

WATERSHED MANAGEMENT IN TRINIDAD AND TOBAGO

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SUMMARY

Recognition of the role of forests in the prevention of erosion, sedimentation and flooding is not new in Trinidad and Tobago. In spite of a considerable amount of work done in watershed management, problems still remain. These activities and problems are discussed.

RESUME

Depuis longtemps le rôle des forêts est reconnu dans la lutte contre l'érosion, la sédimentation et les inondations. Malgré les efforts déjà consacrés à l'aménagement des bassins-versants, des problèmes restent à résoudre. L'auteur discute ces activités et ces questions.

RESUMEN

El reconocimiento del papel de bosques para impedir erosión, sedimentación e inundación no es una idea nueva en Trinidad y Tobago. A pesar de una gran cantidad de trabajo en el manejo de cuencas siguen existiendo problemas. Aquí se discuten estas actividades y problemas.

Introduction

Trinidad and Tobago is a twin-island state with an area of 5,128 square kilometres and a population of 1.3 million people. The country is the most southerly of the Caribbean islands being approximately 13 km from Venezuela at the nearest point.

Climate

The islands have a humid climate with uniformly high temperatures throughout the year (average approximately 30°C). Rainfall exceeds 2,000 mm per annum but varies considerably with location and season being heaviest during the period June-December.

Topography

In Trinidad there are five main physiographic regions: Northern Range, Northern Basin, Central Range, Central Basin and Southern Range.

The Northern Range is an area of rugged topography with peaks of over 900 m and steep slopes. The latter four regions form a composite of low hills, decreasing in altitude from the Central to the Southern Region.

In Tobago there is a main ridge running in a north-east direction for nearly 2/3 of the length of the island with the highest point being approximately 580 m.

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large forest plantations. Twenty to thirty plantations of between 20 and 25 thousand hectares each could sustain, if not increase, the present forest production of the country. At that sort of size, processing industries could be established at, or very near, the plantations. This would not only greatly improve employment opportunities in the rural areas but also considerably increase the value of forest production. There is much more revenue generated by selling processed timber than by the production of the raw material. By considering trees as a crop and taking the growing of that crop as seriously as any other, then plantations will come into their own. With careful species selection and improvement work the crop can be grown almost to specification.

One of the problems that forestry faces, almost all over the world, is that forests tend to regenerate without any intervention by man. What regenerates and how long it takes has, in the past, never been particularly important as there has always been more over the next hill or on the next island. Most parts of the world have now exhausted the last of their hills and islands and are looking at, and exploiting, other people's. However, by making use of the very much increased productivity of forest plantations it will be possible to relieve the increasing pressure on the indigenous forests. It will be possible to conserve the incredibly complex ecosystems of the tropical rainforest, to conserve a reservoir of otherwise endangered animals and plants, and ways of life. The conservation of the natural forest heritage of Papua New Guinea (and the rest of the forested tropics) depends, to a very large extent, on the establishment of a number of large scale, and efficient, forest plantations. Without this the rape and pillage of the natural forest will continue unabated until, in the not too distant future, it will have ceased to exist.

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Slopes

Five slope classes are used in the country. These are as follows:

- Class A (0°-2°)
- Class B (2°-5°)
- Class C (5°-10°)
- Class D (10°-20°)
- Class E (20°-30°)
- Class F (above 30°)

50.93% of the land belongs to Slopes D,E,F of which 28.3% lie in the Northern Range. A modification of the slope classes for upper watershed management purposes will be discussed later in the paper.

Forest Cover

53.2% of the country is under forest vegetation. Of this 42.6% belongs to the State and the remainder in private ownership.

State-owned forests permanently dedicated to Forestry comprises thirty-six Forest Reserves, thirty-five of which are in Trinidad and one in Tobago. Together they cover 24.7% of the total land area. Forests managed primarily as protection forests for soil and water conservation constitute 25.5% of the forest reserves or 6.3% of the country.

Soils

The most widespread soils occurring in Trinidad are soils of the intermediate uplands with restricted internal drainage found throughout a significant portion of Central and Southern Trinidad. Other soils with impeded or imperfect drainage are:

- deep hydromorphic soils of the swamp area
- deep alluvial soils occurring in the plains
- terrace soils of the Northern basin
- steep land soils and soils of the lowlands in Tobago.

