

THE MAINTENANCE OF SOIL FERTILITY IN TROPICAL AGRICULTURE.

INTRODUCTION

The continued development of the tropics will largely depend on the success of the attempts to develop a permanent system of agriculture which will support the growing population and provide an exportable surplus. It will be admitted that much of the present mode of farming in the tropics is of the type described as "mining", little or no consideration being given to the conservation of soil resources. This applies both to native and European methods.

The advent of the European in Africa and other tropical areas has brought settled government and improved hygiene, and the consequent growth of population. Improved means of communication has fostered a rapidly expanding export trade in agricultural products. All this leads to increased drain on soil resources, with the result that the question of soil deterioration is becoming acute in many areas.

It is quite possible that the problem will be solved on lines differing considerably from those followed in temperate countries, but the general principles involved in maintenance of fertility will be the same. It will be instructive, therefore, to examine the methods adopted in permanent agriculture in the old established agricultural countries in the West and in the East.

The European farmer of the present day has the advantage of the accumulated experience of generations of agriculturists. In addition he is assisted by active research institutions engaged in the application of science to agriculture. He has evolved the system of rotation farming, mixed arable and stock farming, the folding or turning under of green crops, and, to a greater or less extent, the application to his soils of inorganic fertilisers. Under these conditions soil fertility has been, over a long period of years, not only maintained but actually increased.

While the period of direct exploitation of soil resources is past in most western countries, it should be noted that they are not self-supporting, as the importation of mineral fertilising ingredients from not inexhaustible natural deposits is carried out

on an extensive scale. Also, there is a transport of fertilising ingredients from the tropics to temperate countries in the form of raw materials for the manufacture of feeding stuffs. Transport of crop products to urban centres of population removes large quantities of plant nutrients, the greater part of which eventually reaches the sea, a small fraction perhaps returning on a long-time cycle through phyto-plankton - fish - birds - guano.

On the other hand, since Crooks, in his famous address to the British Association, stated the problem of combined nitrogen supply, we have developed methods of obtaining synthetic nitrogen fertilisers in quantity from the atmosphere. Incidentally, in the processes using hydro-electric power supply, we are drawing indirectly on radiant energy. The analogy with a class of soil organisms which operate, in the mass, on a more extensive but less intensive scale, is apparent.

In the East, in particular in China and Japan, where conditions have been vividly described by King in his well known book, "Farmers of Forty Centuries", there is little recourse to external sources for artificial fertilisers, but extreme care is taken that residues of fertilising value are returned to the soil. The excreta, not only from animals but from the human population of town and country, is carefully conserved and mixed with earth and waste materials and applied to the soil. This making of composts is a particular feature of Chinese and Japanese farming. It enables raw green plant materials, when fermented with excreta and mud from canals and ditches, to be converted into manure, and the process of nitrification which goes on gives a plant-food rich in humus and mineral elements in easily available form. The extensive system of canals and irrigation ditches conserves water supply where this would otherwise be inadequate. There is the extensive practice of starting crops in nurseries under conditions of high fertility, giving rapid growth of young plants which are later transferred to the field. The practice of planting in hills and rows permits one crop to be planted, germinated, and often hoed, before another crop has been

removed from the field, thus utilising for growth all of the time which would otherwise be consumed in removing the harvest and in preparing the ground for the next crop.

By these means soil fertility has been conserved, and an extraordinarily dense population supported over a period of thirty or forty centuries, but as the cost, it must be stated, of an immensity of human effort.

Sheer necessity has forced the farmer of temperate countries to adopt efficient methods of maintaining soil fertility. He has had the advantage of highly organised manufacturing and transporting agencies, in addition to skilled scientific assistance. What is the position in the tropics? Here agriculture over large areas is still extremely primitive. Rotation of crops is not usually practised, though undoubtedly mixed cultivation has some of its advantages. Over large areas of tsetse ridden country stock cannot be kept, the benefits of green manuring are hardly recognised, and the use of artificial fertilisers is impossible for economic reasons. The native farmer has adopted the system of shifting cultivation, burning off an area of virgin forest, planting his crops with the minimum expenditure of labour, and shifting to a fresh area when yields fall to a low level, which happens after a very few seasons. After this process the land goes back to scrub for a considerable term of years with slow recovery of fertility.

Under such conditions soil deterioration is likely to be both rapid and extensive. Conditions in particular areas have been described by Stockdale (26), Willis (32), Wardlaw (30), (Deterioration of soils in the Caribbean) Lewin (20), and many others. What are the causes of this loss of fertility? Can the original productive capacity of the soil be restored, and can it be maintained if restored? If it can be economically restored and afterwards maintained, then by what means and by what methods?

These are the questions which will be discussed in this dissertation, leaving aside the problems of introducing new methods to the native - best dealt with by local methods in local areas. Part I is concerned with general principles and a survey of part of

the literature. Part II deals with a particular rotation, the rotation in Field Q. This rotation has been running a short time only, and consequently data on which positive conclusions could be drawn are lacking. A balance sheet for the rotation can be given, and it is hoped that some soil determinations will be made, which will provide additional evidence on which a forecast of the probable trend of fertility can be based. The costings and other practical considerations are being dealt with in a separate dissertation.