matter depletion; iii) Contamination; iv) Sealing; v) Compaction; vi) Loss of soil biodiversity; vii) Salinization; viii) Floods and landslides (European Commission, 2006a). Later, two more were added.: ix) Desertification; x) Acidification (JRC, 2011; European Commission, 2012; Costantini & Lorenzetti, 2013). To jeopardize soil degradation, soil bioengineering has been employed in Nepal for nearly 30 years to address slope erosion, highway construction, and riverbank stability. Brush layering, palisades, live check dams, fascines, and vegetative stone pitching are Nepal's most common soil bioengineering techniques (Dhital et al., 2013). However, the major focus of this review paper is on soil conservation measures in Nepalese forests like afforestation (planting of trees), Agro-forestry, and Community Forest management of Nepal.

Forests are not distributed uniformly around the world but instead concentrated in various climate zones. Depending on the climate, forests are classified as temperate, sub-tropical, and tropical forests (Blanco-Canqui & Lal, 2008a). Forests cover 31% of the world's land surface. Approximately half of the woodland remains largely unaffected, and more than one-third is primary forest (i.e., naturally regenerated forests of native species) (FAO, 2020). Forestland is composed of non-agricultural land with at least 10% tree cover (FAO, 2000). In this context, the global forest area is expected to be 4 billion hectares or around 30% of the total terrestrial surface area. (FAO, 2005). Soil erosion is the natural movement of the top layer of soil caused by water, air, gravity, ice, glaciers, biological activities, farming, tilling the land, or other natural forces (Shaw, 2021). Soil erosion reduces crop production by preferentially removing the nutrient-rich topsoil (A horizons) and by adversely affecting soil structural and hydrological properties(Blanco-Canqui & Lal, 2008b).

Soil conservation refers to the use and management of soil based on the soil's inherent capabilities, including the application of best management practices that lead to profitable crop production without degrading the soil. Forest soil conservation is thus a crucial element of forest management and long-term forest conservation (Cotler et al., 2020). Trees with a deep and well-distributed rooting system will decrease nutrient leaching. Leucaena leucocephala is one of the best trees to improve soil forestry. It contributes nitrogen and conserves soil moisture. Dalbergia sissoo is a relatively fast-growing long-lived tree. Being a leguminous tree, it grows well on poor soil as it improves soil fertility. It is also suitable to develop for soil conservation, ravine reclamation, etc. It has an excellent coppicing ability and produces root suckers, and fixes nitrogen. Soil conservation practices are farming operations and management tactics that aim to avoid or restrict soil particle detachment and transport in water or air, to control soil erosion (Baumhardt & Blanco-Canqui, 2014).

## 4. STATUS OF FOREST IN NEPAL

Forests cover 5.96 million hectares, or 40.36 percent of the country's total land area. OWL (Other Wooded Land) comprises 0.65 million hectares (4.38 percent ). Together, forest and OWL cover 44.74 percent of the country's total land area. Out of the total area of Forest, 82.68% (4.93 million ha) lies outside Protected Areas and 17.32% (1.03 million ha) inside Protected Areas. Within the Protected Areas, Core Areas and Buffer Zone contain 0.79 and 0.24 million ha of Forest, respectively. Out of the total area of Forest, 37.80% lies in Middle Mountains physiographic region, 32.25% in High Mountains and High Himal, 23.04% in Churia and 6.90% in Terai. In case of OWL, Terai, Churia, Middle Mountains, and High Mountains, and High Himal physiographic regions share 1.47%, 3.50%, 9.61% and 85.42%, respectively (Forest Resource Assessment Nepal & Nepal, 2015).