The predominant soil type in the Northern Range is the Maracas/Matelot soil series which erodes rapidly once the forest cover is removed.

Watershed Management Activities

Watershed management activities in Trinidad and Tobago are described under the following headings.

Watershed Administration

There is no single agency in the country which is responsible for watershed management. Several Government Ministries and Departments are involved in various aspects of this discipline. For example, the Forestry Division is responsible for the protection and management of watersheds on Government-owned lands. The Water and Sewerage Authority wins water from certain watersheds and distributes this throughout the country. Hydrological data is collected and interpreted by the Water Resources Agency, the Ministry of Works (Drainage Division), the Meteorological Services and several Divisions of the Ministry of Agriculture, Lands and Food Production including the Forestry Division. Water quality studies are carried out by both the Water and Sewerage

Authority and the Water Resources Agency while the maintenance of waterways and control of coastal erosion is done by the Ministry of Works.

There is clearly the need for a single agency to co-ordinate these operations at a national level so that proper planning, implementation and evaluation can be made.

Watershed Policy

In a Revised Forest Resources Policy submitted to Government in 1981 for approval, the recommended policy for watershed management is "to regulate stream flow, improve water quality and quantity, reduce flooding and erosion and protect the aesthetic values of watersheds".

Strategies identified to achieve this policy are:

- Identify the major watersheds and sub-watersheds in the country
- Ensure that the upper regions of watersheds and other stream source areas are kept under the appropriate vegetative cover
- Determine watersheds which require rehabilitation and rehabilitate those on a priority basis
- Protect and manage all critical watersheds
- Cooperate with other agencies to ensure proper watershed management.

Clear land-use statements related to watershed management have also been made in the National Physical Development Plan which was prepared by the Town and Country Planning Division in 1978. Relevant statements are:

- the conservation and management of forest reserves, watersheds and river basins
- improvement in the quality and quantity of water
- effective control of pollution and restoration of polluted areas
- conservation and enhancement of areas of high landscape value and historic sites as outlets of leisure and recreation.

Watershed Demarcation

The country has been divided into fourteen watersheds. These are:

Trinidad	Area (sq. km)
North Coast	368
North Oropouche	606
Nariva	461
Ortoire	479
Southern Range	526
Cedros Peninsula	420
South Oropouche	438
Central West Coast	518
Caroni	1010
Tobago	
North Coast	49
East Coast	49
Windward	114
Courland	39
Lowland	46

Water Production

Water production is estimated at 580,000 m³ (128 m.g.d.). At the present, however, supply is 77,300 m³ (17 m.g.d.) short of demand. Approximately 83% of this water is produced from surface sources and the remainder from aquifers.

Water is distributed to 90% of the population by private house connections and public standpipes. The remainder is served by contractors who deliver it to home.

Watershed Protection and Rehabilitation

The role of forests in reducing soil erosion, sedimentation and flooding has been recognized in this country from the inception of its Forest Reserve. In fact, the first forest reserve in the western hemisphere was established in Tobago in 1765 for the "protection of the rains". The proclamation of legally-constituted Forest Reserves commenced in 1922 and approximately 25% of the Forest Reserves were designated "Protection Forests". One criticism of the overall programme of reservation is that insufficient attention was paid to the most vulnerable part of the country—the Northern Range and its foot hills.

This apparent oversight is explained by the fact that a large percentage of the area was privately owned and used for cocoa production. With the decline of this crop, the lands were misused and mismanaged thus contributing to watershed degradation. The adverse hydrological effects of indiscriminate forest removal from the watersheds of the Northern Range resulted in severe annual flooding and water shortages. In 1972, the Government established the Northern Range Reafforestation Project to revegetate these denuded and semi-denuded watersheds and to date 2,600 ha of forest and agriculture tree crop plantations have been established. In addition, it has constructed over 800 stone check dams 31,000 square metres of bench terraces and 11,000 metres of grass barriers.

This project possesses expertise in nursery work, plantation establishment, land conservation techniques, road construction, road erosion control and fire protection.

