F.R.I Leaflet No. 9/ 80-81

Government of Union of Myanmar
Ministry of Forestry
Forest Department

Aggregate Stability of East Pegu Yoma Forest Soils

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February, 1981

အရှေ့ပဲခူးရိုးမ သစ်တောမြေများ၏ တည်မြဲမှု

စိန်သက်
သစ်တောသုတေသနဌာနခွဲ
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စာတမ်းအကျဉ်းချုပ်

အရှေ့ပဲခူးရိုးမ သစ်တောစိုက်ခင်းစီမံကိန်းအနေဖြင့် သဘာဝတောများကို ခုတ်ထွင်ရှင်းလင်း၍ ကျွန်းနှင့် အခြားအဘိုးတန် သစ်မာများပြန်လည်စိုက်ပျိုးရန် စီစဉ်ဆောင်ရွက် လျက်ရှိပါသည်။ ယင်းသို့ ဆောင်ရွက်ရာတွင် သဘာဝတောများကို ခုတ်ထွင်ရှင်းလင်းချိန်မှစ၍ အပင်များက မြေသားကို အကာအကွယ်ပေးနိုင်သည့်အချိန်အထိ၊ အနည်းဆုံး (၃) နှစ်မှ (၅) နှစ်တိုင်အောင် မြေပြိုတိုက်စားမှုများ ဖြစ်ပေါ်လေ့ ရှိပါသည်။ ဤစာတမ်းတွင် အရှေ့ပဲခူးရိုးမ သစ်တောမြေများ၏ တည်မြဲမှုနှင့် သစ်တောစိုက်ခင်းအချို့၌ ဖြစ်ပေါ်လျက်ရှိသော အလွှာလိုက် မြေပြိုတိုက်စားမှုများ အကြောင်းကို တင်ပြထားပါသည်။ သစ်တောစိုက်ခင်းများ တည်ထောင်ရန်နေရာ ရွေးချယ်ရေးနှင့် ကာကွယ်မှု လုပ်ငန်းများအကြောင်းကိုလည်း အကျဉ်းချုံး၍ ဆွေးနွေးတင်ပြ ထားပါသည်။

Aggregate Stability of East Pegu Yoma Forest Soils.

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Abstracts

Burma Forestry II Project is launching a large scale Planting scheme in the East Pegu Yoma. Clearing of natural forests for planting has produced problem of erosion. It occurs usually for a period of three to five years from the time of clearing of the natural vegetation until there is enough soil cover to check the erosion. This paper describes aggregate stability of forest soils and sheetwash erosion in some part of East Pegu Yoma Project area. Result, selection of sites, and control measures are also discussed.

Contents

Aggregate stability of East Pegu Yoma Forest Soils

1. Introduction

The forests of Burma which cover about 57% of the total land area of the country play a vital role in timber production and soil stabilization. With an expanding forestry programme in utilization, management, conservation, and particularly development of improved silvicultural treatments to ensure the perpetuation of the most commercially valuable species in a desirable forest structure, it is very important to know the condition of forest soils and its relationship to forest tree species. Burma forestry II Project is launching a large scale planting scheme in the East Pegu Yoma and almost 36, 000 acres of forest plantations are to be established within a period of five years.

Forests are very effective in controlling erosion, especially if they are undisturbed. The tree canopy intercepts rainfall and reduces its energy. Drops that reach the ground are quickly taken-up in the leaf litter and from there into the highly porous soil surface. However, clearing of natural forests for planting of valuable species (Teak, Pyinkado, Padauk) has produced problems of erosion. A period of three to five years occurs from the time of clearing of the natural vegetation until there is enough soil cover to check the erosion.

This study is concerned with testing aggregate stability (which is one of indices of soil erodibility) of East Pegu Yoma Forest Soils, and field studies of sheetwash erosion in some part of plantation in East Pegu Yoma Project area after one season of rain. Discussion of the results, suggestion for control measures and site selection are also included.

2. Literature Review

Erosion is a work process, caused by the falling raindrops and surface run-off. The process begins when raindrops strike the surface of the soil and break down the clods and aggregates. During rainfall, both falling raindrops and flowing water are active in loosening and transporting the loose soil particles. Systematic valuation of the factors affecting erosion started in the 1930' recognized that the severity of erosion depended upon the action and interaction of climate, vegetation, topography and soil. Later, in 1956, he included human activities and summarized the factors affecting erosion in the forms:

$$E = f(C, T, S, V, H)$$

Where E = Erosion
C = Climatic factor
T = Topographic factor
S = Soil factor
V = Vegetative factor and
H = Human factor

In the early 1930's attempts were made, with varying success, to relate some of the easily measurable physical and chemical properties of soil to erosion. The properties of soil related to erodibility can be classified as:

(i) Those that resist detachability and transporting forces of rainfall and run-off, and
(ii) Those that effect the infiltration rate and permeability.