Churia is observed to have the highest occurrence of forest disturbance among all physiographic regions, particularly grazing, forest fire, landslide, and bush cutting. Hence, it is the most fragile landform of Nepal and requires conservation attention (Forest Resource Assessment Nepal & Nepal, 2015). About half of the country's total land area (44.7%) is covered by forests in Nepal (Jha et al., 2020). Nepal's forests are under massive pressure as the country's population grows. Forests provide fuel and timber, medicinal plants, and other forestry products to the people. They also use forests for grazing cattle and harvesting fodder to feed many livestock grown to provide manure for crops (His Majesty's Government, 2000). As a result of this pressure, forest acreage has shrunk, and tree numbers have declined. Consequently, it has grown more challenging for people to meet their basic needs for forestry products. Pressure on the remaining healthy forests has increased, resulting in a vicious cycle that exacerbates the already substantial challenges of environmental

degradation and diminishing agricultural productivity (His Majesty's Government, 2000).

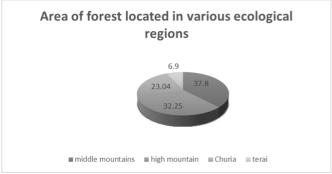


Figure 1: Area of forest located in various ecological regions

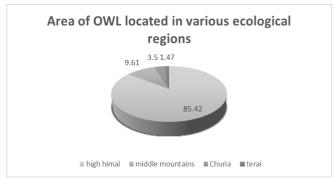


Figure 2: Area of OWL in various ecological regions

(Forest Resource Assessment Nepal & Nepal, 2015)

Various studies indicated that annual soil loss in Nepal ranges from 2-105 t ha-1 with 34% water-induced erosion, 60% mass wasting (geological erosion), and 3 % wind erosion. Other forms of land degradation like flooding (6%) and waterlogging (5%) are present in Nepal's bottom hills and plain areas. In total, 28% of the land is under degradation. Recently launched 20 years Agriculture Development Strategy envisioned reducing degraded land to 14%. Still, there need clear-cut directives and separate Land degradation management policies to address current degradation problems. The susceptibility of soils to water and wind erosion and workability is primarily determined by the erosive potential of the rainfall, slope of the land surface, slope orientation, relief, intensity, the position of the soil in the catchment, and the vegetative cover on the soil surface (Ojha & Chalise, 2016). The primary natural resources of Nepal are Soil& water. Agriculture is the principal source of income for her people. However, population pressure is overloading the production system. The farming of fragile land has further increased the soil erosion rate, which is already very high because the mountains are geologically young. Over the last century, the proportion of erosion induced by growing population pressures on a limited land base has increased considerably. Forest clearing, overgrazing, poorly maintained marginal, arable lands & fire have significantly altered the natural vegetation of Nepal, Leaving the soil exposed to massive degradation. Human factors such as unscientific cultivation, destruction of natural vegetation, improper land Use & haphazard construction, and natural elements such as fragile geology, steep slopes, & intensive monsoon rains have exacerbated erosion & resulted in the environmental degradation Of the country- the related problems of soil. Erosion & watershed degradation is the greatest stumbling block for the development of Nepal. They obstruct the aspirations of the government & the people. Unless appropriate measures are taken to resolve them, the country will suffer a great economic & environmental crisis. Realizing the far-reaching consequences of these problems, His Majesty's Government of Nepal has made every effort to reverse the trend of environmental deterioration (Pandey, 2012a).

#### 5. Roles of Forests in Soil Conservation

Watershed management relies heavily on forests (Indufor, 2016). Watershed management is a sound way to safeguard and restore regions prone to soil erosion and deterioration (FAO, 2021). Reforestation measures that restore and improve soil fertility have several advantages. Since forests play an important role in flood management, extensive afforestation of key river catchments is often recommended. Forest is capable of checking the occurrence of floods in the following ways.