Watershed Planning

On a national scale, the zoning of lands for various uses has been developed. Although useful at this level of planning, the criteria used have proven inadequate for smaller watersheds with areas ranging from 2,000–5,000 ha.

The need therefore to develop guidelines for land-use planning in hilly mountainous areas resulted in a request being made to FAO for a project on Upper Watershed Management Planning. The objectives of this project are:

- training of local staff in watershed planning and implementation
- preparation of guidelines for land-use planning within acceptable socio-economic and physical parameters
- preparation of an annual plan for one watershed and detailed land-use plan for two sub-watersheds
- implementation of the detailed plans
- demonstration of the validity of technically sound and economically viable soil and water conservation techniques.

Although the project is just over one year old it has already done excellent work in certain aspects of watershed planning. A new slope classification has been adopted with six categories as follows:

- 0°– 5°
- 5°–10°
- 10°–20°
- 20°–30°
- 30°–40°
- >40°

This new category differs from the existing slope category in two classes 0°–5° and over 40°. A refinement of slopes above 20° proposes 20°–30° for agro-forestry, 30°–40° for production forestry and above 40° for watershed protection forests only.

Demonstration of simple conservation measures, techniques for reclamation of abandoned quarried sites, completion of land capability maps for two sub-watershed and the installation of erosion and run-off plots and stream gauging stations has also been made.

Research

Collection and Evaluation of Hydrological Data

This is done by several agencies. The Ministry of Works and the Water Resources Agency have jointly established 165 recording and non-recording gauges throughout Trinidad and Tobago. The latter has, in addition, established 6 hydro-meteorological stations and 21 stream gauging stations. Groundwater surveys are carried out by a network of observation wells. All data collected are processed by the Water Resources Agency which publishes its Reports annually. Such reports provide invaluable information on rainfall, run-off, peak and low flows and the extent of fresh water aquifers in the country.

The Forestry Division has set up a meteorological station, a stream-gauging station and ten rain gauges. Plans are underway for the construction of six stream-gauging stations in order to collect data on suspended sediment and stream flow under the following land uses:

- developing housing estate
- natural forest
- fruit tree orchard
- grassland
- quarried land

Additional rain gauges will be installed when these gauging stations are established.

Erosion and Run-off under Different Land Uses

In 1983, six run-off plots were established within the Maracas Watershed (approximately 42 sq. km) of the Northern Range to measure run-off and soil loss under the following land-use practices:

- good natural forest cover ($> 70\%$)
- disturbed forest cover (40–70%)
- grass land (10–40%)
- active cultivation ($< 10\%$)
- unburnt plantation
- burnt plantation

All plots are 50 sq. metres in area and have been selected with similar slope, soil type and aspect. Each plot has a collection trough and three collection drums to measure the daily run-off and soil loss. These drums have a total measuring capacity of 16,000 litres and they are connected in such a way that 1/10 of the excess volume of the first runs into the second and an equivalent volume from the second runs into the third.

Data on run-off and soil loss have just commenced and it is as yet too early to make any analyses.

Water Quality Studies

Water quality studies are currently carried out by the Water and Sewerage Authority and the Water Resources Agency. The former has a Water Quality Control Branch which operates four laboratories in the country. In 1982, this branch examined 20,901 samples of water for chemicals and bacteria in order to determine the suitability or otherwise of the water for drinking purposes.

Measurements of suspended sediment are done by the Water Resources Agency and sediment-discharge curves are prepared. The Upper Watershed Management Planning Project of the Forestry Division will also be measuring suspended sediment loads under a variety of various land uses as already stated.

Education and Training

Training in watershed management is provided at the technician level at the Eastern Caribbean Institute of Agriculture and Forestry in Centeno, Trinidad. The course consists of fifty hours with twenty hours of lectures and thirty of practicals.

In 1983, a Caribbean Network in Upper Watershed Management was formed in Trinidad. One of the functions of this Network is to strengthen the teaching capabilities of the Institute by assisting in the provision of teaching and other training aids and modifying the contents of the course if necessary.

