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TANGANYIKA TERRITORY

SOIL EROSION

A MEMORANDUM

by

E. HARRISON, C.M.G., M.S.A., B.Sc., N.D.A.

DIRECTOR OF AGRICULTURE, TANGANYIKA

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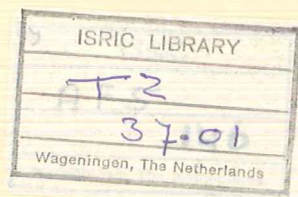
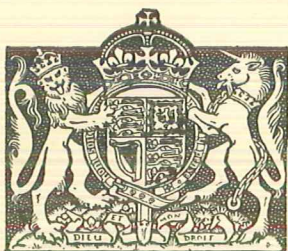
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TANGANYIKA TERRITORY

Memorandum on Soil Erosion

This paper is an attempt to give a comprehensive description of the problems of soil erosion, their effect on the individual and an assessment in regard to the territory as a whole; and the measures taken to counter the ill-effects of careless use of land. Thus the account is presented on behalf of the main departments concerned, viz. the Forestry, Veterinary, Education and Agricultural Departments, and also the Provincial Administrations, whose officers have assisted in carrying out most valuable work in the field. Reports of work done, action taken and results achieved have been received from all the above and are embodied in this review. The assurance can be given that the soil-erosion problem is kept in the forefront by officers of Government, who are even now able to detect the good influence of their work. As I think will be shown later, an appreciable measure of success, pointing in the end to a satisfactory conclusion, has in some parts already been achieved.

Prior to the depression, agriculturalists, in Tanganyika at least, were but little concerned with soil erosion, as prices of most crops were so high that there was little or no incentive to efficiency in production. Yields of crops declined, yet still gave a satisfactory profit. It was not until the onset of the economic depression, with its severe fall in price level, that producers were forced to acknowledge the great loss in soil fertility that had occurred, and that to counteract the fall in prices for agricultural products it would be necessary not only to maintain soil fertility but to improve it. Flood damage to railway works and roads and the high cost of repair further helped to focus attention on the fact that the destruction of natural vegetation and the careless use of the land was a menace. Mr. C. Gillman, Chief Engineer, Tanganyika Railways, had long predicted the destruction of portions of the Railway if erosion or rather "run off" were not checked. The subject was raised in Legislative Council in January 1931.

However, erosion of the soil is a very natural thing. It is obvious that material in elevated situations tends to weather and crumble and fall to a lower level. If people would think rather in terms of *accelerated soil erosion*, and, it is important to add, of desiccation and disintegration, the problem and the practicability of counter-

measures would be better appreciated. It is also perhaps important to add that even when land is clothed with grass and bush, it is not possible for soil to absorb water beyond its capacity and "run off" is inevitable. Floods will arise under undisturbed natural conditions and anti-erosion work is no particular counter to floods.

It is not always possible for the layman to assess the losses due to accelerated erosion; they are surprising even to those who have closely investigated the matter. In America, for example, it is stated that the loss of plant food by erosion in the Middle-West in one year may be even twenty-one times as much as that which would be removed by one heavy crop. In Ceylon it has been shown that erosion equal to a loss of 115 tons of surface soil per acre may occur annually on *moderately* sloping land under cultivation.

The process of soil erosion is not the same throughout the territory. The problem on Kilimanjaro and in other mountainous areas is to cope with a heavy rainfall on steeply sloping land. That of Sukumaland is more varied and perhaps more difficult. Here the conditions are semi-arid, and we have to deal with soil desiccation and wind erosion over a long period of the year, as well as sheet erosion during the heavy rains. Hence the measures taken to control all forms of erosion must vary considerably in different areas, and in addition must be related to the nature of the soil in each case.

In formulating, during 1930-31, a policy to be followed by agricultural officers, the recommendations of the Ceylon Soil Erosion Committee were carefully studied; the most pertinent recommendation of this body, despite the apparent seriousness of the problem of soil erosion in this Territory, appeared to be the one which reads "after educative methods have been tried for seven years, the subject should be brought up for review on the understanding that, if conditions are still unsatisfactory, compulsion by means of legislation should be further considered." Memoranda for the guidance of field officers were issued, numbers of Havilland's Rhodesian pamphlet were distributed, and arrangements for the demonstration of and the dissemination of propaganda concerning anti-erosion measures became regarded as one of the most important parts of an agricultural and district routine.

The intimate connection which exists between soil erosion and crop production, animal husbandry, afforestation, tsetse fly, irrigation, water supplies, roads, railways and public welfare generally led Government early in 1931 to appoint a large committee, under the chairmanship of the Director of Amani, to advise on the problem of soil erosion. (It should be noted that this was before concerted action was taken to increase crop production.) This committee, like the Ceylon Committee, concluded that in the absence of considerable funds for direct attack on the problem, the endeavour should primarily be educative rather than directly ameliorative. It realised that a public opinion was necessary, induced either by demonstration and preaching or by dire necessity, before direct action could even be contemplated. In other words, whilst Government was prepared, through its officers, to show people

the methods and systems by which the erosion of soil could be arrested, it was not prepared to carry out extensive works either to prevent erosion or to check deterioration in eroding areas ; in any case, extensive works were beyond the financial resources of the territory.