- Evapotranspiration consumes a considerable amount of moisture.
- Interception of precipitation to prevent it from reaching the soil surface
- Increasing infiltration capacity of the soil.
- Increasing underground run-off and decreasing the surface run-off
- Reducing erosion and thus, reducing the silting of river beds.
- Improving soil characteristics for building underground water reservoirs

Forests serve an essential role in checking erosion of both water and wind. The main effect of vegetation is improving the infiltration so that there is less water to run off a source effect. It can also restrict the flow rate, the channel effect to diminish the more erosive efficiency of the moving water. The impact of a raindrop is also being reduced, which further reduces the removal of soil particles. Forests with a density of 0.3 are not very effective in controlling the run-off. After afforestation in the fully stocked plantation, small watersheds were effective in a total reduction of 28 % in run-off and 73 % in peak rate of run-off (IAS Exam Portal, 10:33:08 UTC).

- Soil composition and structure: Forest soils are more friable and crumbier. Forests make lighter soil (sandy) heavier and heavy soils (clay) lighter. The roots loosen the soil mass and, when they die, add organic matter to the soil. Porosity in the forest soils is increased because of the effect of organic matter addition through the root system.
- Soil Temperature: It is affected by forest cover due to reduction in insulation and radiation by the overhead forest cover and partly due to the insulating effect of the leaf litter and humus of forest cover.
- Soil Moisture: Forest tends to decrease the amount of soil moisture by intercepting precipitation, retaining water in the forest floor (litter), and by transpiration. They tend to increase the amount of soil water by reducing surface run-off, increasing permeability, decreasing evaporation, and increasing the water holding capacity and storage capacity of the soil.
- Water table: Forests lower the water table under all soil climatic conditions due to the effect of higher evapotranspiration and greater moisture uptake. It has been reported that trees such as Sal, Teak, and oak spread their roots in an area of 100 square meters and go more than 8 meters deep.
- Chemical Properties of Soil: The forest also improves the chemical properties of soil N, Ca, P, K, Mg, and other elements, which are made available in larger proportions. The Cation exchange capacity of soil is also improved. The pH of the forest soil is generally acidic.
- Water regime: The quality of water flowing in a forested area is better. It was reported that water flowing out of the forest area was of high purity, and pH was tending to be slightly acidic. The calcium oxide was the highest among the dissolved chemicals.

Trees have a variety of features that assist in preventing soil erosion, including an extensive root system, huge canopies, and the ability to transpire water. The extensive root system of a tree works as a bind towards any loss of soil around it. The roots maintain the soil in place while also supporting the tree and aiding soil drainage so that water flows into the ground rather than over the surface, preventing soil compaction.

Many trees have broad canopies that reduce the impact of rain on the ground, which helps to avoid soil erosion. Instead of hitting the ground with force, the water flows down the leaves and branches and soaks into the soil, reducing the quantity of soil swept away with the rain. Water flows throughout plants by transpiration, which sends water up the roots, up the stems, and out the leaves. Transpiration stops the soil from becoming excessively moist and heavy, reducing run-off and assisting the roots in anchoring the soil (Trees unlimited, 2018).

#### 6. Soil Conservation Practices in Forests

The major causes of degradation of the soil of forest are mainly due to conversion of forest land into agricultural land. Other reasons are due to natural causes such as soil erosion and a landslide, which is consequently caused due to various anthropological reasons. The soil fertility as expressed by organic carbon, total nitrogen, and cation exchange capacity decreased when the natural productive forest was converted into

agriculture. There was also a decline in soil quality when natural forests became degraded and over-utilized. Exchangeable bases, aluminum, pH, and compaction were significantly affected (Burton et al., 1989). Although the confounding influence of bulk-density changes may have overstated the extent of change in many studies, the conversion of forest to farmland generally results in soil carbon loss (Murty et al., 2021). Although surface erosion is a natural occurrence, it is worsened by surface disturbance and compaction, which lower soil hydraulic conductivity and cause soil aggregates to break down. Because of their disturbance, compaction, and connectedness, management activities and features such as roads and paths, agricultural cultivation, fire, land clearing, and recreation all exacerbate surface erosion processes. Because of their disturbance, compaction, and connectedness along hillslopes, management activities and features such as roads and trails, agricultural cultivation, fire, land clearing, and recreation all increase surface erosion processes. Mountain forest conversion to farmland or plantations permanently diminishes rooting strength, increasing the risk of landslides, whereas timber harvesting followed by secondary forest regeneration reduces rooting strength for up to two decades after initial cutting. [SidleRoy Sidle]

Average soil loss in the forested land was estimated to be 5.1t/ha/year, and in shrubland, it is about 12 times more (Chalise et al., 2019).

