Site Classification in Pantabangan Area, the Philippines

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Introduction

Pantabangan area in the northern part of Neuva Ecija Province in the Central Luzon is located along the upper course of the Pampamga River which runs through the Manila Plain, and is one of the most important watersheds in the Republic of the Philippines (Fig. 1). It is said that the area used to be covered

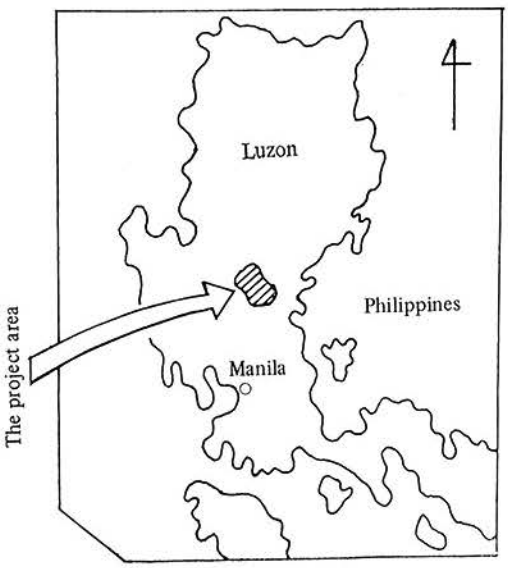

Fig. 1. RP-Japan technical cooperation project site

with a tropical rain forest mainly composed of Dipterocarp trees, and the soil there used to be fertile. But the forest has been completely destroyed in these hundred years by reckless cutting, shifting cultivation (Kaingin), over-grazing, and repeated burnings and the area has been completely changed into open grasslands and other denuded lands totalling to nearly 50,000 ha, and the soil conditions such as physical and chemical properties also have gone from bad to worse. Therefore, the land productivity has become very low, and land collapses and sheet erosions (Plate 2) have occurred in many places. It is now recognized that the area should be afforested as soon as possible not only for the cultivation of woods and restoration of water resources but also for land conservation.

The Republic of the Philippines-Japan Technical Cooperation Project for the afforestation of the Pantabangan area was launched in late November 1976 in order to develop various techniques which can contribute to successful afforestation of the area. The Project has set-up an experimental forest of 8,100 ha composed of Parcel I, II and III (Fig. 2 and Plate 1).

Site factors of the area

1) Climate

The area belongs to the tropical monsoon

Plate 1. Project site (Parcel I and II)

Plate 2. Landslide (Type I)

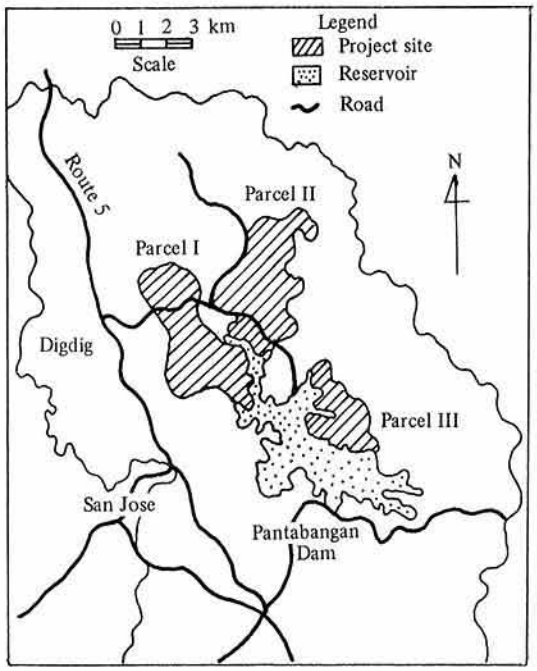

Fig. 2. RP-Japan Technical Cooperation Project site

climate (W. Köppen 1918), and is usually subjected to the very severe dry season for more than a half year: from November to May. The average annual rainfall is 1,965 mm, but it ranges from 1,531 mm (1975) to 2,342 mm (1972) with years, and most of the rainfall is concentrated in the rainy season, from June to October. The average annual temperature is 28°C, and it is characterized by the fact that the difference between the maximum and the minimum mean monthly temperatures is smaller than the diurnal temperature fluctuations.

2) Geology

The geology of the Parcel I is mainly composed of alternation of unconsolidated sand and gravel deposits and shale of Neogene period. Parcel II and III are mainly composed of igneous rocks such as diorite and andesite of Neogene period, and metavolcanics of Cretacious period.

3) Topography

The topography of Parcel I is mostly composed of rolling hills ranging from 250 to 350 m above sea level, while Parcel II and III are mountaneous, and in the former the altitude ranges from 250 to 800 m and in the latter from 250 to 600m. There is a small part of rolling hills ranging from 250 to 350 m above sea level in Parcel III. In every parcel, the geomorphic surfaces such as gentle summits, ridges and convex slopes are geologically rather old, while the ones such as concave and steep slopes are rather young due to the recent dissective action.