This decision required that field officers of the Agricultural, Forestry and Veterinary Departments should first carry out propaganda and should demonstrate the proper management of land and the measures necessary to minimise loss of soil by erosion. Officers of the Department of Education were to include the subject in the school curriculum, both within the class-room and in the school gardens ; the latter everywhere should demonstrate anti-erosion layout. Forestry officers should encourage the planting of wind-breaks and wood lots where necessary ; they were to impress on the people the need for the preservation of the natural forest growth and vegetation on the crests and steep slopes of hills and along water-courses. Veterinary officers should point out the risks of over-stocking, the value of rotational grazing, the utilisation of plant residues as stock food and the value of multiplying watering-places for stock. Officers of the Public Works Department and the Railways were requested to see that water collecting in their roads and railways was disposed of in such a way as not to create erosion below ; the alignment of new roads was to be considered in relation to the general problem. Agricultural officers were instructed to demonstrate and preach the value of soil cover, planting and cultivation on the contour, the use of terracing and anti-erosion banks, contour weed lines, contour strips of undisturbed land, protection of trees and so forth. Agricultural staff was equipped with levels of an exact yet simple type, and many African instructors are now adept in their use.

All these efforts were to be focused by administrative officers, who were, in every way possible, to bring clearly to the notice of the people the real meaning of erosion and the worth of the efforts of the individual cultivator to the clan and its land. A small committee, with the Director of Agriculture as Chairman, was appointed to guide the work.

The reason for the adoption of the policy mentioned was, as indicated above, because soil conservation was conspicuous by its absence and soil erosion was not generally recognised. Any work or act calculated to check soil erosion was usually an innovation. Hence it was essential to treat the problem in a careful and educative manner, as coercion, in the absence of a public opinion on the matter, would fail. Therefore the initial endeavours of Government were not so much directed to the carrying out of operations against soil erosion as to pointing the moral, arousing interest and demonstrating simple ameliorative systems and methods.

The result is that people are becoming interested, some tribes and clans are convinced of the need for soil conservation, and in due course desirable agricultural practices will be carried out as

routine and custom. It is a very simple matter for those unacquainted both with the magnitude of the task and the precise need for it in different areas to talk gloomily of the situation, the menace and the obliviousness of the cultivator to his own interest. From time to time reports of spectacular anti-erosion works in more advanced countries lead to doubts being cast on the progress being made here ; the time-factor is stressed and there is impatience because proved anti-erosion and water-conservation measures are not immediately enforced on all and sundry. I do not say that, sooner or later, general legislative measures will not be necessary to bring a minority into line, but I do most certainly maintain that the time must be ripe before enforcement is applied generally by means of a territorial law.

While appreciating the losses suffered by individuals through erosion of soil, the danger to tribes and to water supplies in certain areas, it must be realised that the whole territory is not seriously endangered by man's disturbance of the land, for the total cultivated or exposed soil area is only about one-thirtieth of the whole. It is computed that 7 per cent. of the area of the Territory is suffering from over-stocking. Thus, in the extreme, only one-tenth of the area of the Territory is affected, and some of that one-tenth is not really menaced.

With so little proportionate disturbance and the natural regenerative effort which vegetation makes over the greater part of tropical Africa, it is unduly pessimistic to be gloomy about the condition of the whole Territory. It is also, perhaps, beyond the capacity of the population to render the whole area impregnable to the forces of nature. At the same time it should be recognised that there is a real haunting fear that essential land, tree cover and some water supplies are seriously threatened. It is chiefly these essential areas which must be protected and saved.

Much earlier than was anticipated Government was able to consider requests from Native Authorities for permission to apply cultivation rules ; in some instances with one or two crops only, in others for application in specific areas, and yet in others of general application in the tribal area. Examples of such local regulations are given as appendices.

If the rules become completely effective within a period of seven to ten years, and if, as we expect, they become customary, an enormous stride will have been taken even though they refer to only one, but admittedly highly important, aspect of the problem. The promulgated rules are regarded by the technical officers concerned mainly as a means for adding strength to their propaganda and demonstrations, but in some areas penalties for non-compliance are now exacted.

I will now turn to a consideration of the methods which may be adopted to reduce to a minimum the downward movement of cultivated land, short of turning the whole territory into a succession of swamps. Clearly, excess rainfall which has not the time or perhaps the opportunity to sink into the soil must find or make

channels by which it can escape to lower levels; in many anti-erosion works these channels can be utilised. Where there are far too many of them, it is wise to see that a proportion are not utilised by escaping waters. This is effected by cutting off the flow of water by means of storm drains above cultivated land and above the smaller channels, which slowly discharge the run-off into those channels it has been decided to retain.

Where the slopes of hill-sides and river banks are so steep that it is unsound to cultivate, it is necessary that a reserve be formed and demarcated by a contour bank. Where, however, sloping land *has* to be cultivated, then the cultivator should take such precautions as terracing, contour banking, or contour strip cultivation. Erosion tends permanently to destroy soil and disfigure the land in vast, grassy, treeless, wind-swept areas like prairies. Plains such as these, if broken up in large blocks under the modern urge for large-scale production (without regard to the planting of windbreaks to check wind effect, or without the lay-out of broad base ridges, or without leaving untouched grassy strips to baffle and hold up moving surface water—and especially where soils are light and are derived from underlying rock *in situ* and early rains are heavy), are the main areas in which we may expect to find devastation by erosion. It is especially in such areas that man must from the beginning be aware of and react against the baleful effects of erosion. Such areas are few and far between in Tanganyika.

