

SELECTED ARTICLE.

Deforestation and Soil Erosion in Trinidad.

DEFORESTATION AND SOIL EROSION IN THE FOOTHILLS OF THE NORTHERN RANGE CAUSED BY SHIFTING CULTIVATION.

By J. C. Cater, Assistant Conservator of Forests.

The Foothills Region. A recent, and perhaps somewhat superficial, survey has been carried out to determine the amount of deforestation that has taken place in the foothills of the Northern Range, since there is sufficient evidence of erosion to give some cause for alarm. The area surveyed has embraced all the land south of the main ridge of the Northern Range between Maraval on the west and Tacarigua on the east. It is true that there are erosion problems elsewhere in the Northern Range, but it was felt that the area indicated above presented by far the most difficult problems.

There is extremely little flat land in the foothills region, about 75 per cent. of the area is over 500 ft. above sea level and about 25 per cent. over 1,000 feet above sea level. Most of the slopes are very steep, some even precipitous. Roads are confined to the valley flats, but bridle tracks lead up from the roads to the ridges. The rainfall is somewhat variable, being about 70 to 80 inches per annum in the valleys and considerably more on the hilltops. South of the foothills the rainfall drops rapidly to 50 to 60 inches per annum. In normal years nearly all the rain falls during the last 7--8 months of the year, and on occasions the rain is extremely heavy. The period January to the beginning of May is usually marked by a drought, when the vegetation becomes tinder dry.

The soils of the foothills are derived from mica and quartz schists, and from the occasional lime-stone masses such as are found at Laventille and Cameron. Owing to the steepness of the slopes, erosion takes place at such a speed that a proper soil profile is never developed, even under high forest. The hillside soils are very shallow, often with the parent rock only 6 inches below the surface, and where serious erosion has taken place the shallow soil is studded with boulders. Were it not for the fact that the mica schists decompose very rapidly on exposure to the elements, there is little doubt that much of the steeper hillsides, where serious erosion has followed persistent cultivation, would consist of the bare rock. The soils, particularly those derived from the quartz schists, are by no means fertile, but here are deeper and more fertile soils in the valleys between the hills.

The Vegetation. The original vegetation supported by the foothills before the advent of the human race to the island, almost undoubtedly consisted of tropical evergreen rain forest, with a proportion of deciduous and semi-deciduous species, such as cedar (*Cedrela mexicana*), cypre (*Cordia alliodora*), poui (*Tabebuia serratifolia*) &c. Balata (*Mimusops balata* var. *Cruegeri*) was probably common, as it is still plentiful on the seaward side of the watershed. The last remnants of this forest can be seen on the upper slopes of the Santa Cruz valley near St. Ann's peak, and further east in the Tacarigua proposed Forest Reserve.

During the period of Spanish ownership of the island, the forest in the valley bottoms was cut down and replaced by cacao plantations. After the advent of the French refugees, about the time of the French Revolution of 1793 and later the arrival of English colonists, when Trinidad became part of the British Empire, more forest was cut down in the valleys and on the lower slopes and cacao was planted. A certain amount of cacao was even planted at the

higher elevations, and there are to-day cacao plantations at an elevation of 2,000 feet above sea level on Morne MaLD'Estomac at the head of the Maraval Valley.

In the main, however, cacao was confined to the valleys and the lower slopes, and there was never any considerable permanent cultivation of the middle upper and slopes of the foot-hills. For a considerable time past a very large proportion of the slopes of the foothills have been subjected to severe shifting cultivation, which has destroyed almost all traces of the original forest vegetation. To-day the vegetation over most of the foothills consists of a very poor type of second growth containing numerous palms such as gru-gru (*Acrocomia aculeata*) and the trash-palm (*Sheelia osmantha*). The commonest trees are bloodwood *Croton gossypifolius* balsa (*Ochaoma pyramidale*), saltfishwood (*Machaerium robinifolium*), gommier (*Tapira guianensis*), and kiskidee (*Vismia falcata*). Shrubs are numerous and frequently the whole mass of vegetation is closely tied up with vines and razor-grass. The bush becomes tinder-dry during the normal dry season and is very liable to be overrun by fires. Small patches of bracken (*Pteridium aquilinum*) can be seen on the hills to the north of Port-of-Spain, and further east. Between 700 feet and 1,500 feet elevation, there are areas of savanna similar to the Piarco and Mausica Savannas. There the dominant grasses are *Trachypogon plumosus* and *Thrasya robusta*, while a sedge, *Scleria* sp., and a coarse grass, *Axonopus equifans*, are also found. The grasses are tufted, with eroded channels between the tufts. The dominant shrubs are *Curatella* and *Byrsonima*. The bracken patches are almost certainly the result of continuous shifting cultivation and fires which have resulted in severe sheet erosion of the originally shallow soil. It is not known if such areas can eventually revert to forest, but the process of re-establishment is likely to be very slow and probably depends very largely on the prevention of fire. At present fires occur almost every year.