In the United States, abusive farming methods combined with drought caused the Great Dust Storms of 1934 and 1935, which transported huge amounts of soil from the Great Plains to the Atlantic Ocean. As a result of catastrophic storms, soil conservation became a national priority. In 1935, President Franklin D. Roosevelt signed legislation creating the Soil Conservation Service, responsible for implementing soil erosion prevention techniques. Later Soil conservation service was renamed to Natural Resource Conservation Service (encyclopedia). New terms and approaches to environmental conservation have emerged in recent years. Soil conservation in this context refers to both erosion control and fertility maintenance (Rijal, 2020).

## 6.1 Afforestation/ Planting of Trees

Large areas of the humid tropics are characterized by moderate to steep slopes, and agricultural plantation crops, such as tea, coffee, cacao, oil palm, rubber, and pineapple, are frequently grown in these areas. There have been cases of severe erosion, for example, under pineapple in Malaysia and on some tea plantations in Sri Lanka. A wide range of agroforestry systems falls under the practice of plantation crop combinations, having in common that an agricultural tree crop is grown in combination with other plants, which may be taller trees above it (as in systems of shade trees over tea, coffee, or cacao), another tree crop (as in coconut with cacao, or coffee with bananas) or an herbaceous crop. The component plants may be spaced either randomly, as is common in indigenous systems, or regularly, as on plantations (Gabrielmrisho, 2021).

The inclusion of compatible and desirable species of woody perennials on farmlands can result in a marked improvement in soil fertility. Agroforestry is only one potential approach to land use, which, if adopted properly, may prove superior to some other use approaches in some situations. Properly practiced, the system is likely to use the nutrients more efficiently and cost-effectively and to increase the sustainability of production from the land. However, the concepts have to be validated by field research before site-specific soil management practices can be recommended (Nair, 1993). Individual trees cannot be expected to exert the same protective effect as undisturbed forest ecosystems. The key to controlling erosion in agroforestry does not lie in the presence of trees themselves but rather in good management practices. Such management practices do not only include methods of maintaining a direct soil cover but may also entail structural measures such as terracing (Wiersum, 1984). Appropriate agroforestry systems improve soil physical characteristics, soil organic matter retention, and nutrient cycling. While there is evidence for the beneficial effects of various agroforestry methods on soils (particularly on more fertile soils), there is a risk of overgeneralization and extrapolation of soil productivity and sustainability benefits. It's past time to bring science into the picture and investigate the effects of agroforestry systems on various soils, as well as vice versa (Ballaré et al., 1987). Vegetations play a crucial role in erosion control on gullies areas and landslides. So, afforestation programs should be prioritized. Although reforestation is believed to decrease the amount of soil loss, the soil erosion may be much severe under certain conditions of mismanaged forest or grazing lands. It is advisable to keep litter or naturally occurring grasses on the surface of the soil to avoid the direct hitting of a raindrop. Large-sized plants leave to rise to a large drop of water. Such large water drops due to increased kinetic energy have more potential to detach soil particles. So, complete removal of litter and grasses should be avoided. Overgrazing of forests not only destroys natural vegetation but also compacts the soil, destroys aggregates, and ultimately reduces water infiltration. Grazing can be permitted to a limit, no causing any environmental hazard. Proper forest management though erosion under forest cover is less. Severe erosion may result when the hill forest area is subjected to clear feeling, selection or shelterwood system should be adopted. Trees also aid in the improvement of soil health. Their roots increase the soil's ability to absorb water and so reduce the risk of wind erosion. Fallen leaf litter adds fresh organic matter to the soil, which is an important component of creating new topsoil. Furthermore, trees provide shade, which helps to regulate soil temperature (Sheers, 2021).