Other localities which will exhibit the effects of erosion are densely populated, over-cultivated areas, but measures for reclamation in such areas are feasible without too much expense, because of the presence of the population. Yet other areas are hill-sides the soil of which is resting in equilibrium maintained only by the anchorage afforded by plant roots, and protected from the disturbing effect of rain by a canopy of branches and leaves or a covering of grass, or both.

It is surely clear that if mankind wishes to use soils of these descriptions and in these situations, it is wise for him to go about it in such a way that the soil remains *in situ*. In almost every district in the Territory, the cultivator has been shown, it is true in varying degree, how he may reduce erosion to a practical minimum. By trial and experiment methods have been devised—which operate to baffle the flow of water and the movement of soil. Such trials will continue until the most feasible and practical measures to suit the diverse conditions of the many different areas of the Territory are known. Traditional tribal usage also cannot be ignored. For instance, *mtuta*—native ridge-cultivation—provides a greater surface for water absorption whatever the direction of the *mtuta* lines.

It was a simple matter to demonstrate the value of the *mtuta* when used as a contour ridge, and then to go one step farther by making cross-checks of soil in the gutters between the ridges. It

was not difficult in some parts of the Territory to demonstrate that native cultivators there had evolved systems of land management which were practically ideal counters to water erosion, such as the traditional methods followed in the Livingstone Mountains, Songea district. We know therefore that, where they must, intelligent cultivators are able to work land without soil loss. Nor was it difficult to introduce sound systems of soil management where a new crop was introduced. But it was and is not easy at once to apply all the schemes and desirable practices over enormous areas. Casual grass burning on hill-sides, yet in the aggregate extensive and leading to the destruction of forest and valuable bush ; overgrazing and tramping by stock ; failure to plant trees ; and shifting cultivation, especially on steep slopes—these are all real difficulties which can only be overcome gradually.

On the other hand, some Native Authorities are busy planting windbreaks across the country ; others are adopting contour windbreaks, are declaring hill-sides and hill-tops as reserves not to be cultivated and grazed only during defined periods. All this indicates that propaganda and demonstration are having their effect. Regularly from this office cyclostyled circulars dealing with the problem of erosion in its many aspects have been issued for guidance, and individual officers have circulated memoranda in districts and provinces.

Before proceeding to an examination of the reaction of the peoples of the various provinces to propaganda for the conservation of soil, forest and water resources, I would give the views of the Director of Veterinary Services on overstocking. I do this specifically in view of the importance of the problem, especially in the Lake and Central Provinces, regarding which areas it has been stated, perhaps rashly, that *cattle are a pest*. The subject is admirably set out by the Director in an article published in the "East African Agricultural Journal," Vol I, No. 5, page 353, and I cannot do better than quote the following extracts :

"... overstocking is of itself evil, but it is neither on humanitarian nor on genetic grounds that it has aroused storms of public disapproval ; what the public are anxious about is the loss of land-soil erosion—which is taking place as the direct result of overstocking.

"This phase of the overstocking problem has attracted so much attention that there is danger of loss of perspective. I have no wish to under-emphasise its importance, but I must point out that it is wrong to refer to soil erosion as though it were practically synonymous with overstocking ; it may be due to many things, of which an important one is overstocking. If the definition which I have formulated be correct, then the only invariable reaction of the land to overstocking is diminution of carrying capacity, and this may be achieved without loss of soil and even without loss of soil fertility.

"And yet from the purely native view-point overstocking is a necessary evil. Although he does not realise why this should

be so, it is the only way by which he is able to maintain a high standard of health among his herds, and it has been deliberately made use of by him from time immemorial. The effect of government by Europeans has been increased peace and security, bringing with them much improved opportunities for accumulating stock, the direct result of which is the overstocking which is so prevalent to-day.

"... The native husbandman is only capable of maintaining large flocks and herds on land the vegetation of which is indicative of arid or sub-arid conditions, since land with persistent vegetation cover favours ticks, flies and worms, against the ravages of which the unaided native is helpless. Therefore, because overstocking inevitably tends to produce aridity and to reduce the incidence of parasitic disease, native stock-owners favour it; preferring seasonal losses from starvation, which they can understand, to continual and greater losses from disease the nature of which is beyond their comprehension. This state of affairs will never rectify itself, and so for the popular misconception referred to above I wish to substitute the following ideas :

- (a) Many traditional native husbandry methods are inseparable from local overstocking, with the attendant risk of soil erosion.
- (b) This deteriorative process is accelerated by *laissez faire*.
- (c) The only hope of checking this growing evil lies in some form of Government intervention.

"The area of Tanganyika Territory stocked to saturation is about 40,000 square miles, and probably 25,000 of these are overstocked, including what was some of the best land of the Lake, Central, Northern and Western Provinces, *i.e.* some 7 per cent. of the total area of the Territory. It has been calculated that this overstocked area is still capable of carrying satisfactorily upwards of two million cattle, together with nearly the same number of sheep and goats, and actually it is being asked at present to sustain half as many more.

"Too much engrossment with the subject of soil erosion is liable to upset mental balance and to make us forget that, in teleological language, the soil was made for man and not man for the soil. In spite of his abuse of his heritage, the native is more important than the land, and in spite of soil erosion, domestic animals are among a country's most important assets. If we interfere we must do so judiciously, and, by using knowledge beyond that possessed by the native, be sure that removal of the reproach of overstocking benefits not merely the land but the stock and people as well."

