The geography of the swamp rice region of coastal Sierra Leone

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THE GEOGRAPHY OF THE SWAMP RICE REGION OF COASTAL SIERRA LEONE

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by

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P R E F A C E

This study was made possible by a Research Fellowship grant offered by the Government of Sierra Leone for the academic year 1964/65 under the Commonwealth Scholarship and Fellowship Plan. Research was centred at Fourah Bay College, the University College of Sierra Leone, under the supervision of Professor J. I. Clarke of the Department of Geography. This dissertation incorporates the research work undertaken during a period of nine months.

The distributional aspects of the study necessitated the systematic mapping of swamps, swamp rice lands and other related features. The 1:50,000 scale maps (First edition in 1961) produced by the Directorate of Overseas surveys were used as base maps, which are the most up-to-date and accurate maps available on land use of Sierra Leone. Only sixty two sheets covering the western half of the country were available at the time of consultation. From these, swamp rice, mangrove, grassland swamps, and other swamp lands were plotted. These tracings were reduced to 1:250,000 using the Grant Projector, and 181 maps were made showing separately the four distribution patterns. Material from these maps was used to compile four maps (on the same scale) to depict the four distribution patterns in the western half of the country as a whole. Subsequently these four maps were photographically reduced to the scale of 1:500,000,

and are incorporated in this dissertation. At all stages of the compilation, a determined effort was made to achieve maximum accuracy and perfection. Aerial photographs of Sierra Leone taken by the Fairey Air Surveys Limited, in 1958 and in 1962 were constantly referred to, to acquire detailed information.

A number of other original maps are included in this study. A few unpublished maps of Professor J. I. Clark, Dr. S. Gregory, (Senior Lecturer, University of Liverpool) and Mr. P.K. Mitchell, (Senior Lecturer, Fourah Bay College) are embodied in the dissertation for which I owe much thanks to them.

Field research was successfully undertaken mostly because of the co-operation and help willingly given by many individuals too numerous to mention here. The author being a foreigner, less acquainted with local conditions, perhaps would not have been able to conduct proper field work, if not for the assistance of several local school teachers and Government Officials who patiently interpreted in the local languages - Mende and Temne. I greatly appreciate the hospitality and help of the chiefs and farmers and also of a number of private individuals both local and foreign.

Dr. H.D. Jordan, the Director of the Rice Research Station at Rokupr, and several other officers of Government

Departments - Agriculture and Natural Resources; Rice; Co-operative; Lands and Surveys - have given their time generously to answer my questions and to provide me with valuable information. To all these individuals and institutions I collectively convey my sincere thanks.

The writing of the dissertation was conducted under the thoughtful guidance of Professor J. I. Clarke, whose approach to the study of Geography to a considerable extent moulded my own approach. He has always given freely of his guidance and help at all stages of this study, and I owe more than I can readily say, to his exceptional critical ability. His scholarly wisdom was generously given to further my own geographical understanding. I express my deep gratitude and thanks to him, whose association though unfortunately limited to a span of nine months, would be always gratefully remembered by me. Messrs. P. K. Mitchell, G.J. Williams, S.J.A. Nelson and other colleagues of the Department of Geography of Fourah Bay College, have throughout contributed suggestions and criticisms for which I am thankful to them.

My grateful thoughts and respects to the Governments of both Ceylon and Sierra Leone, for the opportunity afforded to pursue this study. My parents who have always inspired and encouraged me particularly in my academic work, are respectfully remembered here.

September, 1965. DAYA UPALI HEWAPATHIRANE.

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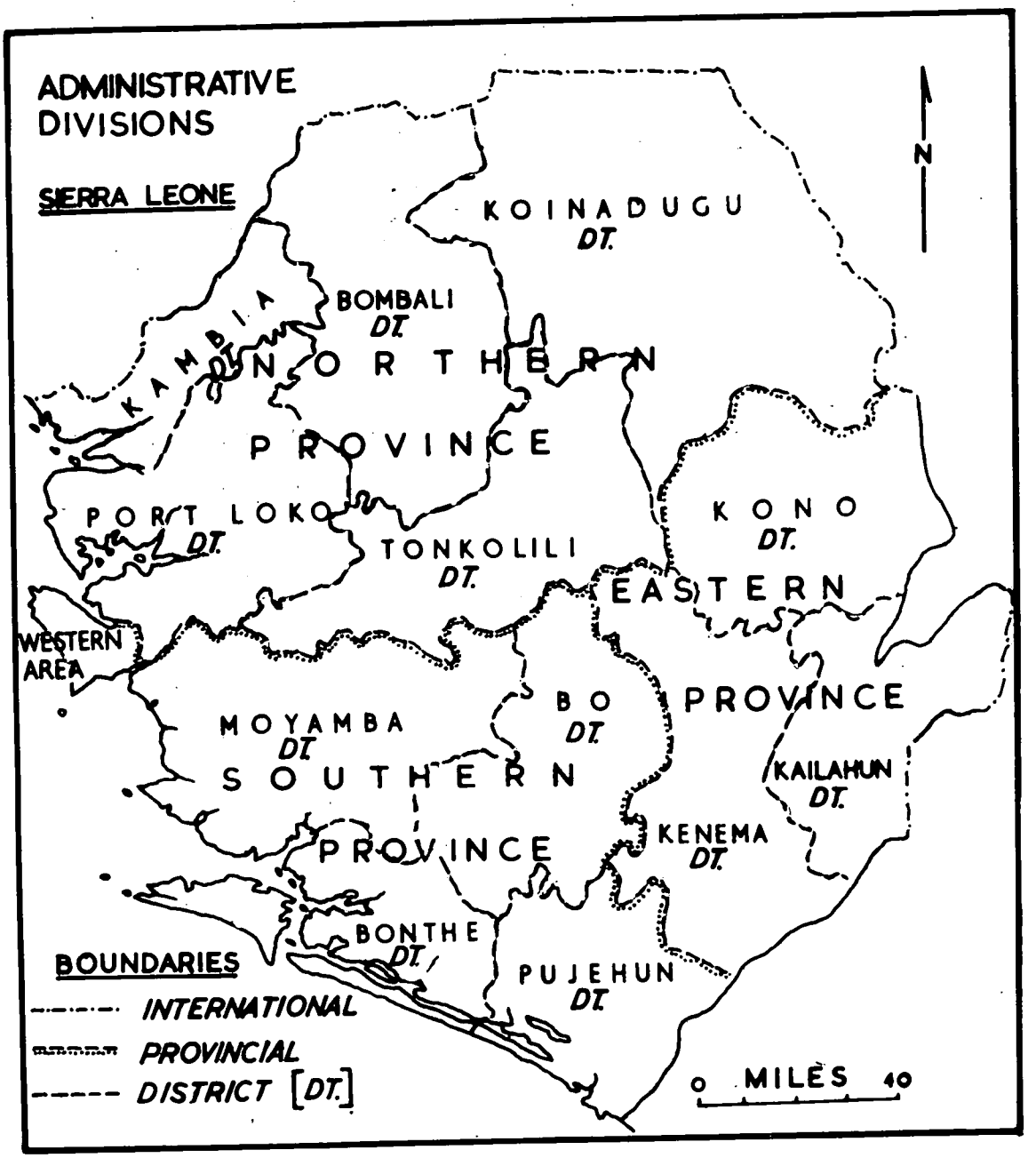
ADMINISTRATIVE DIVISIONS
SIERRA LEONE
N
KOINADUGU DT.
BOMBALI DT.
KAMBIA
NORTHERN PROVINCE
PORT LOKO DT.
TONKOLILI DT.
KONO DT.
EASTERN PROVINCE
WESTERN AREA
MOYAMBA DT.
BO DT.
SOUTHERN PROVINCE
KAILAHUN DT.
KENEMA DT.
BONTHE DT.
PUJEHUN DT.
BOUNDARIES
INTERNATIONAL
PROVINCIAL
DISTRICT [DT.]
0 MILES 40

Fig. 1.

CHAPTER I

I N T R O D U C T I O N

Some Aspects of Rice Culture in the Tropics

Rice culture in the tropical world well exemplifies man's different reactions to similar physical conditions. This is well brought out in a comparative study of tropical Asia and tropical Africa. In the former, rice culture has been, from time immemorial, the dominant human activity, so much so that this region has far surpassed all other rice growing regions of the world in both area and production. The tropical Asian man has not only obeyed the natural environment and developed his fields in places where natural conditions were found favourable, but also in many other places he has modified the environment considerably. The various techniques evolved by his civilization such as irrigation and water control, manuring, and artificial terracing made it possible for him to bring under the plough a great expanse of land. Today almost all land suitable for rice has been brought under its domain. This has resulted in tropical Asia, though comprising only 21% of the total area of the tropical world, possessing about 61% of the total world rice lands and accounting for about 40% of the total world production of rice.(1)

In contrast to tropical Asia, in tropical Africa as a whole rice is of limited importance. The total rice area in tropical Africa accounts for only about 2% of the world's total, and the production is only about 1% of total world production. Vast areas of potential rice lands lie unutilized.(2) A substantial portion of the area under cultivation constitutes upland farms where rice cultivation is conducted on the basis of shifting cultivation or "bush fallow" system. Man's obedience to physical environment is explicitly displayed here. The backwardness of his agricultural techniques has resulted in the quality of this land use being very low. The lands where this type of agriculture is practised are not these most suitable for rice. However, circumscribed by his techniques, the tropical African farmer has had to limit himself to these lands where soils were light and poor but were best adapted to his extensive techniques. He has neglected the swampy and heavy soils of the lowlands and valley bottoms which are endowed with the greater agricultural potentialities, but are less easily utilisable by means of the bush fallow system. It is only recently that the potentialities of the physical environment for rice production have been realized in most parts of tropical Africa. Its real utilisation has been attempted only since the turn of

the present century. This is especially so in respect of the extensive swamp lands of tropical West Africa, which have been acclaimed as ideally suited for the cultivation of rice. "It ensures good yields, avoids the need for fallow, prevents soil erosion and ensures the future," observes P. Gourou in regard to swamp rice cultivation.(3)

The different reactions of man in the two regions to similar physical environments can be therefore accounted for mostly by reference to cultural factors, though micro-physical factors have had their effects too, to a certain extent. The part that civilization plays in respect of land use has already been hinted at. Long established civilization and political stability have a great bearing on the development of agriculture. Tropical Asia reveals explicably the great impact of the flourishing civilizations which emerged in the region, and the evolution of new techniques of cultivation. Natural environment does not compel man to adopt such and such techniques. It is man who evolves or invents them. They are given to man by civilization. Civilization is not the product of physical environments. P. Gourou explains the limited development of rice culture in tropical Africa as "a mark of backward civilization . . .".(4)

The backwardness of agricultural techniques and the

little organization of space through social and political institutions have inhibited the control by the tropical African, for a long duration of large and expanding areas. The relatively sparse population of the region and its unevenness in distribution have been mostly a result of this. Bush fallow system fails to provide increasing amounts of food that a growing population requires. Not only is its output per acre low, but also its productivity per man-hour and the total mass of food delivered to mankind expanding in numbers, is very low. Thus the sparse population that resulted in tropical Africa, had the counter effect of keeping man away from activities which demanded more hands. Therefore it follows that lowland permanent rice cultivation which demands much labour even without controlled irrigation, did not get an impetus or incentive. This fact is clearly brought out when one considers tropical Asia, where its dense population made it possible to bring more and more land under rice cultivation. Dense population, moreover, necessitates the production of greater quantities of food. This leads not only to the extension of land that is readily cultivable, but also to the adoption of techniques and methods to modify physical conditions of the area which do not offer

complete favour with regard to agriculture. Besides, it leads to the intensification of agriculture. All these developments have been noticed in tropical Asia.

In tropical Africa, the coastal lowlands and the riverain areas especially have been very sparsely populated from very early times. This is attributable to slave trading. As the sea and the rivers were the main routes of slave trading, native people fearfully avoided the coastal and riverain areas and found refuge in the interior upland forests. This led to the neglect of rich potential rice lands, particularly the deltas, river banks, flood plains and coastal swamps.

Analysing the physical environment in tropical Asia and tropical Africa, one is inclined to think that local differences in the physical environment of the two regions have also had their effects on the neglect of the potential rice lands in tropical Africa. A noteworthy feature in tropical Africa, is the absence of extensive fertile flood plains and river deltas comparable to those of the Ganges, Red River or Irawaddy. These river basins and deltas have had an inviting effect and greatly facilitated rice cultivation in tropical Asia. Moreover, the fact that the rivers of tropical Africa, having their watersheds

within the tropics has resulted in their relatively light load of nutrient bearing silt. The great rivers of tropical Asia on the other hand have the physical advantage by receiving a good deal of their water and alluvium from their head-streams outside the tropics.

The unhealthy and uninviting nature of the swamp lands of tropical West Africa - the most important potential rice lands of the region - and the difficulty of clearing the dense vegetation cover of mangrove and sedge in them have also had an inhibitive effect in regard to their development for permanent rice cultivation. Moreover, the availability of vast stretches of upland forested land which could be easily cleared by burning and cultivated, would have perhaps led the people away from swamps. Seasonal deep flooding in the latter areas also would have perhaps discouraged people from settling down in river valleys. Tradition, superstition and beliefs also would have had a part to play in keeping the people steadfastly engaged in shifting cultivation in the uplands.

'Rice Region' of Western Tropical Africa

In the western coastal zone of tropical Africa, rice assumes a dominant position. Here the 'rice region' stretches from the Gambia south to the Bandama river in the

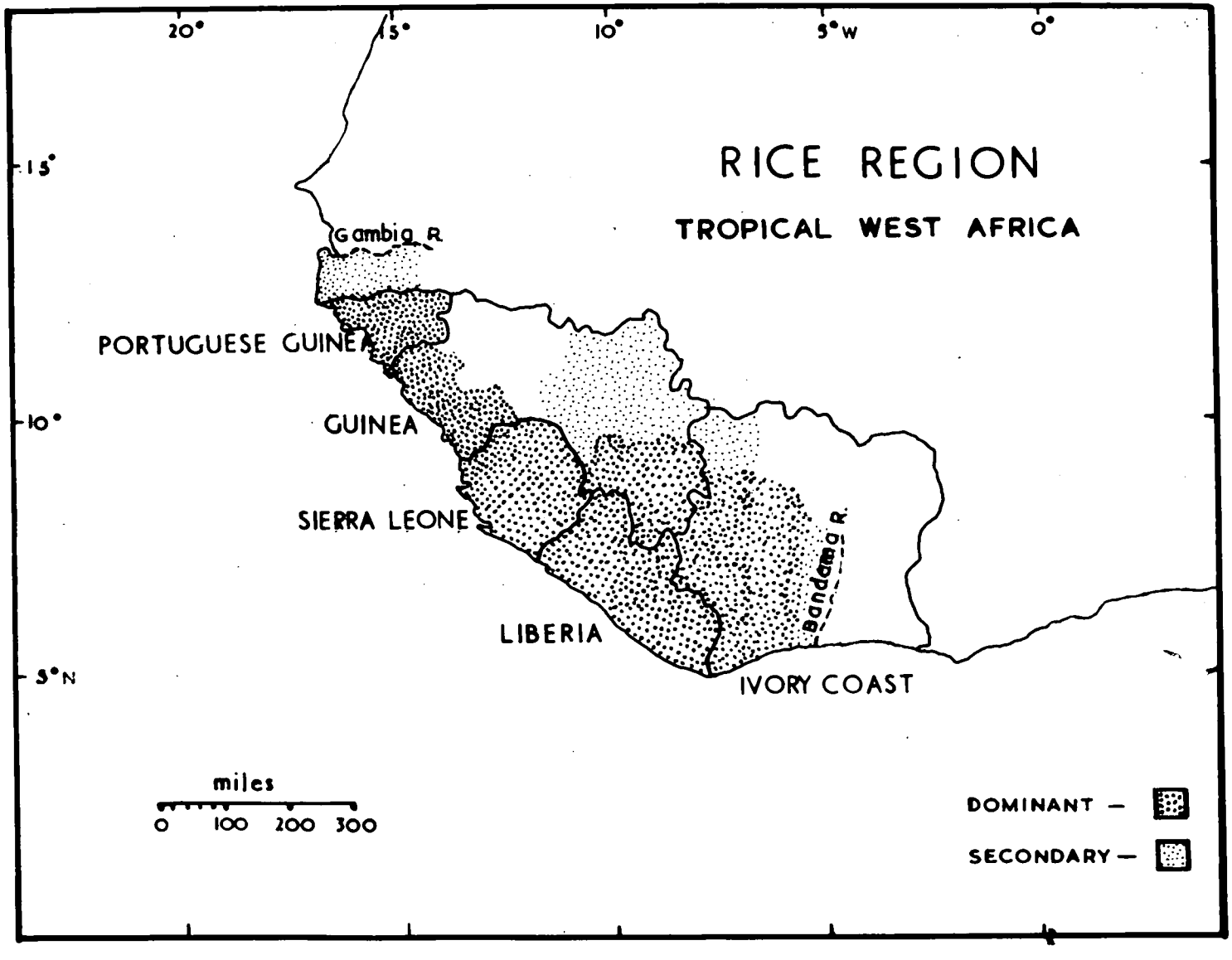
RICE REGION
TROPICAL WEST AFRICA
20°
15°
10°
5°W
0°
15°
10°
5°N
Gambia R.
PORTUGUESE GUINEA
GUINEA
SIERRA LEONE
LIBERIA
IVORY COAST
Bandama R.
miles
0 100 200 300
DOMINANT —
SECONDARY —

Fig. 2.

centre of the Ivory Coast. Within this region, rice shows a preponderance in cultivation in five countries - Portuguese Guinea, Guinea, Sierra Leone, Liberia and Ivory Coast. (Fig. 2) In all these countries rice is the staple food. Among these territories, Guinea and Sierra Leone emerge as the most important rice producers.(5)

In both Guinea and Sierra Leone there has been a progressive decline in the area under rice cultivation in the recent past. However, total production in both countries has shown an upward trend, especially due to increase in yield per acre.