4) Vegetation

All the project sites are, as mentioned above, widely occupied by open grasslands except natural Benguet pine (*Pinus insularis*) forests on the ridges higher than 700 m above sea level and unburnt narrow ribbon forests of Dipterocarp trees along the streams. The composition of the open grasslands is rather simple, being mainly composed of only a few grass species such as *Imperata cylindricum* (cogon), *Themeda triandra* (samon) and *Saccharum spontaneum* (talahib), and as for a ligneous plant *Bauhinia malabarica* (alibangbang) which is a fire-resistant leguminous plant is only scattered.

Themeda triandra is generally distributed on the geomorphic surfaces which are liable to dry such as ridges, the upper part of slopes and residual convex slopes, while *Imperata cylindricum* and *Saccharum spontaneum* are

mainly distributed on geomorphic surfaces which are comparatively abundant in water supply such as concave slopes and gentle slopes at down hill side.

5) Soil

Soils in this area are more or less denuded of their surfaces and they are strongly degraded of their physical and chemical properties due to the repeated burnings of herbaceous vegetation for a long time. They are generally classified into six orders such as Ultisols, Oxisols, Alfisols, Inceptisols, Entisols and Vertisols by American Soil Classification System (Soil Taxonomy 1975).

Ultisols and Oxisols are generally found on stable old geomorphic surfaces such as ridges and convex slopes, while Alfisols and Inceptisols are found on rather young geomorphic surfaces such as straight and concave slopes and the foot of slopes. Entisols are found on very steep slopes which have been dissected lately, and Vertisols are found on very gentle slopes at the foot of slopes and flat plains.

They have been further divided into Suborder, Great Group, and finally Subgroups according to their characteristics.

Site classification

As mentioned above, there are only two seasons in this area; dry and rainy seasons, and the precipitation of about 2,000 mm concentrates only in the rainy season from May to October while there is little rain in the dry season from November to April. Consequently, in the rainy season, the soils such as albic, aquic and vertic subgroups which are found on the flat plain and gentle slopes at the foot of slopes and concave slope are saturated with water and sometimes have stagnant water in the solum. The root system of planted trees may have very hard times in those circumstances. On the other hand, in the dry season, the surface of soils especially litic and ochric subgroups which are distributed on ridges, steep slopes and convex slopes becomes rather dry, but the subsoil does not dry up so much due to the protecting effect of the dried surface horizon. Therefore, there is a fair chance for newly planted trees even on those soils to live through the dry season if their root system has been able to reach the subsoil by the end of the wet season in which they are just planted. For that reason, surface raking before planting is advisable in most cases if there is little danger of soil erosion.

By taking into due consideration these things mentioned above, site classification in Pantabangan area has been made on the basis of topography, vegetation and soils, as follows;

Type I

Topography: Sharp crested ridges or steep slopes (>28°)
Vegetation: *Themeda triandra* or *Imperata cylindricum*
Soils Lithic—Ochric Troporthents or Dystropepts

On the geomorphic surfaces of this type there goes rather active sheet erosion, so that the soils are rather gravelly and immature, low in humus and base contents, and infertile. They are naturally not competent for timber production but are very important for land conservation, so that the replanting must be done in a hurry with species such as *Gliricidia sepium* (Kakawati), *Vitex parviflora* (Molave), *Gmelina arborea* (Yemane) and *Leucaena leucocephala* (Giant Ipil-Ipil).

Type II

Topography: Gentle convex ridges or the upper part of slopes
Vegetation: *Themeda triandra*
Soil: Ochric — Typic Tropudults or Haplorthox

The soils of this type which are distributed on the old residual geomorphic surfaces have been exposed to considerably accelerated leaching of bases and argillation by weathering for a long time, and the supply of organic matter which is the very important energy source for soils has been cut off due to the repeated burnings of the open grasslands. Therefore, they are greatly degraded and the

soil conditions such as physical and chemical properties have been deteriorated. In considering the environmental conditions, stagnation of water in the solum during the rainy season is out of question, but the solum, especially surface horizon, becomes very dry in the dry season. Drought resistant and deep-rooted species such as *Vitex parviflora, Gmelina arborea, Piliostigma malabarica, Pinus caribaea* (Carribean pine) and *Pinus insularis* (Benguet pine) are suitable for the afforestation. Surface raking before planting is very advisable.

Type III

Topography: Convex or straight slopes (10–28°)
Vegetation: *Themeda triandra* or *Imperata cylindricum*
Soil: Typic—Umbric Tropudults, Tropudalfs or Haplorthox

In this type, solums are rather deep and the soil structure is moderately developed, so that the soil conditions are not so bad. But as the solumns become rather dry during the dry season, a consideration must be paid in selecting planting species as in the case of Type II. It is advisable to plant *Acacia auriculiformis* (Acacia "auri"), *Samanea samon* (Rain-tree), *Pterocarpus indicus* (Narra), *Tectona grandis* (Teak), *Swietenia macrophylla* (Large-leaf mahogany), in addition to the species listed above for the Type II.