Mr. Hornby then proceeds to outline a scheme to relieve overstocking by the expansion of a rotational grazing system, the multiplication of water supplies, the control of grass burning and a control of the type and numbers of stock which may use each of the units of grazing, which would be demarcated and developed.

He believes that only through legislation can all the desirable practices be made possible and certain.

The relation of tsetse-fly and the importance of the work of the Tsetse Research Department to the problem of soil erosion has been indicated above. There are many areas, in the Central Province especially, where tsetse has encroached into cattle-grazing lands and driven the cattle back on to what was already overstocked land, thus accelerating the destruction of natural vegetation, with consequent desiccation and loss of soil. Then we have tsetse delaying the spread of people from such over-populated areas as the Mwanza district and the Uluguru mountains of the Eastern Province. At the same time, the presence of tsetse in many parts may be a blessing in disguise, in that "fly" can be regarded as acting as the trustee of the land for future generations.

The Tsetse Research work has enabled this department, in collaboration with the field departments, to formulate and assist in initiating schemes for the elimination of tsetse from blocks of land adjacent to over-populated areas, and their settlement and development on lines which will preserve the land and its water supplies. It is not enough to clear an area of fly and permit it to be overstocked by semi-starving cattle from the nearby overstocked and denuded country. Neither is it desirable that cultivators should occupy the land in a haphazard manner, with small plots here and there and that subsequent fragmentation of holdings which is so complex in the Mwanza district and which render more difficult the application of anti-erosion measures. The intricate problems of native land tenure have an important bearing on soil management; a special investigation regarding this matter is now being carried out by Mr. Malcolm, Assistant District Officer. Also at six centres in the country orderly occupation of the land by natives is being insisted on, and is being guided and supervised with every reasonable safeguard applied to check erosion.

The following pages refer shortly to the erosion position in districts and provinces in the Territory, with an indication of the tendencies.

EASTERN PROVINCE

DAR ES SALAAM DISTRICT.

It is said that soil erosion in this district is not in any way serious. There are, however, undesirable practices in cultivation and bush burning which tend to destroy valuable semi-rain forest, turning it into a bush cover typical of more arid conditions. The cutting of forest-growth on the banks of streams is prohibited. On the other hand, there is a tsetse-fly problem and the only known effective counter to fly to-day is clearing and perhaps non-burning of grass. It is considered important in the vicinity of Dar es Salaam, at least, that fly shall not encroach, and native agricultural practice if organised is a sufficient counter to encroachment.

RUFJI DISTRICT.

Erosion by the river is to be observed, but of course it is impossible to control this. The red earths of the Magongo hills are liable to erode, but the area is thinly populated and little if any damage is observable. In riverine areas there is a tendency for the aggragation of silt rather than the weathering and carrying away of agricultural soils. No combative measures against erosion seem called for.

BAGAMOYO DISTRICT.

A sparse population exists in a district not much subject to erosion.

MOROGORO DISTRICT.

Whilst anti-erosion work has been demonstrated here for six years on the experimental areas, only three examples of deliberate anti-erosion work by native people may be seen in the whole district. One is at Mgeta, where natives have been induced to contour ridge their fields ; another the contour planting of wheat in strip cultivation by natives in the Nguru mountains ; and the third by the 58 squatters in the forest reserve on the Uluguru mountains who have terraced gardens.

Non-natives appear to have done nothing to combat the sometimes serious sheet erosion to which the fields which they cultivate annually are subject.

Hill-side grass burning is quite uncontrolled, but authority has now been given to apply regulations to native lands.

KILOSA DISTRICT.

It is stated that the major causes of excessive run-off in the district are the huge annual uncontrolled fires on mountainous land, which destroy the canopy of bush. Water supplies are reported to be shrinking and natives tend to move down to the plains. Despite propaganda and demonstration, no practice has yet been induced to minimise erosion and no cultivation rules have been adopted. In this district also but few non-natives take any precautions against erosion.

ULANGA DISTRICT.

This is in the main a great valley with a large river, and the remarks made under the Rufiji district apply. Grass burning on the valley sides and escarpment has been checked considerably.

THE SOUTHERN PROVINCE.

Not a heavily populated province which is well covered with bush. No large-scale anti-erosion work is called for, but demonstrations of desirable practices have been set up in each district. In Masasi a badly eroded hill-side is undergoing reclamation. Anti-erosion work is being carried out in the Songea district, especially with the Matengo. The ordinary field cultivation practised by this tribe is a sound system of pit cultivation and the

need for terracing is understood. Coffee is planted under the rule that the land must be prepared to the satisfaction of the Agricultural Officer, therefore practically every Mtengo coffee garden is terraced or protected by contour ridges. Hill-tops are also respected.

SOUTHERN HIGHLANDS PROVINCE.

Within recent years a great deal of anti-erosion demonstration work has been carried out, which is having practical results. With the exception of the Njombe district, where they are not especially needed owing to the native method of "tuta" cultivation on the contour, all the districts in the province have adopted cultivation rules. These are enforced in varying degrees, but are especially respected in the Rungwe area.

Amongst non-native farmers, anti-erosion practice is followed to a limited extent, and new settlers are specially approached to adopt it. The Mufindi tea area is, of course, an outstanding example of anti-erosion work. Interest is arising in the Mbosi and Tukuyu areas.

On the whole this province may be considered to be moving steadily in the right direction.

CENTRAL PROVINCE.