In Sierra Leone, the increase in production of rice in the recent past is attributable to the utilisation of the more productive swamp lands for rice cultivation. The reasonably good yields (according to local standards) which these swamps provided brought about a discouraging influence on the traditional upland farm, which gradually led to a decline in the upland 'bush fallow' system of farming.

Traditional Upland Farming in Sierra Leone

In Sierra Leone, swamp rice cultivation (grown in standing water at least during a part of the growing season, with natural flooding) is of recent origin.

In contrast rice cultivation on upland farms is of considerable antiquity, although exact information on its initiation and development are not available.

Upland farming is dependent solely on seasonal rainfall and the fertility of the soil. Until recently this type of farming not only satisfied all the rice needs of the people of Sierra Leone, but also was able to produce a surplus for export. In 1953 she exported as much as 663 tons. Today production has declined noticeably, although a substantial portion of the rice produced in Sierra Leone - almost half - comes from upland farms. In 1951 it was estimated that there were 700,000 acres of upland farms.(6) In 1957 this dwindled to 590,000 acres.(7) In more recent years this has been reduced still further.

It seems likely that upland rice was one of the earliest cultivated crops of Sierra Leone. This fact is suggested when one considers the other minor food crops of Sierra Leone, such as cassava, sweet potatoes, groundnuts, maize and millets, all of which exemplifying an introduced origin.

The first rices grown in Sierra Leone upland farms have been most probably the red skin rices - Oryza globerrima and Oryza staffii. These are the indegeneous cultivated rice

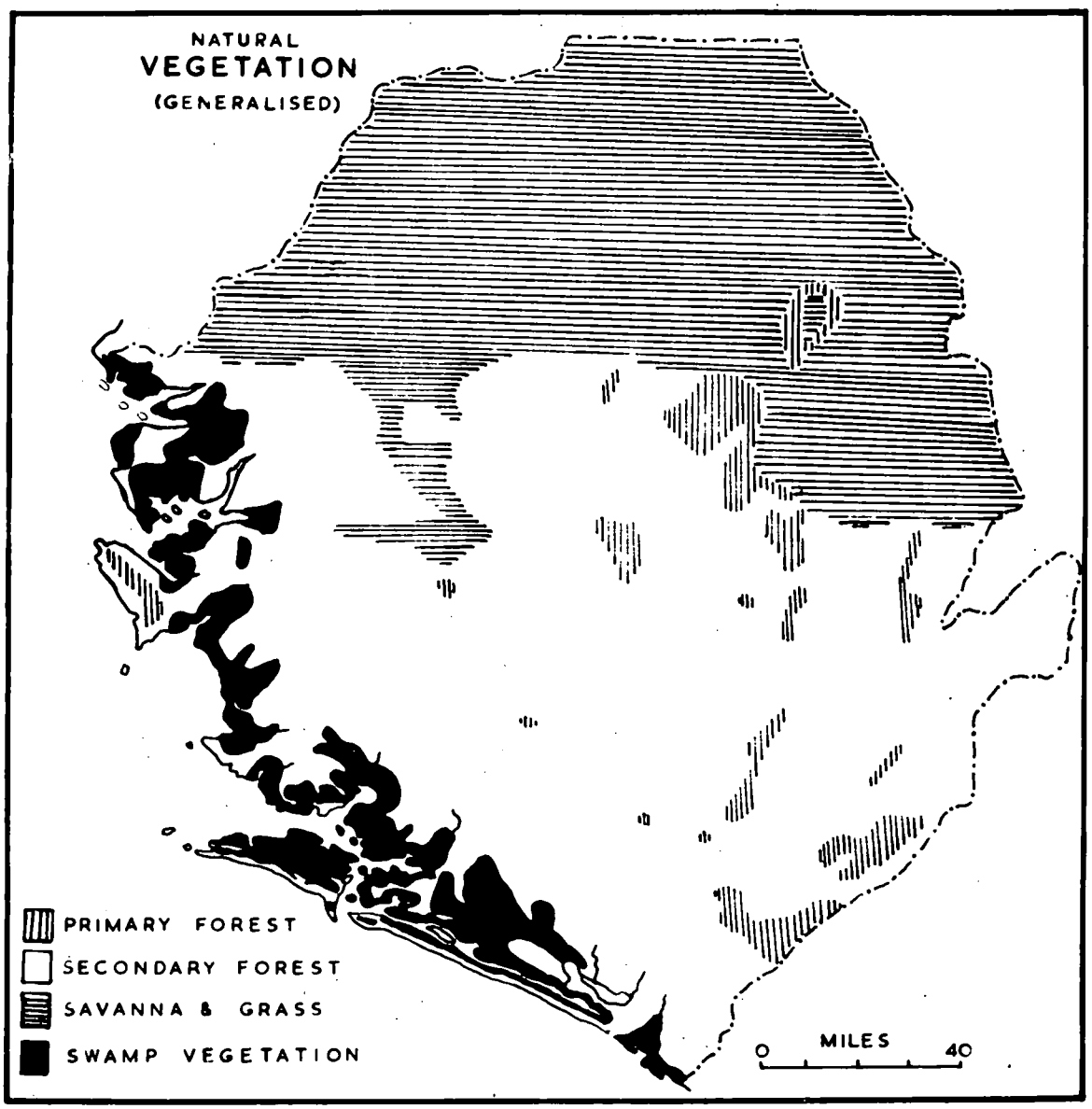
NATURAL
VEGETATION
(GENERALISED)
PRIMARY FOREST
SECONDARY FOREST
SAVANNA & GRASS
SWAMP VEGETATION
0 MILES 40

Fig. 3.

of Africa, grown for some 3500 years. Later, Oryza sativa came into the country probably overland across the Sahara desert. This has largely replaced the earlier varieties.(8)

Upland farming in Sierra Leone is carried on mostly in secondary forests which clothe a greater portion of the area of the country. (Fig. 3) Shifting cultivation in primary forests has played a dominant role in the degradation of these forests to secondary forests. So much so that new primary forests account for only a bare three per cent of the area of the country. The effects of shifting cultivation were seen in savanna lands too. Though natural causes too have played their part in the degradation of land in Sierra Leone, shifting cultivation has to be held more responsible. (Fig. 4)

The method of upland rice farming in Sierra Leone is simple, though its effects are complex. Rice is grown under the bush fallow system so well known in other parts of the tropics. In the dry season a plot of secondary forest is selected and felled. A few oil palms and larger trees may be left standing. These have proved useful in fixing the soil and protecting it from excessive erosion. Tree stumps are also generally not cleared. After the leaves and branches of the felled forest have dried, they are set on fire.

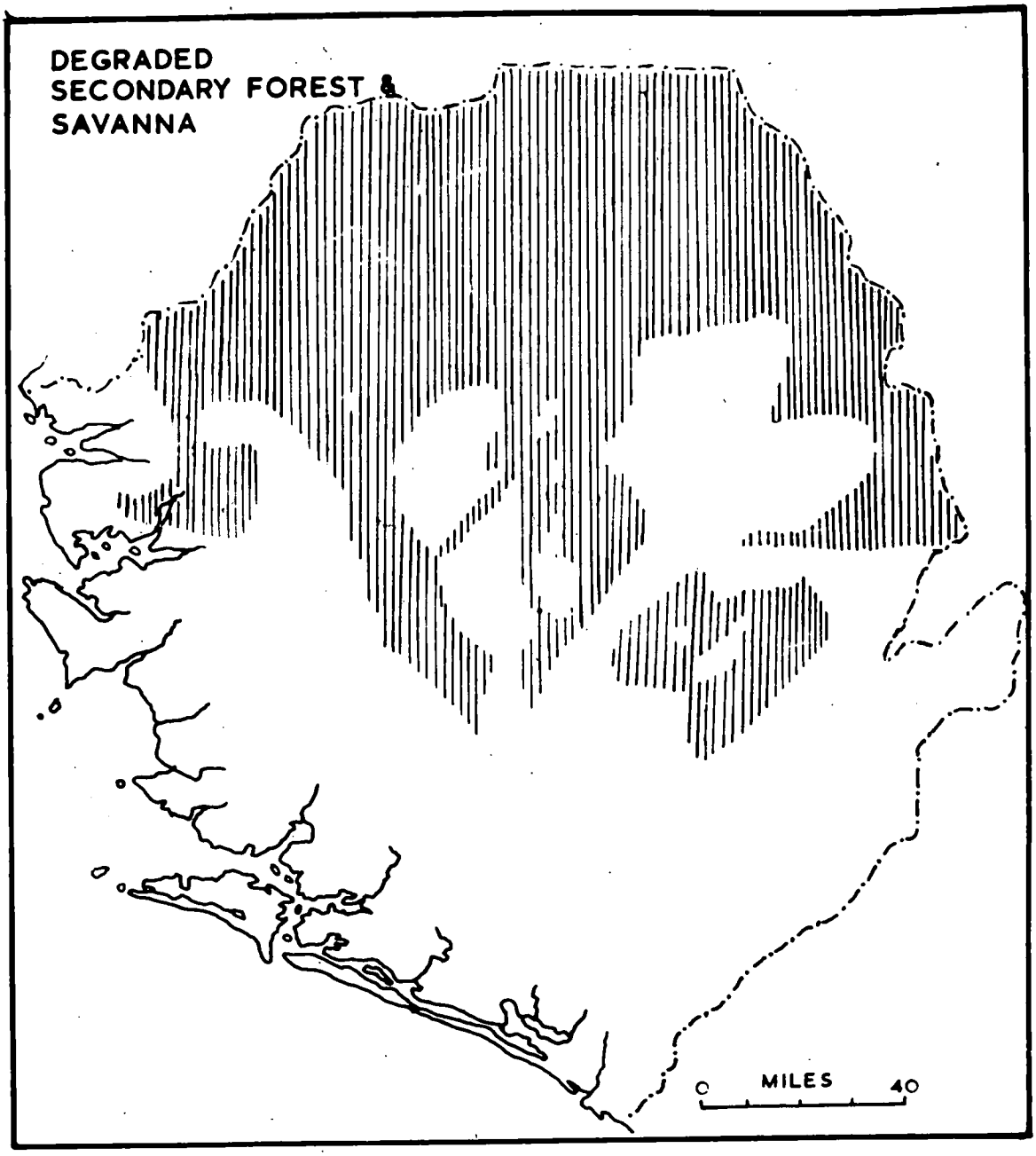

Fig. 4.

This helps the farmer to clear the plot quickly and easily. Fire, while making the forest soil more friable, enables the land to be cultivated without turning up the soil. Moreoever, it leaves fertile ashes on the soil for the nourishment of the forthcoming crop. However, these advantages of 'firing' cannot overwhelm the losses that it causes. 'Firing' leads to the destruction of a great amount of organic matter which could be profitably used. Tremendous quantities of nitrogen go up in smoke. "Potash is reduced to a very soluble form of carbonate which is leached away by the first showers and the humus and bacteria are destroyed."(9) But in spite of these drawbacks, one is faced with the question of the alternative that is available to these primitive farmers, considering the level of their civilization, the nature of the forest, and the hoe and the inadequate axe - the only implements that are usually available to them.

On this 'fire' depends the success or otherwise of the season's farming. If the 'burning' is delayed or rains come early, preparation of the field for cultivation would be made difficult. In the recent past, early rainfall and the impossibility or incompleteness of burn in many uplands have led the farmer to look to the inland valley swamps. An incomplete burn necessitates considerable extra labour in

gathering the unburnt material into heaps and reburning it. Unburnt sticks are used as firewood as well as to build pyramidal frameworks at various sites in the farm, to support creepers such as yams and beans.

With the onset of the rains towards the middle of the year, paddy is broadcast on the cleared plot and is lightly hoed into the surface. Seed rates are usually about sixty pounds per acre. Other crops are also sown mixed with rice, but usually in small quantities. The commonest crops are sorghums, bulrush millet, benniseed, cassava, capsicums, maize, vegetables and in some areas cotton may also be included. But where soil is found less fertile, upland rice is grown as a pure crop. Mixed cultivation helps in avoiding major trouble from pests and diseases.

The growth of rice is entirely dependent upon the rainfall. While the crop is growing, weeding is conducted. Bird scaring is a common practice when rice comes into flower. The crop matures relatively quickly, in ninety to a hundred days. The crop is harvested usually about four months after sowing. Harvesting is normally done with the help of a small knife. Individual panicles are cut and collected and the bundles of panicles are often inverted on stumps to dry for a few days, before being removed from the

farm. The subsidiary crops are harvested as they ripen, and this is usually after the rice crop has been collected.

Very occasionally two rice crops are taken from the same plot of land in successive years. However, in some areas a second crop of groundnuts (in the north) or fundi or cassava (in the south) is grown. But the usual practice is to abandon the land after one crop.

In the past the range of the fallow period was usually twelve to fifteen years. In savanna lands where this type of cultivation is practised, the fallow period usually ranges between six and ten years, and between fallows two years cropping is normally conducted. In savanna lands the farm cycle ends in a grass fallow instead of a bush fallow.

Therefore it would be seen that under the bush fallow system of rice cultivation, the felling of the secondary forest or savanna grassland, and the cropping of soil are carried out in a regular rotation, a varying number of years elapsing before cultivation returns to the same land. The long fallow period leads to the re-establishment of the natural vegetation and of the fertility of the soil. Hence, one is inclined to think that provided sufficient land is available, and the fallow period is of sufficient duration and the slope of the land is not too excessive as to lead to heavy soil

erosion, the system works well, though in fact it is wasteful of land and of labour.

This system of bush fallow agriculture has been able to provide practically all the rice requirements of Sierra Leone until the latter part of the last century, when swamp rice cultivation began to be taken up. However, even today this type of farming is important, for it still forms the basis of all upland farming.

Economic Social and Political Changes and the Consequent Rise in Demand for Rice

Significant developments in Sierra Leone - economic, social and political - towards the end of the nineteenth century and especially after the second decade of the present century, had remarkable effects on all aspects of the country's life. Sierra Leone saw revolutionary changes during this period. Upland farming did not escape these developments. These not only led to a decline in upland bush fallow cultivation, but also resulted in a change in emphasis from upland rice to swamp rice cultivation.

The pacification of the territory and a period of general political stability were gaining ground with the establishment of the Protectorate of Sierra Leone in 1896.

Health and social service activities inaugurated by the Government were improving the general conditions of the people. Along with it, the country started to open up with the development of the railway in 1896. This facilitated not only the stimulation and intensification of trade, but also the emergence of a number of towns and settlements along it. Freetown, the main centre of intercourse and trade began a period of rapid expansion. This growth was accelerated with the increased overseas trade which the port of Freetown was made to handle. All these factors in combination elevated Freetown to a centre of both economic and cultural significance.

Meanwhile, commercial agriculture - coffee, cocoa, palm oil and ginger - was undergoing an era of prosperity and expansion. This agriculture and its allied activities provided opportunities of employment for a large number of people. An increase in the population of the planting areas and a rise in the standards of living were the inevitable outcome. Towns began to grow as collecting and distributing centres, catering to the plantation areas. (Kailahun, Gegbwema, Banda Juma, Pujehun, Yele, Gbangbama and almost all the railway towns.) Road development further helped the emergence of new towns and the expansion of the already existing ones. Thus a notable rise in the urban population

and the population engaged in commercial agriculture, was witnessed in the interior of the country.

The onset of the era of diamond and iron ore mining in the early 1930's further stimulated the development of roads and towns. A steady movement of a large number of people from the farms to the mining areas, in search of better incomes, took place during this period.(10) By 1936, about 14,000 farmers with their families had migrated to mining areas.(11) The new incomes generated in the diamond mining areas led to the rise of the standard of living of the people of the area. These areas also saw the influx of a large number of foreigners. The outcome of all these developments was theemergence of a large, rising non-agricultural population in the area.

Thus it is evident that, with the turn of the century and especially after its first two decades, a remarkable increase in the population of Sierra Leone and a notable rise in the general standard of living of the people were observed.