#### 6.2 Agroforestry practices

Nepal is suffering the problems of less production from the agriculture field; Nepalese have a high dependency on the forest, cultivation on marginal land, and poor livestock breeds (Upadhyay, 2009). Besides agriculture and forestry crop cultivation, livestock raising is considered one of the major components of mountain farming in Nepal. Thus, the development of the agroforestry system has a great scope and is important to overcome these problems by planting trees in the bare land of forests. Agroforestry is a collective name for a land-use system in which woody perennials are grown with herbaceous crops and or animals on the same piece of land by the spatial arrangement or temporal sequence (FAO, 2020). Planting trees around and within croplands reduces soil water and wind erosion. Trees can also store N in the soil through biological nitrogen fixation. Large-scale adoption of fertilizer trees is a potential solution to

replenish Nitrogen to nutrient-starved soils. *Sesbania, Tephrosia, Gliricidia, Leucaena, Calliandra, Senna, and Flemingia* are some of the agroforestry species used for improving soil fertility (Blanco-Canqui & Lal, 2008b).

Agroforestry is a new term for the old practice of growing assorted varieties of trees and shrubs associated with field crops. Steep hills dominate about two-third of Nepal. High Himalayas (> 4000m), High Mountain (2000-4000m), Middle Mountains (2000-3000m), Siwalik (120-2000m), and Terai area are the five physiographic zones of Nepal (60-300m).

The agroforestry system practiced in these zones differs in many cases(Upadhyay & Yadava, 2009).

The forest canopy, roots, and leaf litter all play a part in soil erosion management. They can reduce water, soil material, organic matter, and nutrient losses by controlling run-off and soil erosion (Karki, 2021). An adequate proportion of trees in the agroforestry system-normally at least 20% crown cover of trees is required to maintain organic matter over systems as a whole. They can maintain more favorable soil physical properties than agriculture through organic matter maintenance and the effects of tree roots(Sheers, 2021).

Amatya (1994) highlighted the different agroforestry systems concerning the physiographic zone of Nepal.

Table 1: Agroforestry system regarding physiographic zone of Nepal			
S.N.	Physiographic Zone	Agroforestry Practices	Agroforestry Trees Species
1	Terai and Siwalik	Home garden Planting trees among crops Intercropping with horticultural trees Taungya Silvofishery Silvopastoral System	Albizia Species, Artocarpus lakoocha, Dalbergia sissoo, Eucalyptus camalulensis, Ficus semecordata, Gliricidin sepicum, Leucaena leucocephala, Populus species, Sesbania grandiflora
2.	Middle Mountain	Alley Cropping Home Garden	Albizia Species, Alnus nepalensis, Bauhinia species, Bassia butyracea, Erythrina arborescens, Ficus infectoria, Ficus neriifolia, Ficus semicordata, Garua pinnata, Litsea monopetala, Melia azaderach, Morus alba
3.	High Mountain	Silvopastoral System	Juglans regia, Populus species, Prunus cerasoides, Salix species, Sauraria nepalensis

Agroforestry has the potential to result in a more closed nutrient cycle than agriculture and hence to more efficient use of nutrients. Soil toxicities like soil acidification and salinization can be checked, and trees can be employed in the reclamation of eroded and degraded land. Agroforestry can supplement soil water availability to land-use systems (Karki, 2021). Agroforestry systems can benefit from increased nitrogen inputs from shrubs and nitrogen-fixing trees. By retrieving nutrients from lower soil layers and weathering rock, trees can likely enhance nutrient inputs to agroforestry systems. The decomposition of trees and pruning can substantially contribute to the maintenance of soil fertility. The addition of high-quality tree pruning leads to a rise in a significant amount of agricultural production. The release of nutrients as a result of the decomposition of tree remains can be done in conjunction with the requirements of related crops for nutrient uptake (Karki, 2021).