In this province, the most arid province of the Territory, some of the worst examples of erosion are to be found. The people are largely pastoralists, who grow grain crops for food. Little in the way of export crops is produced and the agricultural work of the people is careless to a degree. The Veterinary Department Headquarters are in the province, and demonstrations of anti-erosion methods have been made by those authorities. On the veterinary farm at Mpwapwa contour banks combined with ridge ploughing on the contour between the banks have proved entirely effective in controlling erosion.

On the small demonstrational stock farms at Kondoa, Singida and Dodoma, by rotational use of the pastures and by planting and encouraging the growth of suitable pasture species, it has been shown that average land in the province can maintain a beast to two to three acres in excellent condition throughout the year (a higher rate of stocking than any district in the province is carrying at present) without increasing any apparent loss of soil whatever.

In August 1936 a provincial conference was convened at Mpwapwa by the Provincial Commissioner and attended by the heads of the Agricultural, Forestry and Veterinary Departments, as well as by District Officers in the province. The main object of the conference was the question of the future agricultural policy for the Central Province, and anti-soil-erosion measures was naturally one of the subjects most discussed.

The value as anti-soil-erosion measures of *tuta* cultivation on the contour and deferred grazing in which recently abandoned

lands and eroding pasture areas should be reserved for dry-season grazing was stressed.

The Agricultural Department has maintained no staff in this province since 1933. No cultivation rules have as yet been adopted by Native Authorities in the Central Province, but authority to apply rules has been extended to the Kondoa-Irangi district.

WESTERN PROVINCE.

In Kasulu in 1929, following advice by Dr. Teale, active steps were taken to counteract erosion on a small scale, and an excellent demonstration was afforded. The problem in this area is much related to reafforestation, and a plan has been prepared, but cannot yet be carried out. Shortage of staff hampers progress. In the Kigoma district in 1929, owing to the railway line near the port having been buried under sand, the Public Works Department applied anti-erosion measures in the valley leading to the port. This with the regeneration of bush growth has been effective in preventing a repetition of the evil.

In the rest of the province cultivation is largely on the "*mtuta* or ridge," and steady propaganda to effect an alignment of these ridges on or near contour is proceeding. Demonstration areas have been laid down and maintained. No cultivation rules have as yet been adopted by the Native Authorities in this province, but authority to make such rules has been given to those in Tabora, Kahama and Kigoma. The provincial authorities are alive to the need for extended demonstration and action.

THE LAKE PROVINCE.

A sub-committee of the Soil Erosion Committee met in Shinyanga on September 3rd, 1931, and as a result of its recommendations windbreaks were planted in Bukwimba, plantations were made in Shinyanga and the extension of *mbuga* grazing in the Huru Huru and other areas with the building of tank dams was undertaken. Government was especially interested in the problem of the "cultivation steppe" in this province, and early in 1932 summarised steps to be taken "until times improve and finances permit of more elaborate developments." These included the acquisition of information on the subject, including the overstocking problem, propaganda for greater consumption of meat by natives, the clearing of land infested by fly and the extended cultivation of fodder plants.

Intense propaganda, which was largely successful, was directed towards the adoption of native ridged cultivation on the contour. Demonstrations of strip cultivation on contour and of contour banks were laid down. As a result, Native Authorities sought permission to make orders in connection with anti-erosion measures, and early in 1936 large-scale connected efforts which were still demonstrations were laid down at Ipela and Mwasita. Dam construction commenced.

In 1932 trials were started by the Veterinary Department (in co-operation with members of the Tsetse Research Department

at Shinyanga and the Agricultural Officer at Shanwa) to test and demonstrate the value of a system of deferred grazing to relieve overstocking in Usukuma and as an anti-soil-erosion measure. The underlying principle here is to make use of non-erodible (and possibly waterless during a part of dry season) *mbuga* areas for wet-season grazing and to reserve eroding home pastures for dry-season use. The principle of reserving dry-season grazing (native term *ngiteri*) is already well established amongst the Wasukuma. The tests were entirely successful, as the stock were found to do well on the *mbuga* grazings during the rains in spite of their muddiness, and the rate of recovery of the reserved home pastures was amazing. After two or three seasons with this method of use, soil erosion due to grazing may be said to become negligible.

In 1935 an Assistant Livestock Officer (Mr. Buckley) was specially detailed to further this scheme of grazing and to organise the seasonal movement of stock in collective herds. Some progress has been achieved, as in each of the three overstocked districts (Shinyanga, Kwimba and Maswa) some 10,000 acres of overgrazed pasture has benefited greatly from the protection from grazing during the growing season. It is reported that the Chiefs are now interested in the scheme, and it appears that the time has arrived when tribal rules should be made to enforce, as an anti-soil-erosion measure, the reservation for dry-season use of any eroding pasture land in Usukuma.

A provincial soil-erosion conference was held at Maswa on May 20th, 1936, where it was decided that the time had arrived for the deliberate formulation of *schemes* for each district to be carried on steadily each year. These commence with increasing numbers of small-size or native demonstrations of anti-erosion work, coupled with plans for windbreaks, hill-side and hill-top plantations, the construction of small dams, the selection of sites for more dams and the encouragement of rotational grazing. In addition, much more strict attention is to be paid to the problem of the small hill, which often is the source of erosion.

Unquestionably in Sukumaland anti-erosion activities are becoming intensified by tribal authority, and constant attention is paid to the problem by many officers stationed in the province and by the Native Authorities there established.