TABLE I

ESTIMATES OF POPULATION OF SIERRA LEONE(12)

1901	1,024,278	1947	1,858,275
1911	1,400,149	1957	2,120,000
1921	1,540,554	1960	2,450,000
1931	1,768,480	1963	2,180,000
1937	1,800,000	(census)	

In the 1930's rice cultivation experienced a setback due to the flow of a large number of young farmers to mining, plantation (cash crop) and urban areas, in search of better incomes. But there was a strong counter influence too, which generated a boost to subsistence agriculture and especially to rice production. This was the rapidly expanding demand for food.

The demand for rice was intensified with the outbreak of the World War in 1939. A large number of farmers was listed for military and constructional work in Sierra Leone. By 1942, war labour and other recruitment connected with war activities totalled about 73,000.(13)

Decline of Upland Farming and the Emphasis on Swamp Farming.

With the turn of the century the demand for food, particularly rice, began to increase steadily as a result of the economic, political and social changes that were taking place in the country. Upland farms attempted to rise to the occasion. Felling of secondary forest was intensified. The cleared plots became larger. Farms penetrated even to the fairly inaccessible parts of the forests. But the most significant adjustment was the shortening of the fallow period due to the great pressure on the land. The twelve to fifteen

years fallow that was prevalent during the early days was reduced to as low as three or four years in some areas. Later, this had great repercussions on the system of agriculture. It led to the slowing down of forest regeneration, which directly affected soil fertility. The insufficient build-up of nutrients in the soil that resulted, led to the deterioration of the productivity of the land. Short fallow meant little growth of vegetation which meant little quantity of ash to enrich the soil. The crops that were cultivated on such land inevitably showed a decline in yields to as low as 400 lbs. of rice per acre.(14)

The expansion of cleared plots, the shortening of the fallow period, and the resultant small growth of vegetative cover enabled rainfall to beat hard at the ground and to rape the land of its friable surface soils. This was more greatly felt in the sloping lands. Thus, the upland farm degenerated considerably. The result was that this system of agriculture could not keep pace with the rising demand for rice, and the country as a whole was fast falling behind in its race between population increase and food production. To ameliorate the grave situation, Sierra Leone started importing rice from foreign countries in increasing quantities. A steady rise in imports was noticed particularly after 1954.

TABLE 2.

RICE IMPORTS[15]

Year	tons	Value £
1954	4,586	289,858
1955	21,065	968,018
1956	36,800	1,650,442
1957	31,052	1,492,270
1958	21,784	1,027,346
1959	43,305	1,991,755
1960	28,542	1,237,279
1961	4,108	209,626
1962	26,827	1,358,981
1963	20,818	941,000

(£1 = Le2.00)

The increasing amounts of money flowing out of the country due to the importation of rice, alarmed the Government and attention was laid on seeking ways and means of improving the situation. The extension of swamp rice cultivation thus received a strong emphasis.

The great potentialities of swamp lands, both coastal and inland, as rice producing lands were noted by the Government as far back as 1920, which led to the setting up

of demonstration farms first in the tidal swamps of Southern Province and later in inland swamps almost all over the country. It was found that swamp rice farming not only gave a relatively high yield per acre (double that of upland farm), but also does not cause degeneration of lands as does upland farming. Moreover, swamp farms could be cultivated annually unlike the upland farms. Therefore, the Government started an extensive programme of providing encouragement, incentives and assistance to those farmers who were willing to come down from the uplands to the swamps. Demonstration farms showed to the farmers, the greater superiority of swamps over the uplands as rice producers. The Government started a loan scheme in 1939 to help farmers to fell mangrove and for swamp clearance. In 1949 mechanical cultivation was introduced and was greatly extended after 1952. Many other facilities including fertilizer and seed paddy distribution, marketing, milling and storage facilities and a guaranteed price scheme were provided. The development of Co-operative societies later on, provided more facilities for the farmer. Thus more and more people were attracted to the swamps and a new era in rice cultivation in Sierra Leone was inaugurated, with a strong emphasis on swamp rice.

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CHAPTER II

SWAMPS OF SIERRA LEONE

Swamp land constitutes a natural resource of utmost importance to Sierra Leone. Its value is increasingly realized today not only due to the general degeneration that has occurred in the rest of the land resources of the country, but also due to the significant economic and social changes that have taken place in Sierra Leone since the turn of the present century.

The agricultural potentialities of swamps, especially in respect of rice cultivation cannot be overestimated. The rich fertile soils and the seasonal renewal of the silt coverage, the water retaining capacity, and the generally friable nature of the soils of a larger part of the swamps make them productive rice lands.

The flat and continuous spread of a greater part of the swamps make it feasible to adopt modern methods of cultivation such as mechanisation, on an extensive scale. This aspect of the land coupled with the coastal and riverain location of a greater part of the swamps make possible easy transport and communication.

Climatically, swamps are particularly suited for rice cultivation, due to the sharp dual seasonal aspect. A large part of the rains coming in one season and the distinct dry season

enable the adoption of judicious farming practices. The seasonal river flooding caused by heavy rains and tidal backing, serve not only as a natural irrigation facility for rice cultivation, but also as a source of a new silt layer. In areas closest to the coast, brackish water influence caused by tides, especially in the dry season, serves as a useful means of controlling and preventing the invasion of weeds on the rice fields.

The significance of swamps is obtrusively seen, when one considers the potentialities of the other parts of the country, especially in respect of agricultural development. It has been already pointed out, in the previous chapter, how traditional upland 'bush farming' has led to the progressive and steady degradation of land, so much so that this type of farming has failed to keep pace with the increasing food requirements of the country. The increase of population, urbanisation, industrial and mining development and the rising incomes, have brought about a boost in the demand for food, particularly rice, the staple diet of the people. This has necessitated the importation of rice. This has resulted in an increasing drain of capital abroad. In this light, the potentialities of swamp lands of the country are exceedingly great.

The swamp lands of Sierra Leone are capable of producing not only rice but also a variety of other crops, such as sugar cane,

bananas, vegetables and fruits,[1] whose demand is apt to rise with the rise in the standard of living and urbanisation.

Sierra Leone is blessed with such vast expanses of swamp lands, that their complete utilisation would enable the emergence of a profitable export trade, especially in rice. Rapidly increasing world population, particularly in rice eating countries, not matched by a parallel increase in food production strengthens this possibility.

At present Sierra Leone is largely dependent on exhaustible exports - diamonds and iron ore - for a large share of her national income. The relatively permanent wealth producing capacity of swamps is therefore of utmost importance in respect of the future economic stability of the country.

P. Gourou comments that "Swamp rice fosters economic stability, a dense population, and a high civilization; and it is the only cereal which can be cultivated year after year on the same soil in a tropical land and which gives adequate yields from poor soil so long as there is a suitable quantity of water."[2] He also points out that "Wherever the cultivation of swamp rice is possible, it is by far the best means of producing carbohydrates."[3]

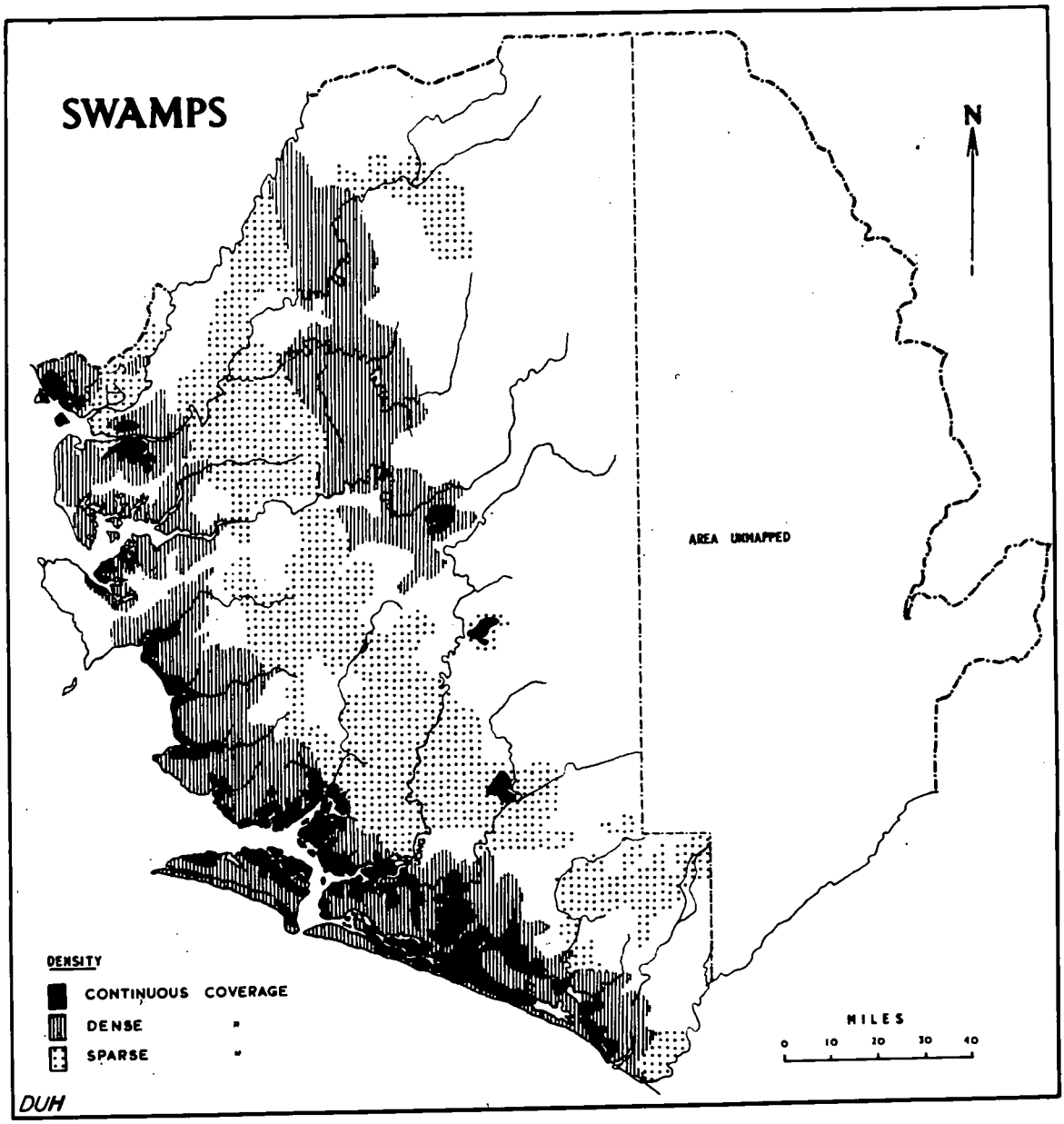
SWAMPS
N
AREA UNMAPPED
DENSITY
CONTINUOUS COVERAGE
DENSE
SPARSE
MILES
0 10 20 30 40
DUH

Fig. 5.

Extent of Swamps

The exact area of Swamp land of Sierra Leone is not accurately known. D.H. Grist[4] and the British West African Rice Mission's report of 1948, observe that there are probably a million acres. In 1951 it was estimated that the total area of swamps consists of 1,495,680 acres or 2,337 square miles.[5] This amounts to 8.4% of the total area of the country. However, an examination of the maps that have been compiled in respect of the distribution of mangrove, grassland, other swamps and swamp rice, (Figs. 10, 14, 17, 18) shows convincingly that the percentage of swamp land estimated by all those mentioned above are underestimates.

Distribution of Swamps

There are three distinct types of swamps in Sierra Leone:-

Mangrove swamp
Grassland or riverain swamp
Inland valley or other swamp

These three are different from each other to a considerable extent in respect of their physical characteristics and location.

Considering the distribution of swamps as a whole, a noteworthy feature is their preponderance in the western half of

the country. The very thick concentration along the coastal tract is strikingly evident.

The swamp density map clearly shows a pattern of three swamp belts. (Fig. 5) Along the coast is a belt about twenty miles wide which shows a very high density of swamps. Beyond this, to the interior, is a belt of sparse density. Further east of this second belt, lies another belt of dense swamp land. The latter belt extends southwards from the Guinea border halfway through the country. To the North-east of this belt is found a small zone of sparse swamp density.

The coastal dense swamp belt includes patches exemplifying continuous and complete coverage of swamps. A large part of them either fringe or lie close to the coast. All three types of swamps found in the country are included in the first belt. However, the most predominant is mangrove. South of the Jong river for the greater part, grassland swamps hold sway. Three areas of continuous swamp coverage are found inland, enjoying isolated positions. These are grassland swamps.

The sparse swamp belt which lies in an intermediate position, is broken up for the greater part by areas devoid of swamps which form mainly forested uplands. The northern section of this belt comprises mostly grassland swamps whereas in the south, inland valley swamps (other swamps) predominate.

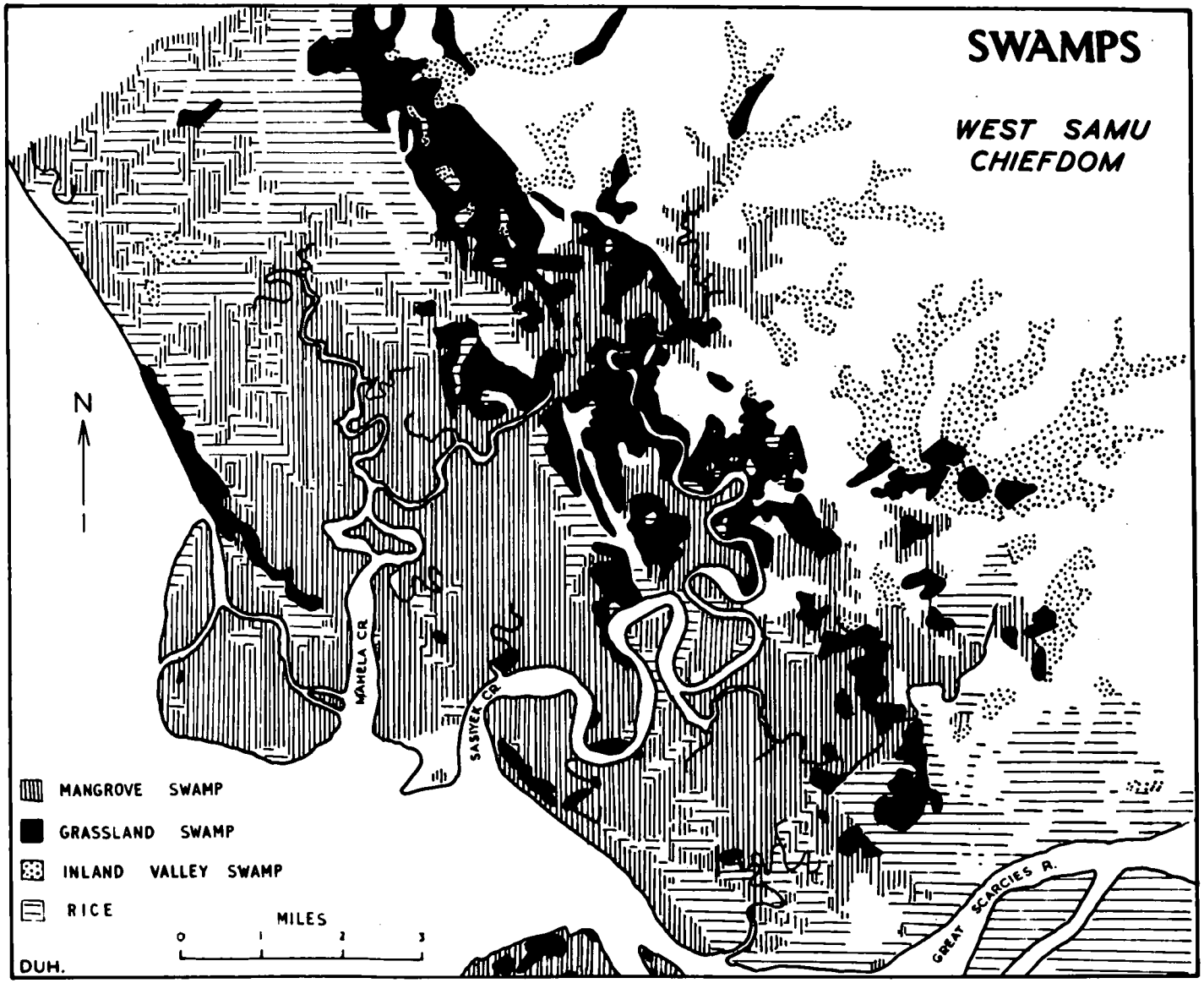
SWAMPS
WEST SAMU CHIEFDOM
N
MANGROVE SWAMP
GRASSLAND SWAMP
INLAND VALLEY SWAMP
RICE
MILES
0 1 2 3
DUH.
MAHELA CR.
SASIVER CR.
GREAT SCARCIES R.

Fig. 6.

The inner belt of dense coverage is a grassland swamp region. This area is commonly referred to as the "Bolilands" region.