This network is also expected to initiate short courses in watershed management for the staff at national institutions in the English-speaking Caribbean countries at the professional and technical levels. The first such course is expected to commence in the latter part of 1984.

A proposal has also been submitted by the Upper Watershed Management Planning Project to organize short courses in this field for local staff attached to the Town and Country Planning Division, Water and Sewerage Authority, Water Resources Agency, and several Divisions of the Ministry of Agriculture, Lands and Food Production.

The teaching of a course in watershed management to 3rd year science students of the St. Augustine Campus of the University of the West Indies is currently being considered. This discipline may be further developed and strengthened by the implementation of the recommendation made at the Eleventh Commonwealth Forestry Conference that a Faculty of Forestry be established at the St. Augustine Campus of the University of the West Indies to cater for the training needs of the Caribbean.

A feasibility study on this was recently completed by the Caribbean Development Bank with funding from the European Development Fund. The findings of the study have not yet been published.

Watershed Management Problems

The problems of watershed management in Trinidad and Tobago are:

Erosion and Flooding

Soil erosion and flooding are serious problems in the country. These have been caused by the indiscriminate clearing of forested lands in the upper watersheds by squatters and slash-and-burn agriculturists for a variety of uses including shifting agriculture, quarrying, and unplanned housing development.

These together with the misuse of other lands have resulted in serious watershed degradation symptomized by erosion and flooding.

Land Tenure

More than 50% of the land in the country is privately-owned. This is particularly serious in the upland areas where most of the land has been converted to agriculture or other uses inconsistent with the Land Capability Survey for the country.

Since there is no law compelling owners to practise the correct use of their lands, watershed rehabilitation is very difficult if not impossible. In 1979, Government appointed a committee to examine the privately-owned lands of the Northern Range (21.6% of the country area) above the 300 foot contour line. The Committee recognized that, because of the high cost of land, it would be impossible for Government to acquire all the private lands for watershed rehabilitation, instead, it recommended that the grasslands which contribute significantly to erosion and flooding should be acquired and the remaining lands be reforested with various forms of assistance from the State. It was estimated in 1981 that these grasslands which, comprised 15% of the private lands would cost TT 50 million to reforest. These proposals have to date not been implemented.

Deterioration in Water Quality

The quality of water in many of the country's rivers and streams has deteriorated considerably over the years. This deterioration is due to the excessive use of fertilizers and pesticides, discharge of industrial effluents directly into water courses, dumping of garbage, mining either directly in rivers or adjacent to them, river bank erosion, intensive cultivation of lands adjacent to rivers and silt deposition.

At least in one Recreation Site in the country, bacteriological counts have indicated quite clearly that the water was unfit for river-related activities such as bathing, washing meat etc. as a result of the application of chicken manure as a fertilizer in lands in the vicinity of the Recreation area.

This serious problem requires the immediate enactment of legislation for the institution of water quality standards. Such standards have two basic components:

—stream use classifications

—numerical and narrative criteria.

Stream use classifications identify the use to be made of rivers, lakes or coastal waters for purposes such as recreation, drinking water, industrial and agricultural uses, fishing areas or a combination of these.

The numerical and narrative criteria place limits on pollutants such as bacteria, toxic substances, taste and odour-producing substances, nutrients, chemicals, sediment etc.

The introduction of these standards must be accompanied by a constant monitoring of the rivers and streams involving daily sampling of the water. As soon as a given pollutant increases above the standard set for it, its cause should be immediately traced and remedial action taken.

Fires

Probably the most dangerous agent of watershed degradation is fire. These are set primarily by the slash-and-burn agriculturists who clear forested lands annually to grow their crops. Accidental fires caused by hunters, hikers etc. occur but these are of minor importance.

The Forestry Division and especially the Northern Range Reafforestation Project has placed great emphasis on fire detection and suppression. To date, six fire towers have been constructed by the Division, a telecommunication network established and simple fire fighting equipment acquired.

During the period March–May, all staff on the Northern Range Reafforestation Project are placed on patrols seven days a week.

In 1983, an FAO Expert in Fire Protection was assigned to the Forestry Division to assist in preparation of fire plans and upgrading the skills of the staff.

The consultant is expected to return soon to continue his work.

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