In Bukoba erosion is not very serious as yet, but permanent demonstrations of contour walls, banks and hedges have been made, mulching is advocated, and progress in tree-planting can be reported. The only rules passed by the Native Authorities by which erosion may be arrested are in connection with the main crop, coffee.

In Biharamulo contour ridging with ties and the digging of storm drains by cultivators are insisted on; the Native Authority is not as yet interested, but Government staff is carrying out extensive propaganda and demonstrations have been maintained. In the Bugufi division each coffee-plot in itself is a demonstration of anti-erosion measures; some time will elapse before these backward people grasp the principles, but at present they are fairly

faithful imitators of an approved lay-out. Progress with the weed contour lines, lines of bananas on contour and storm drains with other cultivations may be noted, and it is proposed to carry this work on to finality.

NORTH-EASTERN CIRCLE.

It will be convenient to deal with the Northern and Tanga Provinces together. Anti-erosion activities in this Circle commenced in 1930 with the coffee crop and the onion crop, especially the native crop, as it was felt that through the medium of these crops, untrammelled by tradition, headway could be made. At the same time demonstrations on food-crops and other new or developing crops could be made. The essentials of the work in these somewhat hilly areas lay in ground cover and contour hedging as a preliminary. The arresting of soil wash by these methods could quickly be demonstrated and people could see for themselves. At the same time it was hoped to include the practice of green manuring as an anti-soil-erosion method. Both indigenous and introduced species of cover plants were collected and used in the demonstrations.

In 1931 the scope of these demonstrations was enlarged and the reaction of native people began to be noticed. They sought instruction, and in one month alone 188 native coffee-growers were assisted in the work. A diorama was prepared by Mr. Harvey, twenty-seven trained native instructors spread the propaganda, and by the end of 1931 few could be ignorant of the means by which soil wash could be arrested. In 1932 coffee rules controlling cultivation and lay-out were passed by Native Authorities on Kilimanjaro, and by the end of 1932 1,200 new coffee-plots were laid out and planted in approved fashion. Large-scale demonstrations were laid out in Lushoto not only for coffee but for citrus and for food-crops. These were terraced.

Cultivation on steep river-banks was recognised as unsound, and from 1931 to January, 1936, the "50-yard" rule was in force. Subsequently a more suitable rule was adopted, whereby the boundaries of cultivations near streams was governed by the life of the land. In addition, the grazing of goats and cattle on valley sides was put under control.

By 1934 increased attention was being given to the problem of food plots by means of demonstrations from the Coast to Mbulu in all hilly high-rainfall areas—Usambaras, Pares, Kilimanjaro, Meru and Mbulu. Communal reafforestation to safeguard slopes deemed too steep to use for cultivation gained impetus and is now significant. By the end of 1935 the Chagga Council adopted simple rules to cover all cultivations, the work thus progressing from coffee and onions to all crops. More native workers and demonstrators were trained and a special endeavour was made in the Pares and Usambaras, while barazas were held by the District Officers with an Assistant Conservator and an Agricultural Officer. The Administrative Officers with the Agricultural Officer, Lushoto, held 31 barazas in 1936, each followed by demonstrations, and these

were further followed up by individual instruction given by the native instructors. Especially was it important that the women, whose chief care is the food plot, should be convinced and understand what is required. Finally general cultivation rules were adopted both for the Usambaras and Pare mountainous areas.

On Meru mountain the thickly populated native areas are divided into plots by the use of Mauritius-thorn hedges, thus considerably arresting erosion. There is a tendency, however, to encroach on the banks of streams. General rules covering hedging, reafforestation and the protection of waters have now been adopted.

In Mbulu there is little progress to record ; in fact, owing to cultivators now being able to overflow into reclaimed areas, there is a tendency to abandon the sound anti-erosion system followed in the areas to which the tribe was originally confined. An attempt is now being made to rectify matters. This area provides an example of the risk attending tsetse reclamation without safeguards in connection with occupation. The design of peasant holding schemes now taking shape in other parts of the country checks this error from the beginning.

The reservation of pastures (usually the same from year to year) for the dry season is a well-established practice of the tribe. The extension of the principle of deferred grazing to include all pasture land, and also the sparsely inhabited area of Karato to the north, which is being gradually populated by the Wambulu, is still being explored.

The rapid recovery of overgrazed pasture if properly stocked and grazed on a rotational basis was strikingly demonstrated on a piece of land adjacent to the Native Authority headquarters, but this demonstration had unfortunately to be discontinued owing to the claims of certain influential tribesmen to the land.

The Sonjo tribe in Masailand, occupying an irrigable area, is in a precarious position because of the deterioration of its irrigable lands by erosion. The situation is understood ; it remains to be seen whether real reclamation is possible.

It will be observed that in the cultivation rules adopted it is directed that work which has been undertaken against erosion must be maintained.

On the coastal plain and the slightly undulating country off the mountains in these two provinces the rainfall induces a rapid plant growth, and the soil is usually well covered for most of the year, thus mitigating the evil. On these soils sisal is the major planting industry, and clean cultivation which might lead to erosion is rarely practised. Much of the coastal plain, Handeni and the up-country plains are but sparsely inhabited, and soil erosion brought about by cattle and goats is exceptional in the Tanga, Pangani and Handeni districts. Thus it has been possible for work to be concentrated in the hilly and mountainous areas, and there in many instances people are anchored to their plots because of density of population and by permanent crops like

banana and coffee. Care was taken to see that the methods used did not conflict with or involve fundamental changes in tribal economy.