The stability of soil crumbs was studied by Emerson (1954 and 1964). He determined their resistance to breakdown in water, and found that the factors governing the breakdown of dry aggregates, when wetted by a liquid, were slaking of the aggregates and dispersion of the clay in the aggregates. Kemper and Chepil (1965) defined an aggregate as a group of two or more primary particles which cohere to each other more strongly than to surrounding particles. The degree of aggregation (amount of granulation) of a soil plays a very important role in the erodibility of soil. Aggregation increases porosity and consequently the rate of water absorption and percolation, and decreases the ease of dispersion making it more difficult to detach the soil particles so that a higher velocity is required to transport soil (Baver, 1933).

Soil erodibility may be assessed either by actual measurement of soil loss under controlled conditions, or by the isolation of certain soil properties as indices of erodibility (Bryan, 1968). Measurement of soil loss under controlled conditions requires elaborate installations and observation for lengthy periods, whereas indices of erodibility can usually be derived from normally analytical data and therefore require little special equipment.

The important soil properties investigated and measured as indices of erodibility are dispersion ration, clay ratio, aggregate stability, porosity and bulk density, organic matter content and particle size distribution of the soil. Adams et. al; (1958) used the dispersion ratio and aggregate stability in a study of the erodibility of some Iowa soils, and compared the results with infiltration rates, run off and erosion values obtained under simulated rainfall in the field. Stability of the uppermost centimeter of soil was an important factor affecting infiltration and erosion.

There are many methods, all of which are more or less empirical, for determining the stability of soil aggregates. Although Williams et. al; (1966) stated that the recorded water stability of the aggregates depends, to a certain extent on the method of analysis, Bryan (1968) found that the water drop method of testing proposed by Mc Calla (1944) would appear to be the most appropriate technique to use in studies of the resistance of aggregates to dispersion by high-velocity rain drops.

2.1 East Pegu Yoma Plantation Project Area

The project area lies on the eastern slopes of Pegu Yoma, bounded on the west by its central ridge and on the east, the boundary extends beyond the Sittang river. It covers six Forest Divisions, namely South Pegu, North Pegu, South Toungoo Forest Division rises abruptly from the plain up to a height of 800 feet above mean sea-level, and the country lying to the west of this ridge is hilly with steep slopes.

Most of the rainfall occurs during the period of May through October. Though There are a few showers in April and December these do not contribute much to the annual total. Average annual rainfall and average mean daily temperature from 1970 to 1977, recorded from the meteorological stations at Pegu, Toungoo and Pyinmana are: -

Table 1. Average Annual Rainfall and Mean Daily Temperature.

Station	Average annual rainfall (mm)	Average mean daily temperature (°c)	
		Max:	Min:
Pegu	3594	36.4	16.1
Toungoo	2057	37.0	14.2
Pyinmana	1494	36.7	14.3

Most of the project area is composed of soft Tertiary Sandstones. Yellow Brown Forest Soils are dominant within the area, and Red Brown Forest Soils are also present in moister parts of the area. The Soils are shallow, friable, well structured, with a loamy texture.

Nitrogen and phosphorus for most tree growth. The Soil reaction is slightly acid with a pH of 5.5 to 6.5.

The chief determining factors in forest distribution throughout the project area are rainfall and configuration. The five main forest types found in the area are as follows.

(a) Evergreen Forests.
(b) Moist Upper Mixed Deciduous forests.
(c) Dry Upper Mixed Deciduous forest.
(d) Lower Mixed Deciduous forests.
(e) Dipterocarp forests (Indaing).

3. Methods

Four plantation sites, one in each division of four forest divisions (South Toungoo, North Toungoo, Pyinmana, Yamethin) were selected for soil aggregate stability test. In each site, five surface soil (0-8cm) samples were collected, placed in a separate labelled plastic bag and taken immediately to the laboratory.

To determine the aggregate stability of soil samples, a procedure was adopted from a method used to determine the effect of microbiological and organic matter treatments on the resistance of soil structure groups or clods to the action of raindrops (McCalla, 1944). A soil lump weighing 0.3 gms was placed on a 1mm screen and hit by drops of distilled water 4.8mm in diameter and falling 25 cm from a constant-head burette. A rate of one drop per 2.6 seconds was used; temperature of the distilled water was (30˙C - 35˙C). The soil lump or aggregate was considered as destroyed when it was broken down and washed through the screen. The number of drops required to start breaking the lump and the total number of drops to destroy it were recorded. Five replicates were run on each soil sample and the mean value of the number of drops required was calculated on the basis of 0.1 gm sample i.e. measured number of drops was divided by three.