The origin of the hill savannas is not known with certainty. They may be the result of continuous shifting cultivation and fires, but there is some historical evidence to show that they may be a natural phenomenon, since a Spanish adventurer of the 16th century has recorded that he sailed up the St. Joseph River and eventually reached a natural savanna from which he obtained an extensive view of the island. It is of course possible that the savannas are the result of human activities long before the advent of the Spaniards to the island.

Cultivation. The methods of cultivation of the hill slopes are wasteful and primitive in the extreme. During the dry season the bush is cut down and burnt. The law requires that fire traces at least 25 feet wide shall be cleared all round a parcel of land which is to be burnt, but adequate precautions are not always taken and frequently fire escapes from the area to be cultivated into the neighbouring bush, and large areas are damaged. No attempt is made at contour-ridging, terracing or planting in lines along the contours, and the extreme steepness of some of the slopes is not deterrent to the would-be cultivator. The fear of praedial larceny drives many cultivators to utilise land at very high elevations, in the hope that the difficulty of extracting the harvest from such situations may deter the thief, who will confine his attentions to the gardens at lower levels.

The burnt land is sown or planted when the rains break, usually during May. The land is then completely bare of vegetation and the heavy downpours play havoc with the exposed soil. Very large quantities of surface soil are removed by sheet erosion and carried down the slopes. Gullying also takes place to some extent, but does not seem to be so severe as sheet erosion. It is by no means uncommon to find stones which were originally on the surface supported, after heavy rains, on a pinnacle of soil two inches or more high. The eroded soil gradually makes its way down the slopes during successive periods of rain and

is eventually deposited on the low-lying lands or carried out to sea. After rain has fallen in the foothills, the rivers which drain them are loaded to capacity with silt and change within the hour from gentle streams to roaring torrents which overflow their banks and floods the flat land in the Caroni plain, destroying small houses and rendering roads impassable.

The crops commonly planted are sweet corn, tomatoes, carrots, chives, yams, &c. They have little effect in decreasing the speed of surface run-off water which is not absorbed by the soil. Usually the crop is reaped within six months of planting. A second and sometimes third crop is grown on some land, but often the land is abandoned after one crop, when erosion and the needs of the crop have exhausted the fertility of the soil. The abandoned land gradually reverts to bush through the invasion of plants from neighbouring areas of second growth and the coppicing of stools not destroyed by fire. After the land has rested for a number of years, usually from three or seven, a certain amount of fertility is built up under the cover of the second growth, and it is again cleared for cultivation.

Ownership of Land in the Foothills. Unfortunately the reservation of land as Forest Reserves did not commence until the beginning of the twentieth century when nearly all the land in the western foothills had been alienated. To-day there are under 2,000 acres of land owned by the Crown in the foothills between Maraval in the west and Tacarigua in the east. The rest of the land, some 28,000 acres of which lie above the 500 feet contour, is divided between small and large proprietors in the rough proportion of 2:1. The renting of lands for shifting cultivation is quite an important item in the revenue of many of the estates, rentals varying from 2'00 per acre to as high as 8'00 per acre.