To the non-native agriculturalist in these provinces during the period 1931-33 demonstrations of suitable anti-erosion methods in coffee were given, and these were laid out or contrived with the aid of some interested planters. These places, which were representative of estates in the Moshi and Arusha districts, were visited by farmers. Papers on soil erosion were read to various Planters' Associations, and the Department offered to lay out the base lines on plantations for contour banks or terraces. A carefully controlled experiment on erosion was established at the Coffee Experiment Station, and each year the results have been published. From bare soil under coffee as much as 25 tons of top soil per acre was moved by rain, whereas practically no loss ensued where treatment was given.

In the drier areas of Arusha the Veterinary and Agricultural Officers, Arusha, have arranged a large demonstration of the use of contour banks—the system ought to be adopted in cultivated land by all farmers.

In the fairly new settlement of Oldeani, where farmers could have checked erosion from the outset, one finds little reaction to the advice of officers given from practically the commencement of the settlement. One farmer has an excellent system of contour ridges and terraces and two others are using box terraces. In Endareda and Kiru erosion is noticeable on many farms, and no noteworthy attempts have yet been made to control it. Advice to cotton planters to leave contour strips of uncultivated bush has not been followed.

In the western Usambaras some planters have commenced to terrace their lands, and on mixed farms some people are countering erosion by the uncultivated contour strip method.

The Muhesa citrus demonstration plot is completely terraced, and in the lay-out of the Mlingano Sisal Experiment Station all sloping land which is cultivated is being contour hedged. Weeded but unused areas are kept under cover crop.

Irrigators must surely realise that a flood of water flushed over sloping land causes erosion and is not good irrigation practice, yet this is the commonest method of irrigation in use.

In the above resumé cultivation rules have been referred to. They are identical in effect, but differ in wording in the different districts. A specimen of each kind is attached.

Cultivation rules covering *all* cultivations have now been adopted by the Native Authorities of the following districts :

Northern and Tanga Provinces :

Moshi
Usambara
Pare
Arusha
Mbulu

Southern Highland :

Uhehe
Rungwe
Mbeya

Rules in connection with one crop only :

Songea
Bukoba

Rules in connection with grazing, the protection of hill-tops and hill-sides from bush cutting and grass burning, tree planting—
See Appendix III :

Usiha, Maswa
Mwanza

Riverside rules :

Moshi
Arusha
Dar es Salaam (by proclamation).

The above rules affect about half the native population of the Territory.

Finally, in order that the problems of erosion shall be studied and concordant action be taken in respect of anti-erosion work throughout the Territory, the Governor issued the following instructions, viz. the Director of Agriculture, the Director of Veterinary Services, the Conservator of Forests, the Provincial Commissioners and the Director of Education should continue to co-operate for the active furtherance of the policy of combating soil erosion in the field on the lines laid down. Formal and informal discussions should take place and close touch with research work and Amani should be maintained. Since some centralisation is essential, to preserve unity of purpose and prevent discordance of policy and effort, the Director of Agriculture or his representative should act as Chairman at formal discussions, records should be kept by him and it is under his auspices that from time to time anti-erosion circulars, explanations, reports and suggestions should be issued. It has been arranged to hold one formal meeting each year, and the foregoing report reviews the position in the Territory up to June 30th, 1937.

I would take this opportunity of expressing the satisfaction and thanks of the Soil Erosion Committee to all officers of Government concerned for their great interest and helpfulness in connection with the problem of soil erosion.

E. HARRISON,
Director of Agriculture.

Morogoro,
25th August, 1937.

APPENDIX I

NATIVE AUTHORITY ANTI-EROSION RULES FOR THE PARE DISTRICT

UNDER AUTHORITY OF SECTION 15 OF THE NATIVE AUTHORITY ORDINANCE

Passed by the Upare Native Council

1. These rules shall be cited as the Soil Erosion rules (1936) of Upare and shall come into force on the 1st day of April, 1937.
2. These rules shall apply to the whole of the district of Upare.
3. On and after the coming into force of these rules no person shall open up or cultivate new land except upon such terms and conditions as the tribal authority may lay down in regard to any particular area or in relation to any particular plot.
4. The onus of ascertaining the directions, terms or conditions of the native authority shall rest upon the person who desires to open up or cultivate any new land.
5. For the purposes of these rules new land shall be deemed to be land that has not been cultivated or occupied for a period of two years or more.
6. The owner, occupier or cultivator of any land which in the opinion of the native authority is insufficiently protected against soil erosion shall take such measures as may be directed by the native authority to prevent soil erosion.
7. Measures which the native authorities may direct to be taken include the following :
 - (a) The introduction of contour ridging by means of the planting of hedges, the building of stone walls or other means.
 - (b) The introduction of methods of terracing.
 - (c) Contour drainage.
 - (d) The prescribing of belts or zones within the land proposed for opening up to be left uncultivated and to order that the bush growing thereon be left undisturbed.
 - (e) The prescribing of the planting of a cover crop for the protection of the soil.
 - (f) The prescribing of the alignment of rows of crops or of uprooted or mown weeds and grass.
 - (g) The prescribing of the disposal of drainage from dwellings or the roofs of houses.
8. The native authorities shall have power to prohibit the opening up for purposes of cultivation or for grazing or for building purposes any land within Upare.
9. Any person found guilty of contravention of the provision of these rules shall be liable to a fine not exceeding Shillings 40 or to imprisonment for a term not exceeding one month.
10. The court in passing sentence may in addition to the imposition of the said fine or the award of imprisonment order that the convicted

person shall be prohibited from cultivating the land in regard to which the offence has been committed until such time as he shall have obeyed the requirements of the native authorities.

