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THE APPLICATION OF SOIL SCIENCE TO FORESTRY IN LAND USE PLANNING AND WATERSHED MANAGEMENT IN SRI LANKA

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ABSTRACT

Allocation of land to forestry in Sri Lanka has hitherto been based on *ad hoc* considerations. The overriding approach has been to allocate the least productive soils to various forms of forestry. Furthermore, even current recommendations of forest species for forestry plantations are made mainly on the basis of climate or geographic region with no recognition given to the occurrence of different kinds of soils within a particular region.

Some very striking and significant soil-vegetation relationships have been observed and described, especially in the dry and intermediate zones of this country, by several field scientists and researchers engaged in the Soil Survey of Sri Lanka since the early nineteen sixties. In several recorded instances it has been observed that the nature of soil exerts a profound influence on the growth and performance of some species that make up the "dry-mixed-evergreen" forest. Some relevant examples are cited and further discussed.

Soil related factors should, therefore, be considered as having a very important bearing on species performance and forest productivity on different kinds of soils occurring within the same agro-ecological region. Meaningful land use planning for forestry should, therefore, be based on a proper understanding of the soil-vegetation relationships. Supporting examples are cited and discussed. An argument is also made for allocating land with better quality soils for commercial forestry plantations.

A proper recognition of the soil water-vegetation-evaporation balance in different environments is considered the key to understanding the role of forests in watershed management both in the dry and the wet zones of this country. Based on studies conducted by the Land Water Use Division of the Department of Agriculture over the last two decades, the selective role of a forest cover in the different environments (dry and wet) of the country are discussed in relation to watershed management.

INTRODUCTION

Allocation of land to forestry in Sri Lanka has hitherto been based on *ad hoc* considerations. The overriding approach has been to allocate the least productive lands to

various forms of forestry. This rationale may have been acceptable during a period when forestry focused on environmental conservation and the preservation of forest cover on a certain percentage of the country's land - rather than considering forestry as an economically competitive enterprise.

Matching the areas that have been demarcated under the category of 'Proposed Forest Reserves' as outlined in the Land Use Committee Report of 1967 and supporting maps against the recent Soil Map of Sri Lanka (1988), shows that the very gravelly, shallow and stony soils have been allocated for forestry and that the deeper, non-gravelly soils have been allocated for various forms of irrigated and rainfed agriculture.

It is also observed that the current recommendations of forest tree species for forestry plantation are made mainly on the basis of climate or geographic regions with no recognition given or reference made to the occurrence of different kinds of soils within a particular region. Hence the importance of using soils information in land use planning for forestry.

In considering the role of a forest cover in the overall hydrological balance, there is no clear understanding of the selective role of forests in the dry zone versus the wet zone environments. Basic information is now available to distinguish between these selective roles in the two contrasting environments, and this should now be applied in future strategies regarding the role of forests in land and water conservation.

PAST STUDIES ON SOIL-VEGETATION RELATIONSHIPS

A few selected studies have been carried out by several workers in the past on soil-vegetation relationships in this country. Joachim and Kandiah (1942) studied the reasons for the existence of Kekilla fernlands and Patana grasslands side by side with forests. They concluded that soils under Kekilla were essentially the same as those of the adjacent forest and that the soils of the Patanas differed appreciably from those of the adjacent forest in their chemical characteristics. They further observed that the Kekilla fernlands and Patana grasslands were ecological successions brought about by the clearing and periodic burning of the secondary vegetation.

Holmes (1951) studied the `grass, fern and savannah' lands and arrived at conclusions regarding their origin and development. De Rosayro (1956) examined some edaphic relationships in the tropical dry mixed evergreen forest and also in some grasslands and savannas. Abeywickrema (1959) studied the natural vegetation in greater variety and extended his research to marine, salt marsh, mangrove, sandy shore, dune and marsh vegetation; and he also attempted a correlation with soils.