The small area of sparse density found to the North-east of the third belt, is an inland valley swamp region.

In areal coverage grassland swamps show the largest extent, mangrove swamps coming second and inland valley swamps third.

Interesting patterns are evident in the relative distribution of the three types of swamps. (Figs. 6, 7, 10, 14, 17) Considering only the coastal area, one finds that mangrove swamps usually fringe the coast, estuaries, and the banks of the lower courses of rivers and creeks. Immediately bordering these swamps, and extending inland generally along rivers and streams, are grassland swamps. Beyond grassland swamps and associated with the upper reaches of streams are found inland valley swamps.

This pattern of distribution, however, is not uniform throughout the coastal tract. South of the Jong river, closer to the coast, and fringing the main rivers are usually grassland swamps, with scattered patches of mangrove appearing here and there. Beyond this zone are found inland valley swamps.

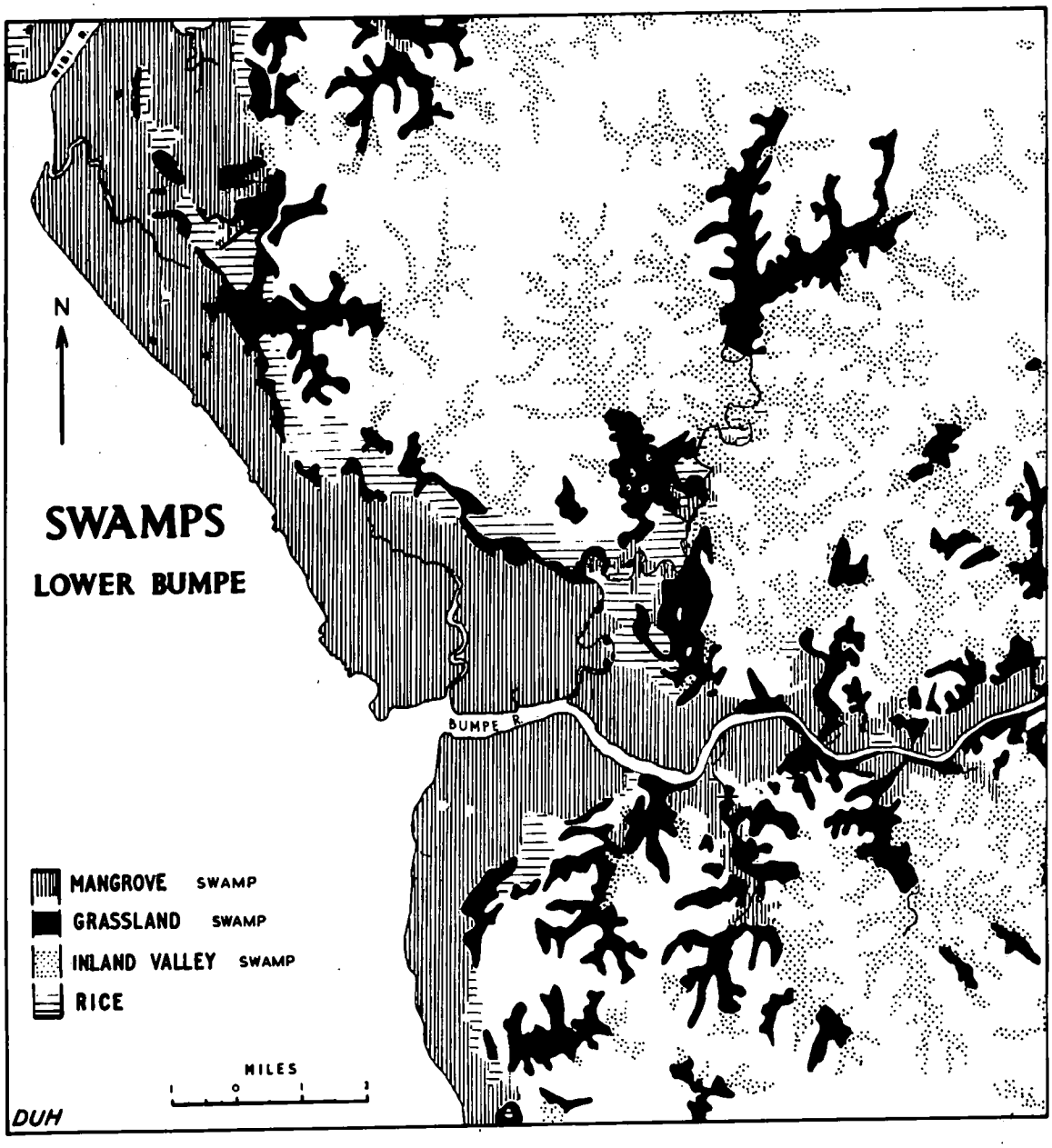
N
SWAMPS
LOWER BUMPE
BUMPE R.
MANGROVE SWAMP
GRASSLAND SWAMP
INLAND VALLEY SWAMP
RICE
MILES
0
1
2
DUH

Fig. 7.

Factors that Inhibited the Development of Swamps

Among the primary factors inhibiting the development of swamps has been the low population of the country as a whole and especially that of the swamp areas. From early times people lived away from the coastal and riverain areas which are the main habitats of swamps, for fear of becoming victims to the slave traders who haunted these areas, and due to the fear perpetuated by superstition and beliefs connected with swamps.

Swamps were held as 'devils land' where various sacrifices were made.(6) Further, the traditional bush fallow agriculture had the effect of keeping the people away from swamp lands. Vast expanses of forested uplands were available particularly during the early days. The farms that were made on these supplied almost all the food requirements of the people. Hence there was no pressure on the land to compel the utilisation of swamps. Changes were however noted with the turn of the present century. The degradation of the uplands and the consequent lowering of yields have already been pointed out in the previous chapter. Though this change increased the value of swamps, and led the Government to take active steps to promote the use of swamps, still, it was no easy task to get the traditional farmers to abandon the upland and come down to the swamp. Ignorance, lack of initiative, and the backwardness of the people were

primary reasons which kept people away from swamps. The great majority of people were ignorant of the immense potentialities of swamps. Even when their productivity was shown in demonstration farms conducted by the government in various parts of the country, still a steady change-over from uplands to swamps was not observed. The backwardness of the culture of the people especially as they lacked proper implements and tools to clear and cultivate swamps also deterred them from attempting this new venture. Swamp clearance is a difficult job. Mangrove felling for example, is both arduous and dangerous.(7) It has always been done by skilled fellers. The shortage of these men especially after 1950 due to the attraction of a large number of young men to mining activities, retarded the clearance of mangrove swamps. The clearance of sedge and grassland swamp has been equally difficult, mostly due to its deep dense root system. The adoption of mechanisation led to the clearance of a part of the grassland swamps, after the middle of the present century.(8)

The people were not accustomed to the relatively complex cultural practices involved in swamp cultivation.(9) People complained of the unpleasant and unhealthy nature of swamps The lack of proper housing land has been and is still a problem in the coastal swamp lands.(10) The lack of fresh water during the dry season in many swamp areas, also prevented people from settling

down around swamps. This problem is still being felt especially in the Bolilands area. Salinity of water due to high spring tidal effects, and soil problems that have emanated when the exclusion of saline water has been attempted, also have been inhibitive factors.(11) Deep flooding and the consequent damage of crops have discouraged the people.(12) The damage to crops caused by fish, crabs, monkeys and a variety of other pests have had the effect of lowering the yields of swamp farms, and weeds made yields decline still further.(13)

The traditional farmer cannot practise mixed cultivation in swamps, as he does in his upland farm. Even the sale of surplus rice is in many areas restricted due to distance from the main rice markets, especially the big towns. Freetown the chief market for rice, is a long distance away from the major swamp areas. Inaccessibility of swamp areas and the lack of proper transport and communication facilities are other difficulties that are encountered. Storage and milling problems are equally grave.

The use of swamp vegetation as thatching material for houses particularly in the interior areas, discourages the clearance of swamps. In the southern coastal swamp areas, raphia palm or piassava which grows in swamps, was a good source of income for the people.(14) Thus, swamps were considered valuable and their clearance was not attempted. With the decline in the price of

piassava (which is a product of raphia palm) and with the introduction of mechanical cultivation, parts of these swamps were cleared.

Fishing is the other activity which inhibited and still continues to discourage people living along the coast from attempting the utilisation of swamps.(15) They consider fishing as an easy and a more profitable job.

In the early days, the high prices of cash crops such as cocoa, coffee, palm kernels, ginger and cola adversely affected the utilisation of swamps. This trend was observed in the southern areas in the 1930's.

The quick maturing nature of upland rices and the relatively long duration which swamp rices take to mature, was a reason that is commonly given by the upland farmer as a disadvantage in swamp cultivation. Upland rices usually take 90 to 100 days to mature whereas swamp rices take 200 to 230 days. Moreover, the upland rice farmers, especially those of the Mendo tribe, have a prejudice against swamp rice. The upland red rice is considered more tasty. Even today in some areas, swamp rice cultivation is conducted mainly for sale whereas the upland crop is for the consumption of the farmer.

In addition to the resistance of sheer inertia, there are other legal and customary restrictions. Land ownership disputes,

land tenure problems, and a dislike of strangers settling down to cultivate the neighbouring swamps, have retarded to a considerable extent the development of swamps.(16)

In many swamp areas, the poverty of the farmers and his indebtedness inhibit not only the expansion of his swamp farm, but also the utilisation of what he has already cleared. Co-operative societies have alleviated this problem to some extent.

Irrigation and water control schemes and the application of modern methods of cultivation will make possible the utilisation of a large extent of the swamps of Sierra Leone. Though physical factors enable these works to be satisfactorily conducted, economic factors do not. The British West African Rice Mission in 1948 stressed the importance of developing irrigation and water control schemes in Sierra Leone to utilise the swamps.(17) As they have pointed out the problem which restricts the taking up of such schemes has been the lack of capital.

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(9) G.M. RODDAN, op. cit.

(10) Sierra Leone: Annual Report ..... Agriculture, op. cit., 1960, p. 1

(11) P.R. HESSE, "Some Differences between the Soils of Rhizophora and Avicennia Mangrove Swamps in Sierra Leone", Plant and Soil, Vol. XIV, No.4, July 1961, pp. 335 - 346

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(15) Ibid., 1930, p. 21

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CHAPTER III

MANGROVE SWAMPS

Swamps found fringing the coast and the estuaries of rivers and creeks are predominantly the habitats of mangrove vegetation. Mangrove grows in swamps of particular physical properties. After colonizing, this vegetation affects those physical characteristics which fostered its growth. This results in noticeable changes especially in soil and water conditions of the swamp. A geographical study of the distribution of mangrove swamps would enable one to correlate the physical characteristics which underlie these swamps with those associated with the cultivation of rice. The potentialities of mangrove swamps for rice cultivation will be revealed in such an investigation.

Mangrove Species

There are five species of mangrove vegetation in Sierra Leone:

1. Rhizophora racemosa
2. Rhizophora harrisonii
3. Rhizophora mangle
4. Avicennia nitida
5. Laguncularia racemosa

The last named is of minor importance, but the other species are commonly found in the tidal swamps of Sierra Leone.(1) Out of

these Rhizophora racemosa and Avicennia nitida are of greatest importance due to their more extensive areal distribution. These inhabit swamps of different physical characteristics. They are especially closely related to the character of the soil and its mode of formation.

Where conditions are favourable Rhizophora racemosa occurs as pure stands. This, however, is not usual of Avicennia nitida which commonly occurs mixed with the other species. Rhizophora harrisonii, Rhizophora mangle and Laguncularia racemosa usually occur as under-shrubs in Avicennia woodland. Sometimes Rhizophora harrisonii and Rhizophora mangle occur as dense thickets in association with the scrub Rhizophora racemosa. This is normally seen in swamps earlier occupied by Rhizophora racemosa forest. Herbaceous plants may be associated with this mixed woodland. The most typical of these are the salt-tolerant fern Achrostichum aureum and in more open places Sesuvium Portulacastrum and Philoxerus vermicularis. Between mangrove land and the higher ground, the palm Phoenix reclinata and Conocarpus erectus may be found forming the bordering vegetation. They may also occur mixed with mangroves along their boundary. Along the fringes of mangrove swamps which are usually sandier may be found Annona Glabra, Heteropteris leona and the climber Stigmaphyllon ovatum. (Fig. 8) Under less saline conditions both on cleared Avicennia nitida and Rhizophora racemosa

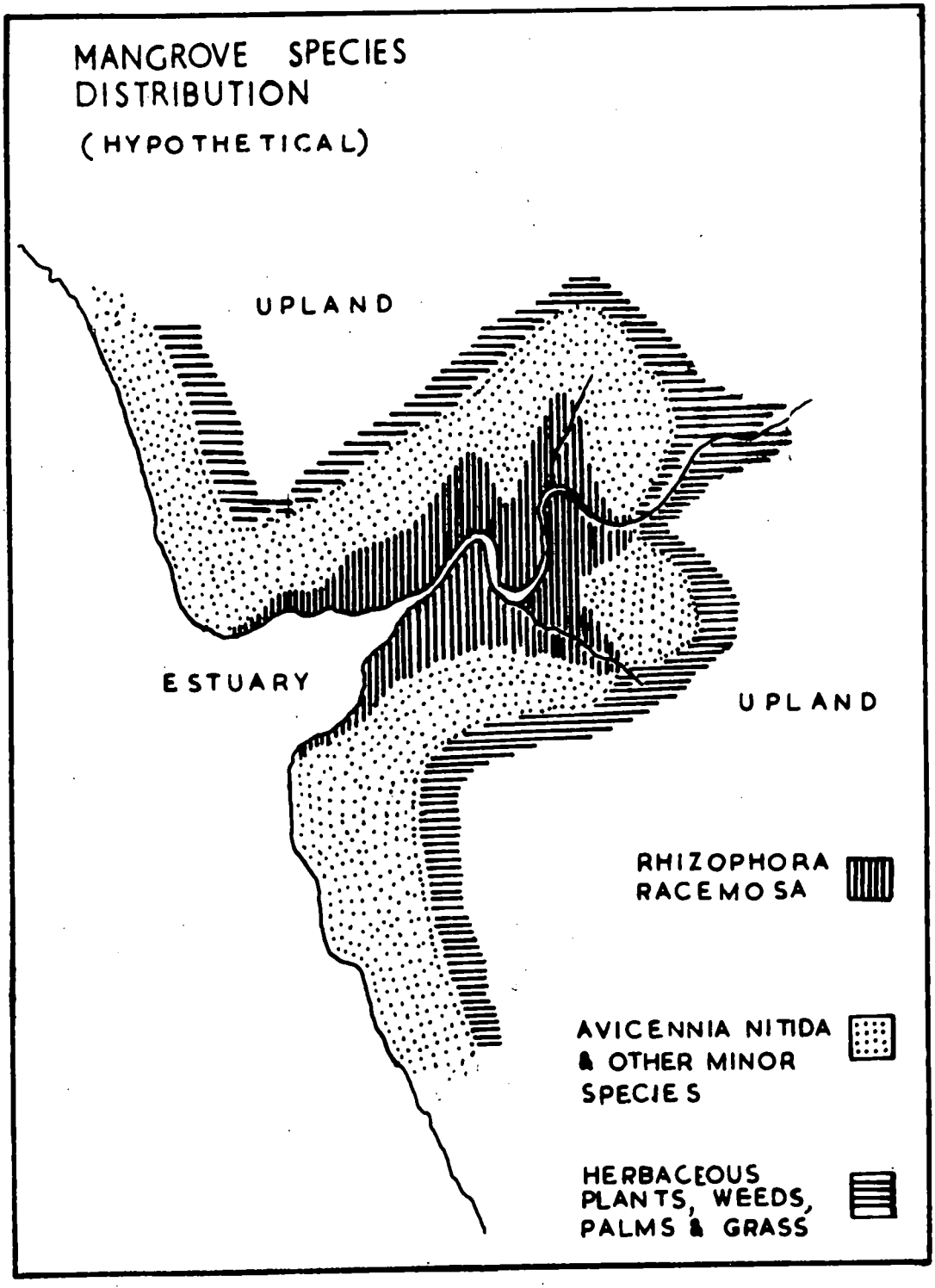
MANGROVE SPECIES
DISTRIBUTION
(HYPOTHETICAL)
UPLAND
ESTUARY
UPLAND
RHIZOPHORA
RACEMOSA
AVICENNIA NITIDA
& OTHER MINOR
SPECIES
HERBACEOUS
PLANTS, WEEDS,
PALMS & GRASS

Fig. 8.

land and generally between the mangrove land and the higher ground, the salt tolerant grass Paspalum Vaginatum may be found.(2)

1. Rhizophora racemosa(3)

Rhizophora racemosa is common in West African as well as in South and Central American swamps. This is the commonest of West African species of mangroves. It is usually known as 'red mangrove.' It is known to the Temne tribe of Sierra Leone as 'E-Kant.'