11. These rules and any rules varying or amending the same shall be executed by the native authorities in consultation with and in accordance with the advice of the Director of Agriculture or his local lawful representative appointed for duty in Upare.

APPENDIX II

NATIVE AUTHORITIES' COFFEE RULES

Rule 1.—Only such coffee seedlings may be planted and only such seed planted in nurseries as has first been approved by the Agricultural Department.

Rule 2.—Every individual wishing to plant coffee must plant not less than 250 trees. All trees must be planted 9 ft. apart.

Rule 3.—Before planting up a shamba every individual must satisfy the Agricultural Department as to the suitability of the soil.

Rule 4.—The land must be prepared to the satisfaction of the Agricultural Officer or his nominee before any individual may plant coffee.

Penalty.—Any individual who does not comply with these regulations is liable to have all plants uprooted by the Agricultural Officer or his nominee.

APPENDIX III

NOTICE

(TRANSLATION)

There is no permission to cut down the trees from the undermentioned hills :

1. Hill of Talaga
2. „ Nyandekwa ; Kubwa
3. „ Uyemba
4. „ Nyang'hombe
5. „ Nyambiti
6. „ Ilobe
7. „ Mwabalungu
8. „ Ngunga
9. „ Lugululwambiti
10. „ Longe
11. „ Mhimbili
12. „ Kilimo
13. „ Mbalagani
14. „ Nagali

15. Hill of Gawa
16. „ Wame
17. „ Salamba
18. „ Siga
19. „ Bunyanyembe
20. „ Ibitwabujiku
21. „ Kitaganda
22. „ Bushoma
23. „ Kisumvani
24. „ Mwibusu

I, Mohamed Makwaia K.M. s/o Mwandu, Chief of Basiya, give out this notice in order to let all people of Usiha know that from this fifteenth day of January, 1937, there will be no permission for a person to cut down the trees from the above-mentioned hills unless if he wants them he should approach the Native Authority for a permit to cut trees—stating the number of trees that he wants to remove from such and such hill. The chief reason of preventing people to cut down trees from these hills is because if the trees are cut down without any good reason, all the trees will be taken and the remainder will be stones alone. The country will become more clear than is needed. If the country is plain, the rain also decreases. I wish all people to understand that there is no permission to cut down trees unless permission is sought for to do so. The trees give good shade and that the wind also cannot blow heavily which would manage to sleep the rain away.

We have been frequently told by the Surveyors that if the country has much trees there might be heavy rain also from the hills and that if the country has none the rain also decreases. If we continue cutting the trees we shall see that there may be no rain at all.

Now I want all people to understand that there is no permission for a person to cut down the trees from the above-mentioned hills.

(Sgd.) M. Makwaia Mwandu, K.M.
Mtemi wa Usiha.

This is a (fairly literal) translation of an order given by Chief Makwaia to the large population of Usiha, Shinyanga District, Lake Province.

APPENDIX IV

RIVERSIDE RULES

CONSERVATION OF WATER AND PREVENTION OF SOIL- EROSION RULES ENACTED BY THE CHAGGA COUNCIL (MOSHI DISTRICT) UNDER SECTION 15 OF THE NATIVE AUTHORITY ORDINANCE

Enacted January, 1936.

1. These rules are issued by the Council of Wachagga Chiefs. They have been approved by His Excellency the Governor.

2. No person may plant crops of any description or cut trees within an area bordering any river, spring or Koronge which has been demarcated by the Native Authority with the advice of the District Officer, except with sanction of his chief.

3. Any person owning coffee planted prior to August 27th, 1931, within a prescribed area of a river edge or spring must interplant banana or accepted shade trees between such coffee. Further, no person shall increase such coffee within prescribed areas.

4. The coffee trees of any person which have been planted within the prescribed areas subsequent to August 27th, 1931, contrary to rule issued by the Chagga Native Authority on that date shall be uprooted, and such person shall be guilty of an offence under these rules and in addition may be compelled to plant trees in their place. Failure so to plant, if ordered, shall be an offence.

5. Every person who owns a shamba bordering on a prescribed area shall when required by the Native Authority place beacons along the boundary when demarcated. The beacons must be constructed of stone or other material accepted by an Administrative Officer or Agricultural Officer or Native Authority, and each beacon must be visible to a person standing at the adjoining one.

6. Any person contravening any of the above rules shall be liable to a fine not exceeding Shillings 50 (Fifty) or to imprisonment for one month with or without hard labour or to both. In addition to any punishment imposed under this rule an offender may be ordered to uproot crops of any description planted in contravention of any of the above rules and to plant *Mfume* or *Tembe* or other approved trees in the area so uprooted.

7. In such Chiefdoms as the Chief in Council with his Elders consider that in the interests of the people and without undue hardship to them the grazing of stock should be prohibited in the prescribed areas, the Chief may, with the prior approval of the District Officer, order that such areas shall be kept free of grazing animals. Any person thereafter grazing stock in such a prescribed area shall be guilty of an offence under these rules.

8. The rules issued by the Council of Wachagga Chiefs with the approval of His Excellency the Governor on September 29th, 1934, are hereby rescinded.