Type IV

Topography: Concave slopes (10–28°)
Vegetation: *Imperata cylindricum* or *Saccharum spontaneum*
Soil: Umbric—Albic Tropudalfs or Tropudults

In this type area, water and nutrients are apt to accumulate in the solum physiographically, and the solum is rather deep and the soil structure is fairly developed, so that the soil is very productive. In most cases, albic horizon which is generally formed by removal of clay and/or free iron oxides is observable in the surface horizon. Therefore, it seems that the solum is saturated with water for a certain period during the rainy season. And even in the dry season, the capacity of water supply of the soil is rather high, and consequently this type area is one of the most suitable site in Pantabangan area for an artificial planting of most species particularly broad-leaved trees such as *Tectona grandis, Pterocarpus indicus* and *Swietenia macrophylla* in order to develop an economically feasible forest.

Type V

Topography: Piedmont gentle slopes (<10°)
Vegetation: *Imperata cylindricum* or *Saccharum spontaneum*
Soil: Albic—Aquic Tropudalfs or Tropudults

In general, the physical properties of the soil are rather bad, and the solum is sometimes over-saturated with water and tends to be reductive during the rainy season. But, as the chemical properties are not so bad, the soil productivity is not so low. This type area is not suitable for silviculture of pines, but is suitable for all other species mentioned in Type IV. Surface raking before planting is recommended.

Type VI

Topography: Piedomont gentle slopes (<10°)
Vegetation: *Themeda triandra*
Soil: Aquic—Vertic Tropudults or Tropudalfs, or Chromusterts

The soils on gentle slopes at down hill side where *Themeda triandra* thrives are heavily clayey, with extremely poor permeability of air and water, and the solum has stagnant water, causing a reducing condition during the rainy season, while during the dry season it has deep wide cracks and dries up to a certain depth. It is one of the most unsuitable soil for afforestation in Pantabangan area. Therefore, it is very difficult to establish an artificial plantation. It is advisable to adopt the mound planting method with *Acacia auriculiformis Pterocarpus indicus, Swietenia macrophylla, Casuarina equisetifolia* and

Table 1. Site classification in Pantabangan area

Type	Topography	Vegetation	Soil	Remarks
I	Sharp crested ridges or steep slopes (>28°)	*Themeda triandra* or *Imperata cylindricum*	Lithic-Ochric Troporthents or Dystropepts	Erosion control
II	Gentle convex ridges or the upper part of slopes	*T. triandra*	Ochric—Typic Tropudults or Haplorthox	Dryness
III	Convex or straight slopes (10–28°)	*T. triandra* or *I. cylindricum*	Typic—Umbric Tropudults, Tropudalfs or Haplorthox	
IV	Concave slopes (10–28°)	*I. cylindricum* or *Saccharum spontaneum*	Umbric—Albic Tropudalfs or Tropudults	Productive
V	Piedmont gentle slopes (<10°)	*I. cylindricum* or *S. spontaneum*	Albic—Aquic Tropudalfs or Tropudults	Productive
VI	Piedmont gentle slopes (<10°)	*T. triandra*	Aquic—Vertic Tropudults or Tropudalfs, or Chromusterts	Heavy clay

Table 2. Relationship between the classified site types and main planting species in Pantabangan area

Species	Classified site types					
	I	II	III	IV	V	VI
Gliricidia sepium (Kakawati)	+	+	+	+		
Vitex parviflora (Molave)	+	+	+	+		
Gmelina arborea (Yemane)	+	+	+	+	+	
Samanea samon (Rain-tree)	(+)		+	+	+	
Leucaena leucocephala (Giant Ipil-Ipil)	+		(+)	+	+	
Piliostigma malabarica (Alibangbang)	+	+	+	+	+	(+)
Pinus caribaea (Caribbean pine)	+	+	+	+		
Pinus insularis (Benguet pine)	+	+	+	+		
Acacia auriculiformis (Acacia "auri")			+	+	+	(+)
Tectona grandis (Teak)			+	+	+	
Pterocarpus indicus (Narra)			+	+	+	(+)
Swietenia macrophylla (Large leaf Mahogany)			(+)	+	+	(+)
Casuarina equisetifolia (Agoho)				+	+	(+)

( ): Applicable

Piliostigma malabarica, though their mortality will be high.

The results mentioned above are summarized in Tables 1 and 2.

This site classification was originally designed for the purpose of successful afforestation, erosion control, and protection and improvements of watersheds in the Pantabangan area. Therefore, it is not directly applicable to all the tropical and subtropical regions in general but the fundamental principle of the basic concept and method of classification based on climate, geology, topography, vegetation and soils will be very useful for the establishment, maintenance, and protection of forest plantations in other areas of subtropical and tropical regions.

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