Rhizophora racemosa typically forms a crowded and generally a tall forest. These stout trees, attain heights ranging from 50 to 60 feet in places where conditions are favourable. This height dwindles as one goes into the swamp away from the edges of rivers and creeks. In the interior the heights of trees fall as low as 12 feet and give an appearance of a low shrubby forest.

The Rhizophora racemosa tree trunk is grey but the bark is carmine when cut. The tree is many branched and its crown is narrow and conical. The leaves are somewhat rounded, leathery and dark green in colour.

All Rhizophora varieties are characterised by a tangled mass of prop roots. Below ground level these roots divide into innumerable fine red rootlets which become very closely packed.

Rhizophora racemosa is a viviparous plant. It drops seedlings twelve to twenty inches long from which trees grew.

2. Avicennia nitida[4]

Avicennia nitida is commonly known as 'white mangrove'. The Temne tribe of Sierra Leone call it 'Ka bure'. It is a more open and delicate tree than Rhizophora racemosa. In places most favourable for its growth, especially fringing the coast, it is found in pure stands of thick growth. But in most places it is a low forest much more open than Rhizophora racemosa forest. Avicennia tree seldom exceeds 25 feet in height and is characterised by a single trunk black in colour. The leaves are light greyish green, and are small, pointed and narrow.

Avicennia tree does not have prop roots. It has a spreading lateral root system just below ground level. These are characterised by numerous asparages like pneumatrophores which are about six inches long.

3. Other Species[5]

Rhizophora harrisonii, Rhizophora mangle and Laguncularia racemosa are usually small shrubby trees. These are generally found mixed with Avicennia nitida. The lax inflorescence with flower buds acute at the apex distinguish it from Rhizophora racemosa. Rhizophora mangle is normally a very low shrub - less than 15 feet in height. It is distinguished by the inflorescence which contain only two to four flowers with acute buds.

Habitats of Different Species of Mangrove

Rhizophora racemosa is found mostly on margins of rivers and creeks and their estuaries. (Figs. 8 & 9). It reaches its optimum size and forms pure stands where it gets a good start in newly deposited soft silt.(6) Rhizophora racemosa is therefore found to abound the insides of the banks of rivers where water is slack and much silt deposition takes place.(7)

The sub-aerial root system of Rhizophora racemosa helps to check the rate of flow of water and facilitates sedimentation around them. This leads to the extension of land and silting up of the intervening channels and in the formation of deltas.

Rhizophora racemosa swamps are those which are flushed for a relatively longer period with fresh river water during the wet season and with brackish water caused by high spring tides, during the dry season. Some Rhizophora racemosa lands which are on the low-lying edges of rivers and creeks are subject to deep flooding. In some interior areas where the tidal fresh water flush and silt deposition are negligible, stunted Rhizophora racemosa is found. The sandier soils found still further away from the influence of tidal fresh water flooding, do not support Rhizophora racemosa.

Avicennia nitida usually has two distinct habitats. It is seen (a) fringing the coast and (b) in the interior areas beyond


RIBI
&
LOWER BUMPE
MANGROVE LAND
RIBI R.
N
BUMPE R.
MANGROVE SWAMP
RHIZOPHORA RACEMOSA
MANGROVE SWAMP
AVICENNIA NITIDA
MANGROVE SWAMP
PREDOMINANTLY RHIZOPHORA HARRISONI
BUT INCLUDING LAGUNCULARIA RACEMOSA AND
RHIZOPHORA MANGLE
SWAMP RICE
MILES
0
2
DUH.

Fig. 9.

Rhizophora racemosa swamps, away from the influence of tidal fresh water flooding, or where this flooding is of a short duration. (Figs. 8 & 9) Thus Avicennia is found generally away from rivers and creeks. These areas are less waterlogged(8) and with bad drainage, and are associated mostly with sandy firm soils, which are for the greater part saline. This salinity is due to the influence of the high spring tidal flushing of saline water during the dry season, to which these swamps are subjected. During neap tide periods the surface of the swamps dries out and deposits of salt are found at places caused by evaporation of salt water. During the wet season, heavy rains help in washing off some of the salinity of these swamps.

In these same areas Rhizophora harrisonii, Rhizophora mangle and Laguncularia racemosa occur mixed with Avicennia nitida. Sometimes the former species are secondary colonizers in these swamps, in association with the weed Paspalum Vaginatum.

Avicennia nitida swamps found fringing the coast are intensely subject to tidal effects. They are thus largely associated with saline water, which floods these swamps twice daily. The soils of these areas too are mostly sandy and are firm and saline.

A substantial part of the Rhizophora racemosa mangrove swamp land has been utilised for rice cultivation, especially in the Searcies rivers area in the North-west of the Country. Large

13° W

12° W

GUINEA

KAMBIA

ROKUPR

Great Scarcies R.

Little Scarcies R.

PORT LOKO

Port Loko Cr.

Seli R.

Rokel or

FREETOWN

Ribi R.

Bumpe R.

MOYAMBA

Kagboro Cr.

Bagru R.

Sherbro R.

Jong R.

Kittam R.

Sewa R.

Waanje R.

Malen R.

PUJEHUN

L. MABESI

Moa R.

Mano R.

MANGROVE

AREA UNMAPPED

-N-

9°N

8°N

7°N

- SCALE OF MILES -

10 5 0 10 20 30 40 50

DUH

expanses of Rhizophora racemosa are found in the mangrove swamps of Moyamba and Bonthe Districts. Avicennia swamps are very common in both Northern and Southern Provinces.

Distribution of Mangrove Swamps

Mangrove swamps are almost entirely confined to the coastal areas of Sierra Leone. (Fig. 10) They are concentrated within 20 miles of the coastline. The thickest concentrations extend at most about six to seven miles from the coast. From these continuously swamp covered deltas and banks of the lower courses of rivers and creeks, are seen projecting inland fringing the rivers and creeks, limbs of mangrove swamps. As they extend inland they contract in size to become very narrow. Thus the areal distribution pattern is more or less a triangular one. Relief as well as the extent of tidal flooding have to a great extent brought about this uniform pattern. The intricately meandering pattern of the rivers and their associated multiplicity of smaller streams and creeks at the lower courses, help to moisten a large expanse of land, and are therefore responsible for the continuous concentrations of swamps found along the coast.

Compared to the other types of swamps found in Sierra Leone, mangrove swamps are much more compact and continuous. From the mouth of the Bagru an unbroken stretch of mangrove extends along

the left bank of the river for a distance of about 12 to 13 miles inland. From the same estuary a continuous area of mangrove is evident running south fringing the coast up to the Jong river estuary, for a distance of roughly 12 miles.

1. Sherbro - Bagru - Jong Rivers area

The largest concentration of mangrove swamp is around Sherbro, Bagru and Jong rivers. Vast expanses between Jong and Bagru rivers are entirely under mangrove. Branches of swamps extend inland associated with the tributaries of the rivers and creeks of this region making a dendritic pattern of distribution.

Within this major region, the Bagru river area stands out as the thickest concentration of mangrove swamp. The great volume of the river, its twisting meanders and the large number of associated tributaries help to flood these extensive flat deltaic land. Among the rivers of the Southern Province, the Bagru has the greatest extent of tidal influence. These factors have given this area a complete mangrove clothing.

Between Titibul and Moteva creeks is the most well watered, the most low-lying and the constantly silt deposited area of this region. This area forms one continuous stretch of mangrove. Along Titibul and Moteva creeks swamp land is found projecting inland for almost six to seven miles from the coast. The islands

associated with this region - Edmonstone, Rendall and Bobs islands - are completely mangrove covered. From Edmonstone island along the river for a distance of about 20 miles are found mangrove swamps.

Between Moteva creek and the Jong river are a number of creeks - Mbaoma, Rongetok, Teso and Mongeri being the main ones. Associated with these creeks is a region, flat and well watered and with a thick mangrove growth. Along the loosely meandering Teso creek this swamp extends to a great distance inland narrowing at its interior edge. Long island and East island in harmony with its neighbourhood, are completely mangrove covered.

The Jong river and its associated creeks - Mongeri, Yaigini and Bende - area is another compact concentration of mangrove swamp.

The Sherbro island forms the other major mangrove habitat of this vast southern mangrove region. The island is nowhere more than 15 feet above sea level and a large part of the southern area of the island, particularly the coastal stretch, is covered with very sandy soil. Creeks and streams are more common in the northern half of the island. These factors have confined the mangrove swamps of the island mainly to the northern and north-eastern sections. Thick expanses are associated with Bimbi, Nyama, Nymsa, Toba and Lubu creeks. In the west a long area of mangrove swamp is found extending inland along the Black creek. West of

Shorbro are a number of islands such as Mut, Yele, Baki, Hoong, Macauley, York, Yelibana, Allridge and Barvettes, which are for the most part mangrove-clothed.

2. Rokel River - Port Loko Creek - Bunce River area

The second largest area of mangrove swamp is associated with the estuaries and lower courses of the Rokel river and Port Loko creek and the Bunce river. The Kumrabai, Petifu, Kambia, Daru, Madina, Konta and Grabai are the other main creeks which drain this area. A dendritic drainage pattern is dominant in the swamp land of this region. A greater part of this swamp consists of narrow elongated projections extending in all directions. These incorporate the numerous streams and creeks of this area. A part of the swamp of the lower courses of the Port Loko creek and Rokel river has been cleared and used for rice cultivation. Relief has played a dominant role in the distribution of mangrove swamp in this region. The higher ground has confined the swamps only to the narrow lower stretches bordering the rivers, creeks and streams.

The numerous islands that are found in the large estuary of this area, are largely covered with mangrove. The main islands include Tasso, Yema, Pepel, Konkay, Hagboli and Tumbu. Dense mangrove coverage is evident in the coastal area around the mouths of Bunce river, and the Kumrabai and Konta creeks.

3. Scarcies Rivers area

The third major concentration of mangrove swamp is found in the coastal region between the Great Scarcies and Guinea border. This is the remnant of a formerly extensive region of mangrove swamp associated with the Great Scarcies and the Little Scarcies rivers. Most of this swamp has been converted to productive rice lands. The existing mangrove area mostly fringe the intricately meandering creeks such as Mahela and Sasiyok. The swamp extends inland for about four miles from the coast. The very low-lying nature of this land and the constant effects of tide water have enabled the conversion of this land to mangrove swamp. However, the interior uplands and especially the sandy ridges have restricted the extension of the swamp. The islands in the neighbourhood, such as Yelibuya and Kortimaw, are almost fully mangrove covered. The northern extremity of this region consists of rice lands which were once mangrove swamp.

4. Ribi - Bumpe Rivers - Kagboro - Thauka Creeks area.

Four smaller mangrove swamp regions are found associated with the estuaries and the banks of the lower courses of the Ribi and Bumpe rivers, Kagboro and Thauka creeks. These show a more or less triangular pattern of distribution, being bread at the coast and narrowing inland along the rivers and creeks. These swamps extend inland for about 10 to 12 miles from the coast.

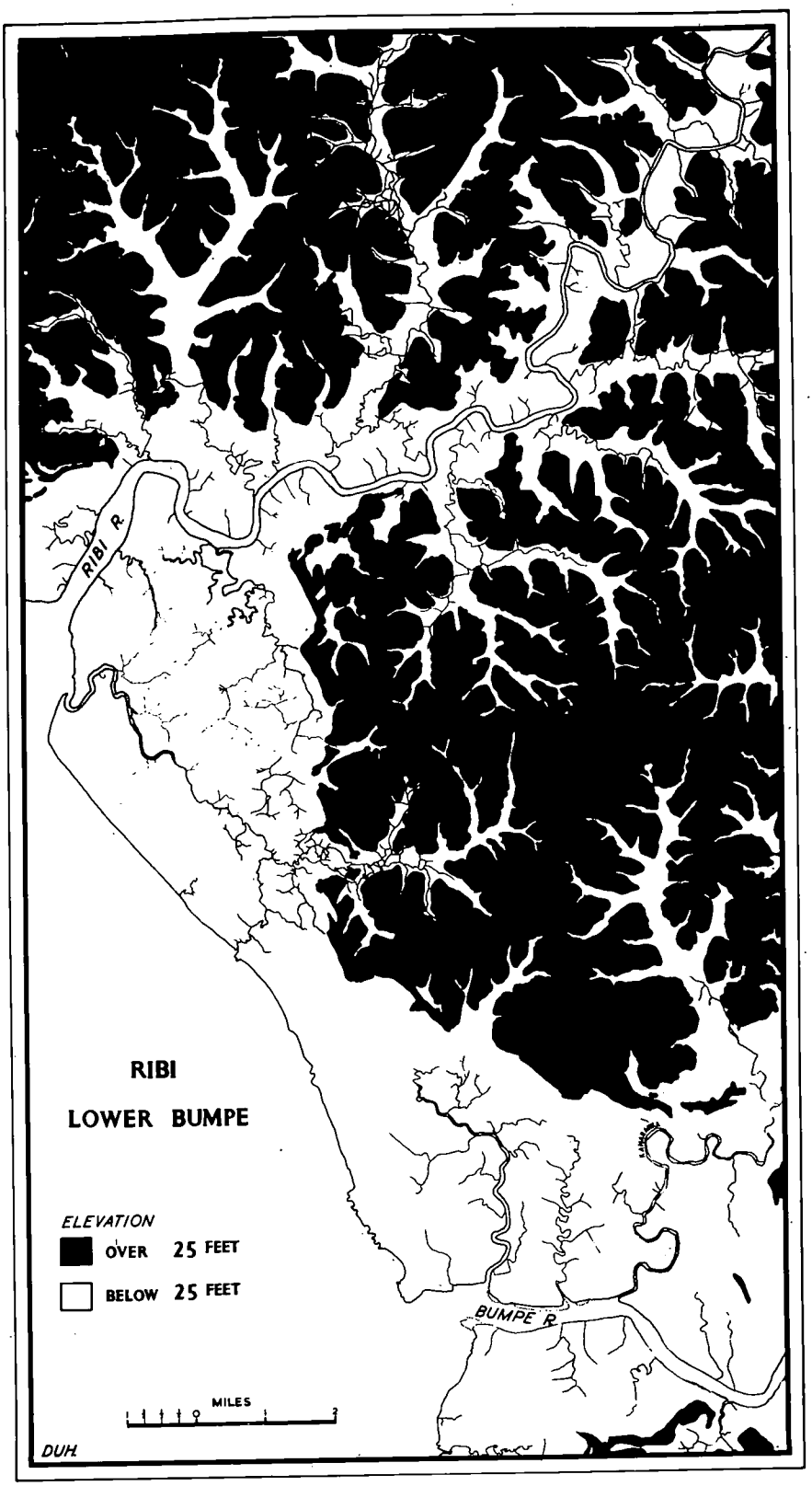
RIBI R
RIBI
LOWER BUMPE
ELEVATION
OVER 25 FEET
BELOW 25 FEET
BUMPE R
MILES
DUH

Fig. 11.

Thick and continuous coverages of mangrove are seen occupying the coastal areas south of the Ribi river, north of the Bumpe river and south of the Kagboro creek. These areas are associated with a large number of meandering streams and creeks mostly feeding the main rivers. They are all less than 25 feet above sealevel and for the greater part flat land, conveniently covered by tidal waters. (Figs. 9 & 11)

The effect of relief, felt particularly in the restriction of the influence of tidal flooding; the relatively small volumes of water carried by the rivers and creeks; and the sandy and stony nature of the soils in the interior are some of the major factors which have caused the limited and compact nature of swamps associated with the Ribi and Bumpe rivers and the Kagboro creek.

The Thanka creek is associated with a large number of creeks and streams running in all directions. Fringing these are narrow fingers of mangrove swamp penetrating inland showing a dendritic pattern.

5. Sewa - Waanje - Kittam - Malen - Moa Rivers area.

The southern coastal areas of Sierra Leone (roughly east of 12° .15' W. longitude) show a very dispersed pattern of distribution in respect of mangrove swamp. The associated rivers are Sewa, Waanje, Kittam, Malen and Moa. A number of lakes also are found in this region. The relatively limited tidal brackish water

influence, the long fresh water flooding period, the great depth of this flooding, the sandy nature of a large part of the coastal tract, have all contributed to the scattered nature of distribution seen in the swamps of this region. A characteristic feature in the distribution of mangrove swamps in this region, is that they do not spread from the coastline inland as in the case of the mangrove swamps of the rest of the country. These swamps are found starting usually one to two miles inland away from the shore in respect of the patches seen between Lake Mape and the Moa river, and south of the Kittam river. The scattered mangrove swamps found north of the Waanje and Kittam rivers, are about four to five miles away from the coast. This interior location of mangrove swamp is also a feature in the south of Sherbro island. This may be attributed to the sandy nature of the soils of these regions as well as to the limited tidal effects. Relief has acted as a controlling factor in some limited areas.