Suggested Methods of Control. Shifting cultivation and its attendant evils have now reached serious proportions in the Northern Range foothills, and it is highly desirable that some form of control should be introduced to protect the community. To decide what form the control shall take, however, is not an easy problem. Considerable quantities of food are grown on the foothills, an important matter to a community which is largely dependent on imported foodstuffs, and it is most undesirable to reduce the total land area under cultivation of locally consumable crops.

One method, and the most drastic, springs to mind at once. It is to prohibit all cultivation of the shifting type on land lying above the 300 feet contour, and allow the land to revert to forest. This would undoubtedly result in an enormous reduction in soil erosion and flooding. To compensate for the loss to cultivation of some thousands of acres of land, it will be necessary to find suitable land elsewhere. This should present no insuperable difficulty. Apart from the large areas of derelict land throughout the Colony, where, in spite of the low fertility of the soils, crops of vegetables could be raised under a system of controlled shifting cultivation there are thousands of acres of abandoned or almost worthless cacao plantations on somewhat better soils. Such cacao produces a negligible crop, which it is not economic to harvest, and even requires a considerable expenditure of public funds in the form of a subsidy to maintain it at all. This cacao could be cut down and replaced by a mixed animal and vegetable crop husbandry which would afford a decent return to the cultivator and be of great value to the Colony.

An alternative, less drastic and probably less effective method of dealing with the problem, would be to permit cultivation of the slopes up to a higher elevation, say the 500 feet contour, and try and educate the cultivators in measures which would reduce the rate of surface water run-off and hence erosion. Research work is required to determine what measures are most effective and

economical in preventing erosion, and it is suggested that terracing, contour ridging, planting along contour strips alternating with strips left in bush or grass, and the use of a grass-sod of species having a prostrate form through which the crop is planted in shallow holes should, among other methods, form the subject of experiment. No cultivation of temporary crops should be permitted above the 500 feet contour, but the cultivation of orchard crops such as tonka beans, limes, &c., might be allowed between the 500 feet and the 800 feet contour, provided the soil was protected by an adequate grass cover and drains were properly aligned and constructed. Above the 800 feet contour no cultivation of any crop other than cocoa should be permitted, and as much of the land as possible should be allowed to revert to forest. The process of reversion to forest could be accelerated by tending operations such as vinecutting, removal of excess coppice shoots, &c. Whatever form of control of cultivation in the foothills is adopted, there is no doubt that the sooner the control begins the better for the welfare of the Colony.

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The Rape of the Earth.

A WORLD SURVEY OF SOIL EROSION.

By G. V. Jacks and R. O. Whyte, London, Faber and Faber Ltd., 1939. pp. 301

and Index, with 47 photographic reproductions. Price 21s.

(Review P. H. in *Tropical Agriculture* Vol. XVI No. 10, P. 223—225.)

In the opening chapter of this book, Mr. G. V. Jacks, the Deputy Director of the Imperial Bureau of Soil Science at the Rothamsted Agricultural Experimental Station, England, gives a very readable account of the modern aspects of soil erosion, in which he particularly stresses the broad economic relationships of the problems of land maintenance. "As the result solely of human mismanagement, the soils upon which men have attempted to found new civilizations are disappearing, washed away by water and blown away by wind...Already...nearly a million square miles of new desert have been formed, and a far larger area is approaching desert conditions". Despite the invention of efficient agricultural implements, the introduction of better varieties of crops, and the increased use of manures, the average output of the land per unit area taken the world over, is rapidly diminishing: this is mainly attributed to the ravages of soil erosion which "is altering the course of world history more radically than any war or revolution". Nevertheless, soil erosion is a beneficent process without which the world would long ago have died, being Nature's way of discarding its old worn-out skin and renewing its living sheath of soil from the dead rock beneath. In Nature, it takes place slowly, so that equilibrium is always maintained between soil removal and soil formation under particular conditions of climate. *It is the great acceleration of erosion through human mismanagement that has changed the process into "one of the most vicious and destructive forces that have ever been released by man"*. Deforestation, the destruction of natural herbage by overgrazing and excessive cultivation may so hasten soil removal that fertile land, taking centuries to form, may be entirely lost within a year or even a few days.

Until recently, soil erosion was regarded merely as a local matter, but it is now recognised as "a contagious disease, spreading destruction far and wide",