Agroforestry also helps to mitigate the danger of soil salinization, which is becoming more prevalent in dry and semi-arid areas. Planting trees in locations where soil salinity has damaged the land's productive potential has decreased salinity enough to bring formerly barren land back to life. Agroforestry controls soil erosion by checking run-off, grass strip, ditch, and bank structure (Young, 1989). There are no rules and principles for the selection of species under the agroforestry system. Popular species under cultivation are *Tectona grandis, Acacia nilotica, Dalbergia sissoo*, etc., raised in a different part of the world (Dwivedi, 1992). Forest has a role in soil conservation and provides nutrients (Rijal, 2020).

Agroforestry is a dynamic, ecologically based, natural resource management system that, through the integration of trees in farm- and rangeland, diversifies and sustains smallholder production for increased social, economic, and environmental benefits (RRB, 1996) Examples of the use of agroforestry for soil erosion control:

- Trees on terrace risers, Ethiopia (after a recommendation for trials in von Carlowitz, 1986c) (forest genetic resources information).
- Trees on risers of irrigated terraces, Nepal.
- Hedgerow intercropping with Leucaena laid out on a slope (after a photograph in Kang et al., 1984) (Kang & Miller, 1984).
- Model for land use as an alternative to shifting cultivation, north-east hills region, India (Young, 1989b)(after Borthakur et al., 1979).
- Plan view of suggested land use on slopes, combining barrier hedges with trees on grass barrier strips, Philippines (after Celestino. 1985) (Young, 1989).
- Possible development of reclamation forestry into productive use by selective clearance of contour strips (based on Poulsen. 1984; Young. 1985b).
- Supplementary use of trees in erosion control: Alnus nepalensis on banks of terraces irrigated for rice; the tall, narrow form is the result of repeated pruning. Kathmandu, Nepal.

# 6.3 Community Forest management in Nepal

In Nepal, community forestry is one of the most well-known participatory forest management initiatives. As of 2011, a total of 2.1 million households

(about 40% of the country's total) are managing almost 1.6 million hectares (27.4 percent of the country's total) of national forests as community forests through 17,685 Community Forest User Groups (CFUGs) (Forestry facts, 2017). The Government of Nepal has the policy to maintain 40% of the land with forests. The Government of Nepal has the policy to maintain 40% of the land with forests. Community-based forestry methods have proven to be effective in reclaiming degraded areas. As a result, forest areas and conditions in Nepal's central mountains have improved. The major classifications of forests depending on land ownership are national forests and private forests. However, there are no statistics on the size of private forests. Government forests have been divided into five categories based on management aims and management rights: government-managed forest, community forest, leasehold forest, religious forest, protected forest, and forest under the protected areas systems (Upadhyay, 2009). Community-based forestry is the second largest forest management regime after the government-managed forest. In this strategy, government forests have been handed over to the local communities for their autonomous management and use. More than 19000 community-based forest user groups are managing about 25% of the total national forest area (Ministry of forest and soil conservation, Nepal, 2009). The paper concludes that all forest management practices, including private forestry, agroforestry, participatory forestry, sacred/religious forestry, and protected forestry, would be the best for meeting the twin objectives of forest conservation and utilization if forests are managed on a sustainable basis. The proportion of conservation and management may vary based on the objective. Because "sustainable forest management (SFM) is "the stewardship and use of forests and forest areas in a manner, and at a rate, that maintains their biological diversity, productivity, regeneration capacity, vitality, and their potential to fulfill, now and in the future, relevant ecological economic and social functions, at local, national and global levels, and without causing damage on other ecosystems" (Pandey, 2012b).