Factors Controlling the Distribution of Mangrove Swamps

1. Relief

Relief plays a controlling effect in the distribution of mangrove swamps. All mangrove lands are confined to either flat or very gently undulating land of very low elevation. Coastal plains, lower banks of rivers and creeks, small deltas and alluvial

islands are the predominant mangrove habitats. All these mangrove areas are found below 50 feet elevation, but a greater part of them are less than 25 feet above sea level. (1:63,360 and 1:62,500 sheets of Sierra Leone show this clearly).

When a flat or gently undulating land is encountered, it is seen that mangrove swamps spread continuously in a single stand. The control of relief is evident in the narrow limbs of mangrove swamp which stretch inland normally occupying the low-lying fringes of rivers and creeks. These are seen sandwiched by high land on either sides. Typical examples of this feature are the mangrove swamp limbs associated with Kagbere creek, Thauka creek, Bagru river and their numerous tributaries.

Relief determines the extent of flooding and the consequent silt deposition which are also important controlling factors on mangrove distribution.

2. Tides, Flooding and Silt deposition

The extent of tide water flooding determines the extent of spread of mangrove swamps. All mangrove swamps are found below the level of the high spring tides and all are consequently flooded to a greater or lesser extent by tide water.(9) The longer duration and relatively intense salinity of the tide water over-flowing the coastal areas have resulted in the emergence of

Avicennia nitida mangrove swamp, which is more resistant to salinity. The short duration of fresh water flooding or its absence, and the prevalence of brackish water flooding during high spring tides have resulted in saline conditions in the interior regions of mangrove swamps. Here again Avicennia holds sway, sometimes intermixed with other minor mangrove species.

During the rainy season when the rivers and creeks are carrying large volumes of water, the backing of the tides results in the overflow of these drainage lines. This not only moistens an extensive area, but also leads to the deposition of soft silt over a wide expanse. These are, incidently, the domains of Rhizophora racemosa mangrove. A primary reason for this type of mangrove dominating over the areas fringing the rivers and creeks is the fact that these areas are subject to seasonal soft silt deposition. Rhizophora racemosa grows best on this type of soil. Avicennia is confined to areas where silt deposition is negligible or completely absent.

The controlling effect of flooding and draining the land on the distribution of mangrove swamp is well brought out when we consider the drainage systems associated with mangrove areas. Areas with a dense network of meandering rivers and creeks, and a multiplicity of tributary streams, are always densely mangrove-covered. The finest examples that can be cited are the Great and the Little

Scarcies rivers (a greater part of this mangrove land has been now converted to rice fields), Port Loko creek area, Bagru river area, and the Jong river area. The relative absence of such a dense network of tributary streams in respect of the Moa, Mano, Waanjo, Malon and the Sewa rivers and the dispersed and sparse nature of the mangrove swamp they support, is noteworthy.

5. Geology and Soils

Geologically all mangrove swamp lands are confined to the belt of Pleistocene sediments (Bullom series). These are found to consist of alternating bands of clays, sands and gravels. The soils over this area for the greater part are alluvial and constituting large quantities of organic matter. Over this soil the seasonal deposition of soft silt takes place. The soils possess a considerable capacity for conserving water.

Some soils of the inner and coastal areas of mangrove swamp are firm and sandy. These support Avicennia Mangrove.(10) Very sandy soils do not support any mangrove. Such soils are found mainly in the coastal stretch of southern Sierra Leone.

4. Climate

Mangrove swamps are confined almost entirely to the wetter regions of the country, a greater part receiving a mean annual rainfall of more than 110 inches. (Fig. 12) The South-western mangrove

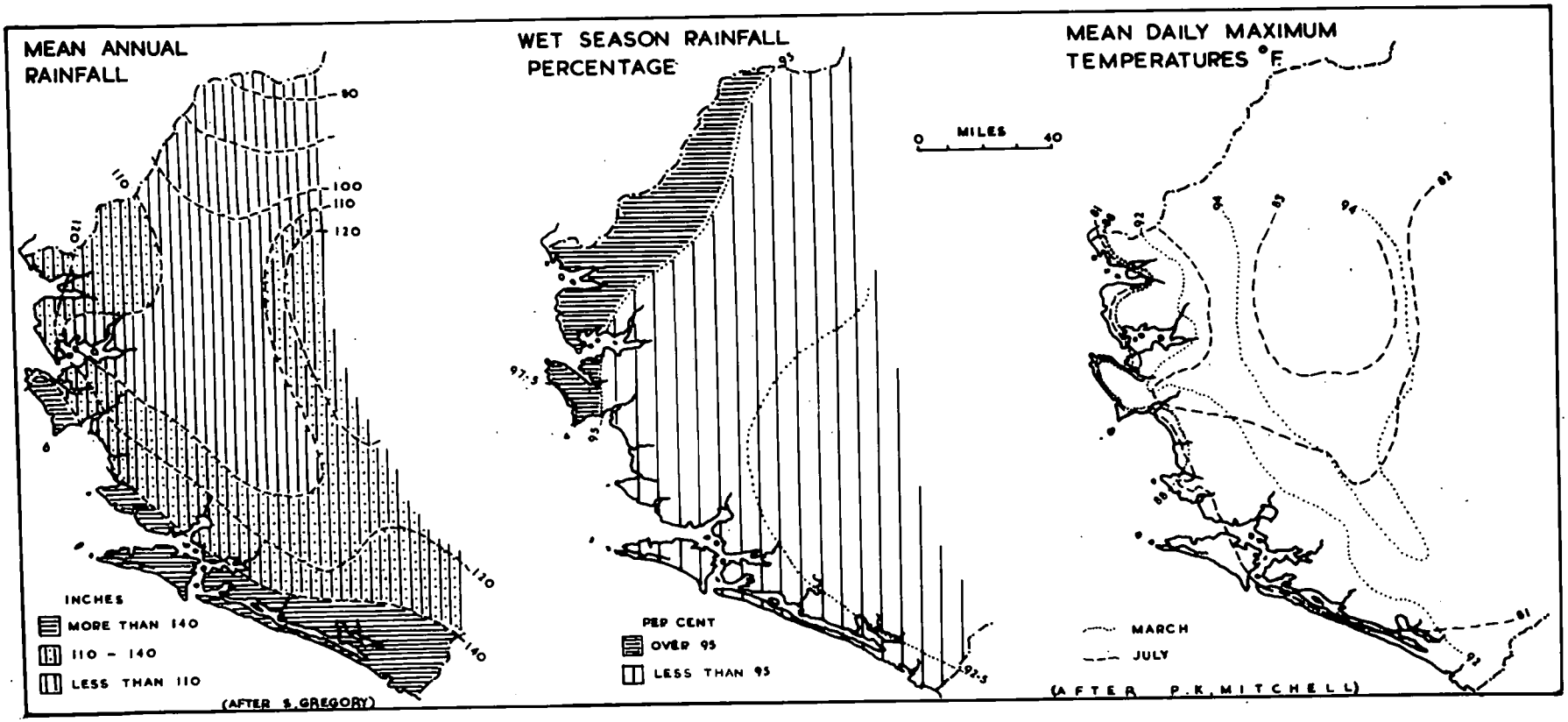
MEAN ANNUAL RAINFALL
80
100
110
120
110
110
110
140
INCHES
MORE THAN 140
110 - 140
LESS THAN 110
(AFTER S. GREGORY)
WET SEASON RAINFALL PERCENTAGE
95
92.5
92.5
0 MILES 40
PER CENT
OVER 95
LESS THAN 95
MEAN DAILY MAXIMUM TEMPERATURES °F
92
93
94
95
96
97
98
91
92
MARCH
JULY
(AFTER P.K. MITCHELL)

Fig. 12.

area around the Kagbere and Thauka creeks and Sherbro island receives as much as 140 to 160 inches mean annual rainfall. The Scarcies rivers area experiences 110 to 130 inches. Out of the main mangrove areas, the least rainfall of between 100 and 110 inches annually is received by the Rokel river - Port Loko creek area. The effect of high rainfall on the distribution of mangrove swamp is thus evident. A correlation is also brought out in respect of the variability of rainfall. The main mangrove swamp areas have a relatively small variability of 10 to 12.5%. The variability of rainfall in the patchy scattered mangrove swamp area, (east of 12°.15' W longitude), the Ribi river area and the Western area (former colony), is 12.5 to 15%.

The whole mangrove swamp area of the country generally experiences an annual average temperature of around 80°F. At the height of the wet season in July, the region has a mean daily maximum temperature of 80° to 82°F. In March during the dry season, the mean daily maximum temperature rises to about 86° to 92°F. (Fig. 12) During the wet season and especially in July, August and September, persistent cloud cover is reflected in a low monthly duration of sunshine over the mangrove area. High relative humidity is evident during this period.

Mangrove Swamps as Rice Lands
Their Potentialities and Limitations

Mangrove swamps have been utilised for rice cultivation more than swamps which support other vegetation types. Approximately 53,000 acres of coastal swamp rice land of the country were formerly mangrove swamps.(11) It has been estimated that there are still about 250,000 acres of mangrove swamp lying unutilised for any productive purpose. A substantial part of this could be converted to rice fields without much difficulty other than the initial felling and clearing. The development of the rest would involve the adoption of adequate measures of water control and drainage. About two-third of the total mangrove swamp area are in the Bonthe and Moyamba Districts. A greater part of the mangrove swamps readily available for clearing and suitable for rice cultivation are those regions around Bagru and Sherbro rivers. In parts of Sherbro island and in the coastal areas of Moyamba District, the obstacle to rice cultivation is primarily the intense salinity of Avicennia nitida mangrove swamp. The same is true of Samu chiefdom mangrove swamps and a greater part of the area around the estuary of Port Loko creek and Rokel river.

From the viewpoint of terrain, no mangrove swamp offers obstacles to their development as rice fields. The flat or gently undulating nature of the land not only facilitates the retention

of water in the land which rice cultivation demands, but also enables the convenient application of modern methods of cultivation, especially mechanization.

Mangrove swamps are mostly associated with tidal rivers, the tide water being fresh during the wet season and saline during the dry season. This fluctuation in the nature of the tide water which is particularly seen in the swamps neighbouring rivers, is very advantageous for rice cultivation. The long fresh water flooding period enables the growth of the rice plant, and after harvest the saline conditions during the dry season restrict the growth of weeds in the field. This advantage however, depends greatly on the length of the period of fresh water flooding. The limitation in respect of rice cultivation in the mangrove areas of the interior away from the rivers and also of those fringing the coastline, is primarily salinity due to inadequate flooding of fresh water. Even the high rainfall which the coastal areas receive, is incapable of ameliorating the situation to enable rice cultivation in the greater part of the Avicennia swamps. This however, should not make one conclude that these areas cannot be considered as potential rice lands. The empoldering techniques that have been practised in respect of these swamps have been found successful in overcoming the limitation.(12) Also, clearing the existing creeks and streams, draining these areas and the

construction of channels to moisten these areas with fresh rain and river water have helped to a considerable extent in some parts of the Scarcies rivers area to moderate and ultimately to exclude saline conditions. Empoldering swamp land to exclude the inflow of saline tidal water has been successful only in respect of Avicennia swamp.(13) In the case of Rhizophora racemosa land and also in Avicennia lands which were previously inhabited by Rhizophora racemosa, empoldering has resulted in adverse soil conditions, preventing the cultivation of rice.(14)

Deep flooding conditions in the Rhizophora racemosa swamp lands immediately fringing rivers and creeks pose difficulties in respect of the utilisation of the swamp for rice cultivation. A system of water control has been found to be necessary to surmount this obstacle. In some areas floating varieties of rice which withstand deep flooding conditions have been cultivated with impunity.

Climatically, mangrove swamp areas have been found ideal for rice cultivation. The heavy rainfall which is received seasonally, followed by a marked dry season, the relatively long period of daylight and sunshine, are all inviting factors in respect of rice cultivation.

The soils of mangrove lands are for the greater part alluvial. The areas bordering rivers and creeks receive a seasonal clothing of a silt layer. These soils are ideally suited for

rice growth, not only possessing a good water holding capacity but are also abundant in soil nutrients. Swamps supporting Rhizophora racemosa are eminently suited for rice cultivation from the viewpoint of soil. Avicennia soils are for the greater part firm and sandy, and the silt cover is either negligible or absent. But what is more important is that they are saline.(15) However, it has been found possible to improve the texture and nature of the soil to suit rice cultivation with the application of proper drainage and water control measures. Ample evidence to support this is available in the Searcies rivers area particularly in the Mambolo and the Sama chiefdoms, and Maswari of the Western area.

Rhizophora racemosa swamps are more fertile due mainly to the high organic matter content of the soils associated with them. The decomposition of the dense root system of this vegetation is responsible for this condition of the soil. However, as much as it being an advantage, the same factor has posed a decisive restriction to the development of these swamps for rice cultivation. To exclude either the inflow of saline tide water or to control deep flooding Rhizophora racemosa swamps were empoldered in the Searcies rivers areas in early 1950's. The empoldered soils were desiccated during the dry season and led to intense acidity of the soils. The pH value fell from the normal 6 and 7 to 3. This was due to chemical changes taking place in the soil associated

with the fibrous root system of Rhizophora racemosa.[16]

Empoldering, moreover, has the added disadvantage of the restriction of the deposition of silt so favourable for rice growth.

Recent trials in empoldering Rhizophora racemosa swamps by the Rice Research Station, Rokupr, have demonstrated that the following scheme of empoldering enables satisfactory reclamation of the swamp for rice cultivation.[17]

1. Empoldor
2. Left to dry to achieve maximum oxidation
3. Reintroduction of tidal wash to remove the acid in the soil
4. Permanently empoldor
5. Addition of the correct amounts of lime
6. Leaching with rain water until the salt content of the soil is sufficiently low.

Estimates of Suitable and Unsuitable Swamps in respect of Rice Cultivation

R. R. Glanville in his 'Agricultural survey of the existing and potential rice lands of the Scarcies rivers area' - (1940),[18] made the following estimates :-

1. Saline swamps unsuitable for rice cultivation

(a) Great Scarcies and Samu chiefdom area	-	14,278 acres.
(b) Little Scarcies area	-	1,440 acres.
Total of the whole area	-	15,718 acres.

2. Swamps readily available and suitable for rice cultivation

(a) Great Scarcies and Samu chiefdom area	-	17,318 acres.
(b) Little Scarcies area	-	358 acres.
Total of the whole area	-	17,676 acres.

The years that followed saw the reclamation of a considerable portion of these swamp areas. By 1950 all land suitable for rice had been brought under cultivation. A large portion of the saline swamps of Little Scarcies river area were reclaimed. The area unutilised today is mostly found in the Samu chiefdom.

G. M. Reddan in his reports of 1938 and 1939 made the following estimates :-(19)

1. Mangrove swamp area believed suitable for the cultivation of rice :

(a) Bonthe District	-	69,320 acres.
(i.e. Sherbro Island	-	16,210 acres
Mainland	-	53,110 acres)
(b) Moyamba District	-	67,731 acres.(Fig. 13)
(i.e. Ribi river area	-	3,597 acres
Bumpe " "	-	10,067 acres
Kagbere" "	-	12,857 acres
Thauka " "	-	5,465 acres
Bagru " "	-	25,773 acres
Titibul" "	-	9,972 acres)

Therefore the total acreage of mangrove swamp suitable for rice cultivation in the two districts was estimated at - 137,051.