In a very significant study reported by Koelmeyer (1957), the performance of teak in relation to geology and soils is discussed. It was concluded that site suitability is related to the depth of soil and its moisture conditions. Panabokke and Somasiri (1968) have reported on the edaphic and biotic factors that govern the development of the `damana'

grasslands of the Tamankaduwa area from observations they made while conducting soil surveys of the area. They observed that on the strongly alkaline solodized soils, the vegetation is almost exclusively a sparse grassland but with a few isolated copses of stunted and gnarled trees. It is postulated that the grassland on these solodized solonetz soils represents an edaphic climax. The soil-vegetation complex occurs in the form of widely scattered but very small localized patches, more especially in the northern parts of this region.

The more extensive and typical savannah type grasslands, which consist of a combination of different kinds of grasses as well as trees, are almost uniformly distributed over three main kinds of soils; namely, non-calcic brown soils, old alluvial soils and sandy regosols. These soils are characterized by a shallow depth as well as a coarse texture. Here, there is sufficient supporting evidence to suggest that the biotic factors have largely determined the development of this soil-vegetation complex and that the periodic burning and grazing that has been going on since medieval times does appear to have aided the permanent maintenance of this savannah type grasslands.

As far as the genesis of these so-called damana grasslands of the Tamankaduwa is concerned, it could thus be inferred that the edaphically conditioned grassland which occurs on the strongly alkaline solodized solonetz soils would have constituted the original loci of invasion of grasses into the adjacent surroundings, consequent on human interference.

APPLICATION OF SOIL SCIENCE TO FORESTRY IN LAND USE PLANNING

A landmark publication by de Alwis and Eriyagama (1969) on the soil-vegetation relationships in the dry and intermediate zones brings out very clearly the nature of the influence that soils exert on the growth and performance of some species that make up the `dry-mixed-evergreen' forest. The earlier cited reference by Kolmeyer (1957) also brings out the striking influence of soil depth and internal drainage on the performance of a single species, namely teak (*Tectona grandis*).

As further rightly observed by de Always and Eriyagama (1969), "It would be incorrect to conclude that each type of vegetation exists on one great soil group only, or that each great soil group supports only one type of vegetation; numerous variations in the micro-climate and biotic and historical factors preclude such a possibility. The vegetation described is representative of the dominant natural plant communities surviving on each kind of soil".

Soil related factors should, therefore, be considered as having a very important bearing on species performance and forest productivity on different kinds of soils occurring within the same agro-ecological region. Meaningful land use planning for forestry should,

In the light of new directions and developments taking place in commercial forestry, a strong case can be made for allocating land with better quality soils for commercial forestry plantations. This is specially valid for the dry zone of the country where a significant extent of land with deep soils such as the deep red-yellow latosols are ideally suited for forestry plantations. These occur in the Mullaitivu and Mannar districts. The excellent growth of cashew on the red lastosols of Kondachchi in the Mannar district provides a strong rationale for this view.

SOIL WATER-VEGETATION-EVAPOTRANSPIRATION BALANCE

A proper recognition of the soil water-vegetation-evapotranspiration balance in the different agro-climatic environments is considered the key to understanding the role of forests in watershed management both in the dry and wet zones of this country.

In studies conducted over a five year period from 1979 by the Land and Water Use Division of the DOA in a mid-country wet zone and intermediate zone catchment, it has been clearly established that a forest cover contributes towards a higher dry weather or base flow, while at the same time reducing soil loss and surface erosion. A forest cover thus contributes towards enhanced base flow during the dry season.

In studies conducted by the Land and Water Use Division of DOA from 1991 to 1994 in the Nachchaduwa catchment located in the dry zone environment it has been established that:

- the initial rains do not produce run-off until a cumulative rainfall of around 100 mm is received

- the surface run-off from cleared chena land is much higher than from land under forest of scrubland

- nearly half of the rainfall that is received in the wet Maha season is consumed by the forest vegetation during the Maha season; the total Yala rainfall received during the Yala season is consumed by the forest in evapotranspiration.

- towards the end of the Yala season the whole soil profile has dried out, and the base flow even under a 100 percent cover has ceased at the end of the Maha season in February.

- although forest and scrub jungle yield very little run-off, these vegetation types should be retained for other environmental reasons. Soil losses from forest and scrub land are negligible.

In the light of the foregoing information, the selective roles of a forest cover in the wet zone versus the dry zone are clearly discernable. In the wet

reduce soil erosion and also enhances dry weather base flow, while in the dry zone a forest cover mainly contributes towards reducing soil erosion.

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