For sheetwash erosion study, South Toungoo Forest Division center (Kabaung Reserve, compartment 221) was selected. Five (0.2 hectare) plots were located subjectively, based on slope steepness and aspect. Method of measuring sheetwash erosion was based on Dunne (1977). Within each plot, four rows of eight stakes (32 stakes) were placed along the contour. Stake (15cm x 5cm x 2.5cm) with a mark at the center was driven into the soil until the mark levelled with the ground at the time of installation. During the rainy period sheetwash erosion from around and beneath the mark lowered the ground level. The difference between the mark and the ground level provides a measure of the sheetwash erosion rate during the period.

4. Results and Discussion

Mean values of the number of water drops required to start breaking, and to destroy, the soil aggregates are shown in Table 2.

The number of water drops required to start breaking the aggregate is highly correlated (0.9) with the total number of water drops required to destroy them. Within the study area, Ngalaik soil appears to be the most stable while Minbyin soil is the least stable. However they are not significantly different.

Table 2. Summary of Aggregate Stability of Surface Soil.

Forest Division	Site	No. of Water Drops / 0.1 gm soil			
		Start to break	To destroy		
		Mean	Mean	Max:	Min:
South Toungoo	Kabaung	12.5	16.4	22.4	7.5
North Toungoo	Saingyane	11.2	16.3	16.8	15.4
Pyinmana	Minbyin	10.8	18.7	30.1	7.3

Bryan (1968) concluded that aggregate is the most important soil property governing resistance to erosion in many soils, and the most profitable field for further study in indexing soil erodibility would be aggregate stability and distribution.

Sein Thet (1975), using water-drop method of McCalla (1944) tested aggregate stability of the Lower Cotter Catchment soils of the Australian Capital Territory. He found that mean values of the number of water drops required to destroy 0.1 gm of granite and shale soils were 43.3 and 31.3. He also stated that both of those granite and shale soils were liable to erosion when exposed. Thus according to this observation, all soils of East Pegu Yoma sites appear to be very unstable and are liable to erosion when exposed due to clearing of natural vegetation.

Sheetwash erosion rate of Kabaung soils are shown in Table 3.

Table 3. Summary of Sheetwash Erosion of Kabaung Soils.

Plot	Slope		Sheetwash Erosion Rate (Depth in Cms)			Crop
	Steepness	Aspect	Mean:	Max:	Min:	
1	21˙(38%)	SE	1.0	4.3	0.3	Teak, Pyinkado, Paddy
2	22˙(41%)	NW	1.0	4.8	0.3	Teak, Kha-yan
3	25˙(47%)	W	1.2	4.1	0.3	Teak, Pyinkado, Maize
4	27˙(50%)	SE	2.3	5.1	0.5	Yinma, Yamane, Chinbaung
5	32˙(62%)	SE	1.4	3.3	0.3	Yinma, Pumpkin

Sheetwash erosion is directly correlated with the slope steepness, but not aspect. Abruptly increase in sheetwash occurred at 50 percent slope but again slightly decreased at 62 percent slope with some ground cover of pumpkin.

Packer (1963)prescribed ground cover density of at least 70% to maintain soil stapility. Meeuwig (1970) applied simulated rain to small plots on seven mountain rangeland sites in Utah, Idaho and Montana, and found that the magnitude of erosion depended primarily on the soil surface protected from the direct raindrop impact by plants, litter and (in some cases) stone. This study supported that sheetwash erosion at 62% slope without ground cover. The study also indicated that at some stakes, tremendous amount of sheetwash erosion occurred, I.e. nearly half (4cms-out of 10 cms)of top soil (A horizon)was washed away within five months, starting from date of installation (30-5-80) to first measurement date (26-10-80).

5. Conclusion

At all sites within the study area, East Pegu Yoma Forest Soils are unstable and are liable to erosion. It shows that sheetwash erosion increases with slope steepness, and abruptly increase in sheetwash occurs at 50% slope. It also indicates that with some ground cover like pumpkin can reduce the sheetwash erosion. So, selection of sites for plantation plays a very important role against erosion at East Pegu Yoma Project Area. It is wise to avoid steeply dissected area where slope steepness in 50% and more. One control measure suggested is to keep the soil ground cover as much as possible, from the time of clearing natural vegetation to the stage of plantation where there is enough vegetative cover to protect soil from rain water erosion.

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