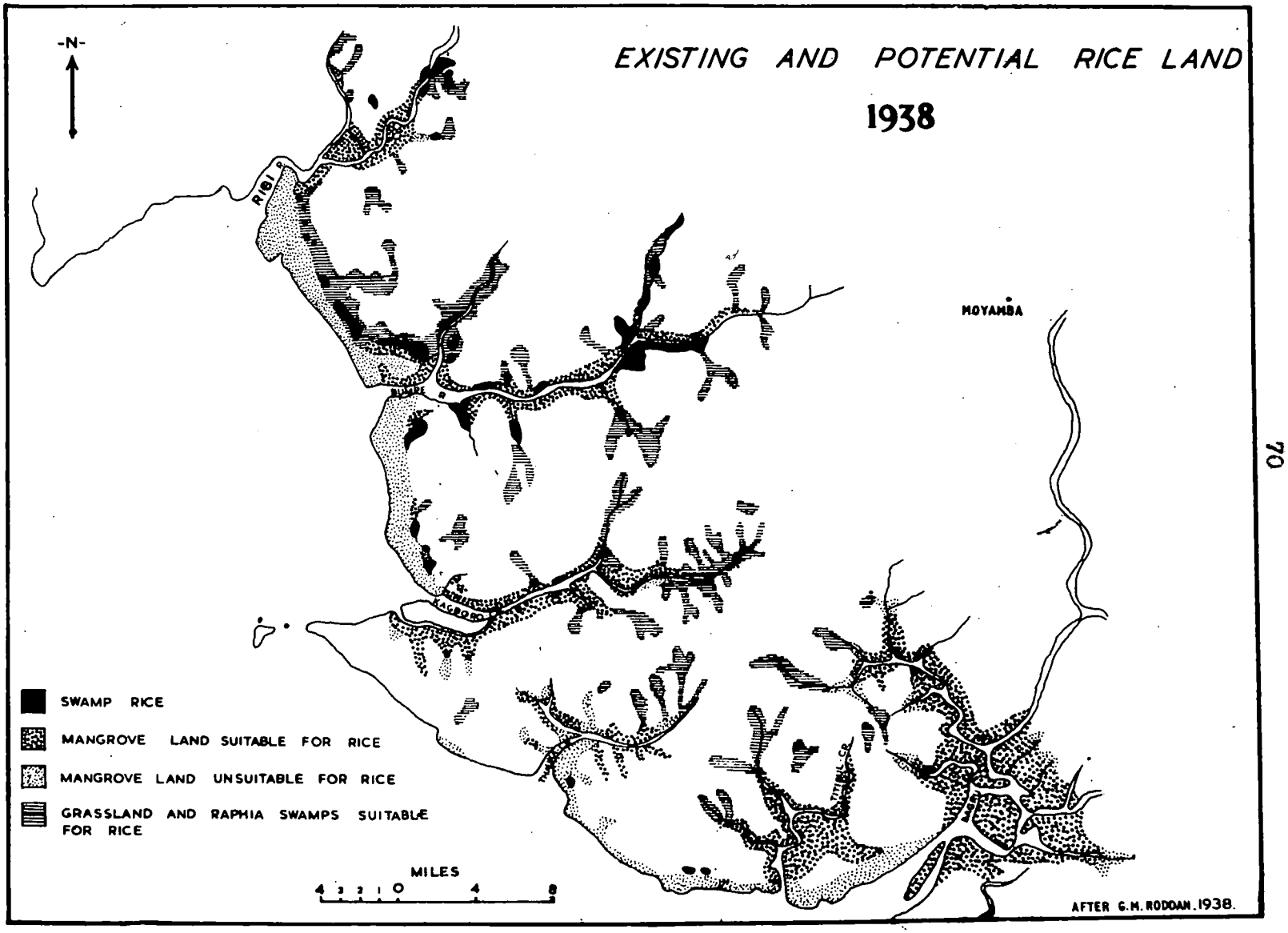
-N-
EXISTING AND POTENTIAL RICE LAND
1938
RIGI
MOYAMBA
KAGBOSI
SWAMP RICE
MANGROVE LAND SUITABLE FOR RICE
MANGROVE LAND UNSUITABLE FOR RICE
GRASSLAND AND RAPHIA SWAMPS SUITABLE FOR RICE
MILES
4 3 2 1 0 4 8
AFTER G.M. RODDAN. 1938.

Fig. 13.

2. Mangrove swamp area believed unsuitable for the cultivation of rice :

(a) Bonthe District	-	6,970 acres.
(i.e. Sherbro Island	-	6,390 acres
Mainland	-	580 acres)
(b) Moyamba District	-	44,141 acres.(Fig. 13)
(i.e. Ribi river area	-	1,587 acres
Bumpe " "	-	20,403 acres
Kagboro" "	-	5,766 acres
Thaukn " "	-	4,806 acres
Bagru " "	-	3,381 acres
Titibul" "	-	8,198 acres)

The total acreage of mangrove swamp believed unsuitable for rice cultivation in the two districts was estimated at 51,111. This acreage is almost completely unutilised to the present day.

Sessional Paper 1 of 1951 estimates the total acreage of mangrove swamp suitable for rice cultivation at 137,000 acres, in the Southern Province.

Mangrove Clearance for Rice Cultivation

The felling of mangrove vegetation and the clearing of the swamp for rice cultivation, is an arduous and time consuming task. It was around 1880 that Temne farmers at the mouth of the Little Scarcies river, first began felling mangrove and cultivating rice.(20) The yields derived were almost double that got from upland farms. Quickly this type of cultivation spread and by 1920 the area of

mangrove felled along the Great and the Little Scarcies rivers was noticeable. This led the Government to introduce this system of cultivation to the Southern Province.(21) But, till 1939 mangrove clearance for rice cultivation has been more or less sporadic in areas other than the Scarcies rivers.(22) In the latter area felling was so steady that by 1950 almost all mangrove lands readily available for rice cultivation have been cleared.(23) This was mainly the Rhizophora racemosa mangrove swamp, where soils and water conditions were found satisfactory for rice growth. Later on, attention was focussed here on the development of saline swamps mainly Avicennia.(24) This involved empoldering of swamp to exclude saline tide-water inflow. By 1951, 35,000 to 40,000 acres of mangrove had been felled and cultivated in the Scarcies rivers area. This was the largest region of cleared mangrove swamp.(25)

Mangrove clearing was seen to increase in the Southern Province particularly after 1939.(26) The areas cleared were mainly those readily available for rice cultivation. Here, development was primarily due to Government initiative and assistance. In 1938, surveys and estimates were made of the mangrove lands of the province. In the year that followed, the 'Swamp clearance loan scheme' was started. Farmers were provided with loans under this scheme to fell mangrove and prepare fields.(27) Skilled Temne mangrove fellers from the Scarcies rivers areawere employed here to

do the work of felling mangrove for the farmers. By the end of 1939 a total of 573 acres of mangrove were felled and cleared.(28)

With the outbreak of the war, the need to increase food production was more greatly felt. The Government sponsored a vigorous campaign to increase swamp rice production.(29) An extensive seed paddy distribution scheme was also started. In 1941, 6,435 bushels of seed paddy were distributed to farmers for planting.(30) In 1943, this was increased to 21,835 bushels,(31) and in the year that followed, to 23,477 bushels.(32) This shows the rapid extent to which mangrove swamps were made use of during this period. In the Bumpe area, the Temne farmers who had migrated from the Scarcies rivers area, established swamp farms producing reasonably good crops.(33) The productivity of swamps as rice landswas realised by the farmers of the Southern Province, many of whom without Government assistance of loans, felled and cleared mangrove for cultivation.

In 1940, the Protectorate Mining Board took up the 'Swamp clearance loan scheme' and increased the amount allocated from £500 in the previous years to £2,000 annually.(34) This benefited more people and more and more mangrove was felled.

Not only the central Government, but also Native Administrations took interest in swamp rice. They employed fellers, cleared plots and rented out to farmers. Seed distribution also took place.(35)

In 1941, a guaranteed minimum price for rice of 6 shillings per bushel was installed. This had an encouraging effect on swamp farmers who in the past had found that large farms are generally productive at low price.(36)

The loan scheme was primarily meant to aid the farmers of the Moyamba and the Bonthe Districts to fell mangrove and cultivate rice. In the Scarcies rivers area unassisted independent farmers felled and cleared mangrove.

The period of rapid mangrove clearance in the Southern Province which started in 1939 continued for fifteen years till 1953, when it suddenly stopped.

The 573 acres of mangrove felled in the Southern Province in 1939 rose to 4,360 acres in 1944.(37) Moyamba District had a total acreage of 3,302 felled by 1947, of which 2,475 were under cultivation. The same year Bonthe District had a total area of 2,165 acres of felled mangrove, of which 813 acres were planted.(38)

In the Bonthe District the greatest expansion in mangrove clearance was seen in Bendu and Imperri chiefdoms. Here shortage of uplands was an incentive to mangrove clearing and swamp farming. But the most rapid progress was in Bumpe chiefdom. This was due not only to the enthusiastic Temne farmers but also to the fact that Bumpe chiefdom had an immediate rail head for produce evacuation. The initiative and interest taken by the Chief of the chiefdom also cannot be ignored.(39)

By 1948 the total area felled increased to 6,244 acres in the two districts and the area planted rose to 4,156 acres.(40) By the end of 1950, 8,206 acres were cleared in the two districts of which 3,371 acres were by unassisted farmers and 97 acres by Native Administrations.(41) With a slight increase in 1951, the total cleared in 1952 rose to 8,552 acres.(42) The most noticeable increase was in 1953 when the total area felled amounted to 9,121 acres.(43) With this climax, mangrove felling underwent a drastic and sudden fall. The years that followed saw a very small area cleared.(44)

The reasons for the sudden decline and loss of interest in mangrove felling are varied. The changes that were taking place in the country as a whole - political, economic and social - particularly after the first few decades of the present century had remarkable impact on mangrove felling. The development of the mining industry and urban areas, led to the attraction of more and more farmers to these places in search of the more remunerative employment they provided.(45) Mangrove fellers as well as swamp farmers migrated in large numbers to these areas. Thus an increasing shortage of mangrove fellers and the rise in the cost of mangrove felling were the results. These effects were felt even as far back as 1942. The population of the two districts - Bonthe and Moyamba - was low, and the migration of farmers away from these

districts made the situation worse. Decline of the population meant abandoning a larger part of the farms already cleared. There was no incentive to expansion of farms or felling of mangrove.

Secondly, the farmers were discouraged due to the problem of weeds, particularly 'Kiri Kiri' or Paspalum Vaginatum. Farmers were faced with the difficult task of heavy digging to control weeds. The farmers of the Southern Province who were not accustomed to this type of work found it uncongenial.(46) Monkeys, birds and army worms were problems to rice cultivation.

Thirdly, mangrove felling and farming were slackened due to the change in emphasis by the Government from mangrove swamps to grassland swamps. Since 1950, it was realized that large expanses of riverain grassland and inland swamps could be cleared and brought under cultivation more easily using mechanical methods.(47) Yields in these areas were found to be encouraging. Thus people were more inclined towards swamp grasslands and were reluctant to attempt the difficult task of felling and clearing mangrove swamps.

There were also acute difficulties of transport and communication in the swamp areas of the Southern Province.

In the Searcies rivers area and in some parts of Moyamba District mangrove swamps that were readily available were cleared. Further extension had to be on the more saline Avicennia mangrove. Salinity posed a problem here. In other areas deep flooding made it difficult to make use of the swamp.(48)

Reclamation of Saline Swamps

Reclamation of saline swamps was attempted on an experimental basis in Maswari (Western area), in 1941.[49] Later it was extended to the Scarcies rivers area and Wellington (Western area). Clearing of Avicennia mangrove and empoldering to exclude saline tide-water was attempted. The notable Schemes in the Scarcies rivers area included :-

(a) Bakepat project
(b) Bambia "
(c) Mapotolon "
(d) Luti-Rosino-Funkedeh project

Besides these some private farmers cleared and empoldered saline swamps in the Samu chiefdom.[50]

The schemes started by the Government in the earlier stages did not show much promise,[51] and some of them had to be abandoned while in others the techniques of reclamation had to be changed.[52]

Mangrove Felling - Temne Method

No mechanical method has yet been found to fell and clear mangrove. Though chemical methods of eradicating mangrove have been discovered,[53] they are more costly and not extensively used. Almost every aspect of mangrove clearing for rice cultivation, therefore, is done by hand.

The most serious drawback to a much more extensive use of mangrove swamps has been the difficulty and expense involved in felling mangrove vegetation and clearing the area. The felling of stout mangrove trees is a skilled task.(54)

There were Temne professional mangrove fellers in the Scarcies rivers area from the early part of this century. Usually these men were employed by farmers to fell mangrove. It cost the Scarcies farmer approximately 10 shillings in cash plus 3 shillings in food etc., to get one acre of mangrove felled. Sacrifices are made to spirits before and after felling and clearing.(55)

" Mangrove is felled in the dry season. Lanes are cut through the mangrove forest parallel to each other and at right angles to the prevailing wind from the west (i.e. sea). First, the aerial roots are cut and the trunks are left untouched. Felling is begun at the interior eastern end of the block to be cleared. The trunks are cut half-way through in the morning on the side away from the prevailing winds. In the afternoon when the sea breeze rises the cut is completed from the other side. In this way all mangrove is made to fall in the same direction.

After felling, clearing of the plot is done by the farmer. For the first year the felled trees are left untouched. In the second year dry season the branches are trimmed off and either burnt or collected for firewood. The heavier logs are left to rot,

which would take a number of years. Generally, by the eighth year the farm is clear, although stumps may remain for as long as 20 years.

A toredo called 'Au bilo ramont' by the Temne, which is a worm-like mollusc, have been of great help in clearing the farm of mangrove stumps and trunks. This mollusc bores in the timber and reduce it to a mere shell.(56)

Factors that Inhibited the Utilisation of Mangrove Swamps for Rice Cultivation

Natural as well as cultural factors were to a great extent responsible for the poor utilisation of mangrove swamps for rice cultivation. Cultural factors appear to have offered the most inhibitive influence. Most of these factors have already been enumerated in Chapter II. The factors that directly concern mangrove swamps are discussed here.

The difficulty of felling and clearing mangrove for cultivation had been a big problem. This was particularly so in respect of Rhizophora racemosa mangrove with its prop roots and stout trunks. The high cost of felling, the long time involved in the clearing and preparation of the swamp for cultivation, and above all, the difficulties encountered after cultivation from the weed Paspalum Vaginatum, birds, fish, crabs, monkeys and army worms, were discouraging factors.

Shortness of the fresh water period and soil salinity encountered in Avicennia mangrove swamp areas restricted their utilisation. This was especially so in the Samu chiefdom, Shorbro island, Rokel river and Port Loko creek estuaries areas. Soil acidity caused by empoldering Rhizophora racemosa mangrove land, was inhibiting their utilisation, as did deep flooding associated with Rhizophora racemosa land fringing rivers and creeks.

Inaccessibility hindered the development of many mangrove areas of the interior, especially Avicennia land and the swamps bearing minor mangrove species. The unhealthy and unpleasant nature of the swamps did not encourage their utilisation.

The low population of mangrove areas, especially in those of the Southern Province, did not offer an incentive to their extensive utilisation. The uplands in the neighbourhood or the already cleared swamp plots supplied sufficient food for the existing population. Moreover, farmers did not like strangers intruding into their neighbourhood and making swamp farms. This was particularly so in Samu chiefdom.(57) Most mangrove swamps closer to uplands especially in the Southern Province were neglected, as upland farming enabled mixed cultivation and was relatively more easy. The people were not accustomed to the cultural practices involved in swamp farming.

In Sama chiefdom area, Shorbro island and Pujehun District, fishing was found more profitable (58) and easy by many people, and swamps were neglected. Mangrove land was considered as the dwelling of the devils and its utilisation was purposely avoided in the early days. Even later on when mangrove felling was started, sacrifices and presents were offered to devils.

Around 1950, Government's change of attitude in regard to swamp farming laying more emphasis on the utilisation of riverain grassland swamps and inland swamps, also slackened and restricted the clearance of mangrove areas.

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CHAPTER IV

GRASSLAND OR RIVERAIN SWAMPS

Most grassland or riverain swamps are found above the high spring tide level, generally adjoining the inner margins of mangrove swamps. Though mainly associated with rivers and streams, they are also found a considerable distance away from drainage lines, occupying low-lying areas and depressions, which are found in the interior, adjoining uplands. The latter swamps are commonly evident in the North-central part of Sierra Leone popularly referred to as the 'Bolilands' region, and also in the Scarcies rivers area.

Riverain swamps possess physical characteristics peculiar to themselves. Their individuality is explicit not only in their grass or sedge vegetation cover, but also in their submission to either seasonal prolonged fresh-water-flooding or to briefer periods of rapid and deep submergence. Unlike in the case of mangrove swamps, here tidal brackish-water-flooding is largely absent. This factor coupled with the highly fertile soils of a greater part of these swamps, have been advantageous from the viewpoint of utilising these swamps for rice production. In fact, grassland swamps are held today as some of the richest potential rice lands of Sierra Leone.

Swamp Vegetation

Vegetation of riverain swamps varies from thick high grasses and sedges to short grasses of many different species. The latter are primarily associated with the grassland swamps of the Bolilands region. It appears that vegetation does not play so dominant a part as in the case of mangrove, in affecting soil and water conditions of the swamps. However, the dense root system of the grasses and sedges of the swamps of the Scarcies rivers area and Southern Province area, has contributed substantially to the enrichment of the soils by supplying organic matter. A correlation is evident between the thick grasses of the Southern Province, the Scarcies rivers and other relatively coastal riverain swamp areas and their great fertility, and between the short grasses of the North-central grassland swamps and their low fertility.

The clearing of the vegetation has been found to be a fairly difficult task, particularly when thick tall grass and sedge were encountered.

The common weed found in the swamp is Paspalum vaginatum.

Vegetation growth is luxurious in the swamps during the wet season. In the dry season to a large extent these swamps dry out. The common vegetation types of the Jong, Sewa and Waanje rivers swamp areas are Rottboellia-exaltata (Galei in Mende), Oryza barthii (wild rice), and Pennisetum purpurium are also found here

SWAMP GRASSLAND

13°W 12°W 10°N 9°N 8°N 7°N

GUINEA

KAMBIA
ROKUPR
Great Scarcies R.
Little Scarcies R.
Mabole R.
MAKENI
PORT LOKO
Port Loko Cr.
Rokel or Seli R.
FREETOWN
Ribi R.
MOYAMBA
Bumpé R.
Kagboro Cr.
Thouka Cr.
Bagru R.
Sherbro R.
BONTHE
Jong R.
Sewa R.
Waanje R.
Moien R.
L. MABESI
Moa R.
PUJEHUN
Mano R.