Community forestry was initially defined, by FAO, as "Any situation in which local people are intimately involved in a forestry activity." It encompasses a wide range of situations, from woodlots in areas where wood and other forest products are in short supply for local needs, to the growing of trees on farms to provide cash crops and the processing of forest products at the household, artisan, or small industry level to generate income, to the activities of forest dwelling communities" (FAO). The Community Forestry program was formally launched in Nepal in 1978 with the enactment of the Panchayat Forest Rules and the Panchayat Protected Forest Rules. The Community Forestry policy, along with Community Forestry legislation, has been continuously reformed over time (ACHARYA, 2002).

The study done by a team of scientists in Indonesia found that Hutan Desa (village forest) Reduced deforestation and poverty were linked. In 51% of cases, 'win-win' outcomes were found, which included (a) positive outcomes for both forests and poverty, (b) a positive outcome for one aspect but a negligible outcome for the other, or (c) a positive outcome for poverty in areas where the natural forest was already scarce prior to Hutan Desa tenure(Santika et al., 2019).

### 7. LANDSLIDE CONTROL IN FOREST LAND

Slumps, rock falls, debris slides, and earth-debris and mud-flows all fall under the category of landslides. Changes in slope stability generate landslides, which can be shallow or deep-seated. Logging, road and track construction, and forest conversion are the activities that contribute to erosion and slope instability in the uplands. The construction of roads without proper surveys to avoid budget freeze has been the major cause of landslides in various spots of the hill districts of Nepal (Forbes et al., 2011). To reduce soil erosion and protect soil, the earth needs sustainably maintained forests. Tree roots stabilize ridge, hill, and mountain slopes and supply the soil with the mechanical structural support required to avoid shallow landmass movements: landslides are rare in areas with dense forest cover (trees unlimited, 2018). Bedrock features, hillside hydrology, slope gradient, length and curvature, and soil depth and type all influence landslide risk and stabilization procedures. The amount of vegetation cover also matters. By fortifying soil layers and enhancing drainage, deep-rooted trees and shrubs can lessen the likelihood of shallow, swiftly moving landslides. Roots may penetrate the entire soil mantle in shallow soils, giving anchors into more stable layers and stabilizing soil surface layers against landslides. Transpiration through broad root systems also lowers soil water content and the risk of landslides. Forests can also help to reduce pollution by attenuating and blocking smaller debris flows and rockfalls by forming a physical barrier. Across much of rural Asian countries like Nepal, upland roads are often built in conjunction with agricultural or forestry activities without adequate attention to engineering standards and, as such, are a frequent cause of landslides (Forbes et al., 2011). Following landslides, early stabilization of damaged locations can assist minimize ongoing stream sedimentation, avoid additional landslides and mudflows, and help local inhabitants re-establish their livelihoods. It takes time for microbial and nutrient biomass to regenerate, and other species may be better suited to new circumstances than those that were previously present. Rapid, effective reforestation using bigger seedlings reduces the time without vegetative cover or root reinforcement, and higher seeding densities may result in more rapid canopy development and root recovery, and ultimately soil conservation (Forbes et al., 2011)

#### 8. CONCLUSION

The forest ecosystem is the heart of human civilization. Without it, the existence of the human population is impossible. But forest and forest soil require various management and conservation practices to minimize the exploitation of forest lands. Hence from making appropriate policies to various practices, this article tries to explain the approaches of soil conservation in the forest of Nepal. Forest ecosystems are built on the foundation of soils as they aid in the regulation of essential ecosystem processes like nutrient uptake, organic matter decomposition, water storage, and providing tree anchorage. In turn, trees and other plants, and vegetation play a vital role in forming new soil as leaves and other vegetation rot and decay. In this way, soil erosion, deforestation, overgrazing, unscientific farming in the sloppy lands, haphazard construction of roads, etc., are the main drivers of soil degradation in the forest lands of Nepal. As a result, agroforestry, afforestation, and community forest management are effective soil conservation practices to cope with soil erosion and landslides in the present situation. New studies and investigations are still needed to encourage the adoption of more scientific practices in the future.

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