AREA UNMAPPED

-N-

- SCALE OF MILES -

10 5 0 10 20 30 40 50

DUH

and there.[1] In the Scarcies rivers area grassland swamp vegetation is mostly mixed. Some common species include, Panicum repens, Paspalum commersonnii (hungry rice), Berreia pankum, Parviforium, Thalla geniculatai, Oryza barthii and Polygonum.[2]

Distribution of Grassland Swamps

Grassland or riverain swamps are confined almost exclusively to the western half of Sierra Leone. Unlike in the case of mangrove, grassland swamps for the greater part show a dispersed pattern of distribution. This is particularly seen in the North-western quadrant of the country. (Fig. 14)

Except in some parts of Loko Masama, Nongoba Bullom and Kwamebai Krim chiefdoms, all grassland swamps are found beyond the inner margins of mangrove swamps. (Figs. 6 & 7) The other margins of grassland swamps are either higher ground covered with forest or savannah scrub or other swamps (inland valley swamps). A larger part of grassland swamps therefore occupy predominantly inland locations.

The map showing the distribution of grassland swamps reveals two distinct regions. (Fig. 14) The area north of latitude 8° N. shows a more or less dispersed pattern of distribution. Here, the only compact and continuous swamp areas are the left bank of the Little Scarcies river in Loko Masama and Mambolo chiefdoms, Kholifa

Mabang chiefdom in the Tonkolili District associated with the Rokel river, and Kamajai chiefdom in Moyamba District associated with the Jong river. On the contrary, the grassland swamps that are found south of latitude 8° N. are mostly compact and continuous in their distribution. Almost the entire grassland swamp area of this region is confined to the Bonthe District. Compared to the grassland swamps of the rest of the country, those of the southern region have a coastal location. This is particularly so in the case of the Kittam - Waanje rivers and Shorbro island grassland swamps.

The grassland swamps of Sierra Leone could be generally considered under two bread divisions:

1. Lower riverain grassland swamps
2. Interior grassland swamps.

1. Lower Riverain Grassland Swamps

Within this division, four distinct sub regions are identifiable, all confined to a region about 28 miles from the coast.

(a) The Sewa - Waanje - Kittam - Malen - Jong rivers area

(b) The Shorbro Island area

(c) The Searcies rivers and Samu chiefdom area

(d) The Ribi - Bumpe rivers area.

(a) Sewa - Waanje - Kittam - Malen - Jong Rivers Area.

This is the most important of all grassland swamp areas of Sierra Leone from the viewpoint of areal coverage and potentialities. Here, the trellis pattern which the Kittam - Sewa - Malen - Waanje system exemplifies is manifest in the distribution of grassland swamps. (Fig. 14) The close relationship between rivers and these swamps is thus clearly evident. This vast grassland swamp area shows a more or less compact and continuous aspect. From the coast, bordering the Sewa river, these swamps extend inland for about 22 miles continuously. Fringing the Kittam and Waanje rivers a belt of grassland swamp runs parallel to the coast for a distance of nearly 40 miles from the Kittam estuary upto Lake Mape. The continuity of this belt is broken at some places by mangrove swamp and rice fields. The thickest spread is seen associated with the Sewa river, particularly on its right bank. Grassland swamps bordering the Malen river, parts of the Jong river and the Mongeri and Bendo creeks, extend to join the main Sewa river swamp region. These grassland swamps are bounded by mangrove and other swamps.

Compared to the total area of grassland swamp found in this region, the area devoted to rice is very small. The main rice lands are found fringing the Sewa river especially on its eastern bank and bordering the Kittam and the Waanje rivers. (Fig. 21) In the rest of the grassland swamp region are found scattered patches

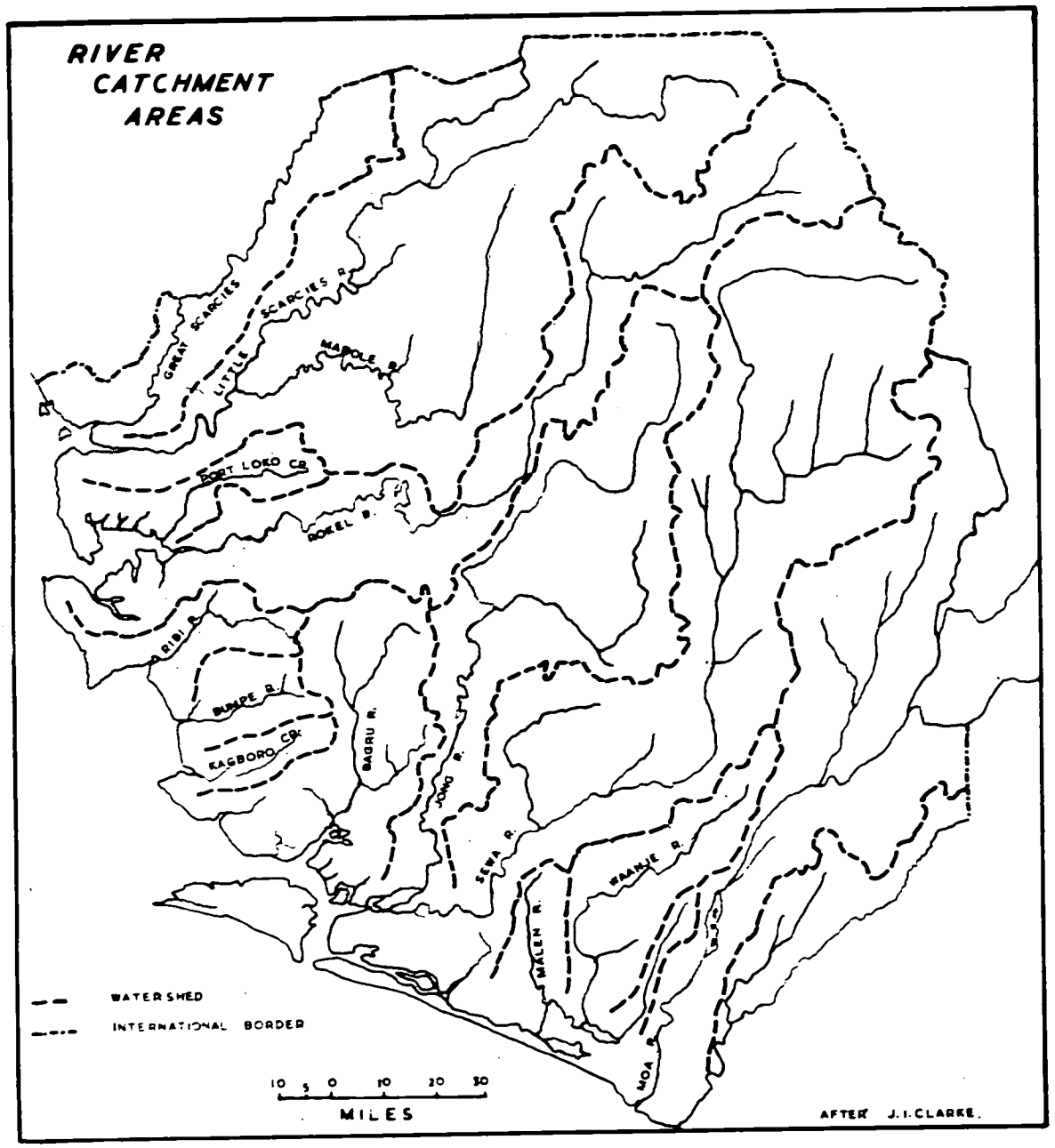
RIVER
CATCHMENT
AREAS
GREAT SCARCIES
LITTLE SCARCIES R.
NAPOLE R.
PORT LORO CR.
BOREL R.
BIBI
BUMPE R.
KAGBORO CR.
BAGRU R.
JONO R.
SEWA R.
MALEN R.
KANKE R.
MOA R.
WATERSHED
INTERNATIONAL BORDER
10 5 0 10 20 30
MILES
AFTER J.I.CLARKE.

Fig. 15.

of riceland being very negligible in total area.

Among the factors controlling the distribution of grassland swamps in this region, those of primary importance are the extensive fresh water flooding facilitated by the high rainfall, the large volume of water of the rivers and the low-lying nature of the region. The Sewa is one of the three rivers of Sierra Leone with very large catchment areas, (Fig. 15) (the others being the Great and Little Scarcies rivers). Especially during the wet season the Sewa river carries an enormous volume of water. The intricately meandering nature of the river extends the influence of flood waters to a wide expanse of land. The Sewa waters help to raise the Kittam and Waanje rivers and the numerous streams associated with these rivers. A greater part of the banks of these rivers therefore are subject to deep and prolonged flooding. This is particularly so in the region north of the Waanje river and lying parallel to the Sewa river, forming an intermediate belt between lakes Baiama, Kwako and Kamasen and the Sewa river grassland swamp. Flooding starts usually in July and may reach a depth of 10 to 15 feet on these low-lying sites. The normal flooding of the Sewa river is four to six feet in August, but a peak upto 15 feet is not uncommon.(3)

The rivers of this region for the greater part are not tidal and are mostly fresh-water rivers.

Almost all grassland swamps of this region are confined to land below 50 feet elevation. The barrier effect of high ground restricting the extension of flooding and the consequent grassland swamp development is seen in the areas between the grassland swamps of the Malon, Sewa and Waanje, to the east of lakes Popoi and Tibi, between the grassland swamps of the Sewa river, Bendo creek and the Jong river, and between the grassland swamp of the Kittam river, Jong river and Bendo creek. Along the coast, sand ridges found here and there limit the spread of grassland swamp seawards.

Mangrove swamps with their characteristic brackish water influence, form a limit to the grassland swamps in the interior of Turners peninsula and in parts of Nongoba Bullom, Yawbeko and Bum chiefdoms.

Lakes have acted as barriers to the spread of grassland swamps in the Bum chiefdom area.

This is one of the most well-watered areas of Sierra Leone from the point of view of rainfall. (Fig. 12) It receives a mean annual rainfall of more than 120 inches but an extensive part of the region receives about 140 inches. A large part of the catchment area of the Sewa river receives over 100 inches mean annual rainfall. This accounts for the great volume of this river in the wet season.

The grassland swamps found in the interior of this region, away from the influence of the main rivers, are mostly flooded by the heavy rains which drain the surrounding uplands.

The soils on which swamps have developed are river deposited silt. These are deep and rich though slightly saline near mangrove swamps.

(b) Sherbro Island Area

About 1/3 of the area of the island consists of grassland swamps. These are mostly found in the central tracts beyond the inner margins of mangrove swamps. The continuity of the grassland swamp area is broken here and there by other swamps. In contrast to the Sewa - Waanje - Kittam area, here grassland swamps are not associated with large rivers. Banks of small streams and abandoned longitudinal lagoon tracts and depressions form the predominant habitats of grassland swamps in the island.

Rainfall plays the most dominant role in controlling the distribution of grassland swamps in this area. An average annual rainfall of over 150 inches helps to raise the streams and flood a large part of the island. The low-lying aspect of the land offers little obstacle to extensive flooding. Flooding is intensified by tidal backing. The coastal stretches naturally suffer from the effects of saline water, but salt-free conditions are restored at the end of July in most areas and last till mid-December.(4)

The interior swamp regions enjoy a longer salt-free period.

(c) Scarcies Rivers and Samu Chiefdom Area

Grassland swamps are largely found on the banks of the Little Scarcies. (Fig. 14) Smaller concentrations are evident associated with the Great Scarcies, Samu chiefdom and western Loko Masama chiefdom. Except for some parts of the Little Scarcies area, grassland swamps are located predominantly beyond the inner margins of mangrove land. A greater part of the grassland swamps of this region thus enjoy an interior location. The noteworthy exceptions are however, those of Western Loko Masama chiefdom and the small patches in Samu chiefdom, found along the coast. Only along the upper reaches of the Scarcies rivers do grassland swamps fringe the rivers, elsewhere they are associated wholly with the tributaries of these principal rivers. In Samu and Western Loko Masama chiefdoms the banks of smaller streams and creeks support grassland swamps. Thus the alignment of the swamps shows the pattern of the streams and creeks. Unlike in the Sewa - Waanje - Kittam - Malen - Jong rivers area, here grassland swamps are found for the greater part as limbs spreading out in all directions in harmony with streams. The interior limits of these protrusions are usually high ground covered with forest or other swamps.

A relatively continuous stretch of grassland swamp is found on the left bank of the Little Scarcies river. This area includes

the Gbonti, Makomba and Rebump swamps.

The grassland swamp area associated with the Great Scarcies river is small in total area. In the Samu chiefdom grassland swamps exhibit a scattered pattern of distribution, (Figs. 14 & 6) but the larger concentrations are associated with the upper reaches of the Mahola and Sasiyok creeks and their tributaries.

The factors controlling the distribution of grassland swamps of this region are similar to those enumerated in connection with the Sewa - Waanje - Kittam - Malon - Jong rivers area. The relatively high rainfall which the vast catchment areas of the Great and the Little Scarcies rivers receive, (Figs. 15 & 24) provides these rivers with an enormous volume of water. Tidal backing results in the flooding of extensive areas. The Great Scarcies being very tidal, fails to provide continuous flooding, but the Little Scarcies is less tidal and a large area is continuously flooded with fresh water. Salinity is a common feature in the Great Scarcies waters due to tidal influence, but the Little Scarcies is predominantly a fresh-water river.(5)

The flat terrain of a greater part of the region permits convenient flooding. (Fig. 22) This is particularly so in the case of the Little Scarcies area where uplands are more fragmented than in the case of the Great Scarcies area. In the Samu, central Mambolo and in parts of Loko Masama chiefdoms, the finger-like

distribution pattern of swamps are caused by the interlocking nature of uplands on either sides of the swamp. Climatic conditions have already been discussed under mangrove swamps of this region. (p. 63) Generally high rainfall and relatively high wet and dry season temperatures mark this region. The grassland swamps here are dry only for a part of the dry season. The interior grassland swamps of this region are nourished predominantly by heavy rainfall rather than by direct river flooding. Seepage and run-off from the surrounding uplands make these swamps waterlogged.

Soil conditions are similar to those of the regions already discussed. Conditions similar to mangrove soils are found in those grassland swamps which have been previously inhabited by mangrove.(6)

(d) Ribi - Bumpe Rivers Area

On either sides of the Ribi and Bumpe rivers, are found elongated limbs of grassland swamps, trending inland and fringing the numerous tributaries of the two rivers. All these swamps have an interior location, beyond mangrove swamps which fringe the coast and main rivers. (Figs. 14 & 7)

Almost all the grassland swamps of this region are confined to the region below 25 feet mean sea level. (Fig. 11) The restricted nature of grassland swamps in this region is due to the unfavourable conditions brought about by the extensive tidal influence to which

the Ribi and the Bumpe rivers are subject. In the rainy season the Ribi river is tidal as far as Mabang and brackish water flooding is common. The tidal influence of the Bumpe extends beyond Retifunk and Mokambo.(7) Prolonged deep fresh-water flooding is common only in the upper reaches. The grassland swamp areas associated with tributaries of the Ribi and the Bumpe rivers being above the high-spring tide level are devoid of saline water effects and enjoy fresh-water flooding during the wet season. The heavy rainfall during this season helps to make the swamp waterlogged. It has been estimated that 83 acres associated with the Ribi river and 582 acres associated with the Bumpe river are subject to deep flooding.(8)

The effects of relief is similar to that enumerated in respect of Scarcies grassland swamps. The climatic influences are similar to those associated with the Sewa - Waanje - grassland swamp area. Soils of this region are similar to those of other swamp grassland areas.

(c) Minor Regions

Associated with the tributaries of the Port Loko creek and the Rokel river are limbs of grassland swamp forming a small total area. These generally occupy interior locations, away from the influence of brackish water of the tidal river and creeks. They are however, subject to a seasonal fresh-water flush and consequent

silt deposition. The Port Loko creek with its relatively limited volume of water drawn from its small catchment area, (Fig. 15) is incapable of flooding an extensive area. Relief, moreover, offers a restrictive influence on flooding, confining the grassland swamps to the shallow depressions associated with minor streams.

2. Interior Grassland Swamps

The grassland swamp region of the interior associated with the upper reaches of rivers and streams, is mostly confined to the North-central part of the country, including Northern and Eastern Kambia District, Bombali District, Eastern Port Loko District and Western Tonkolili District. Within this large area scattered irregular patches of grassland swamps of varying sizes mark the distribution pattern. (Fig. 14) The eastern section of the grassland swamp area is the so called Bolilands region. The abrupt eastern limit of this region is a noteworthy feature. The Bolilands region deserves special consideration due to its peculiarities. Compared to the rest of the interior grassland swamp region, the Bolilands area consists mostly of a very dense concentration of grassland swamps. To the west of the Bolilands region is a large area where abundance of narrow elongated stretches of grassland swamp, are found widely diffused and associated with small streams. The dense concentrations of grassland swamps in the interior are

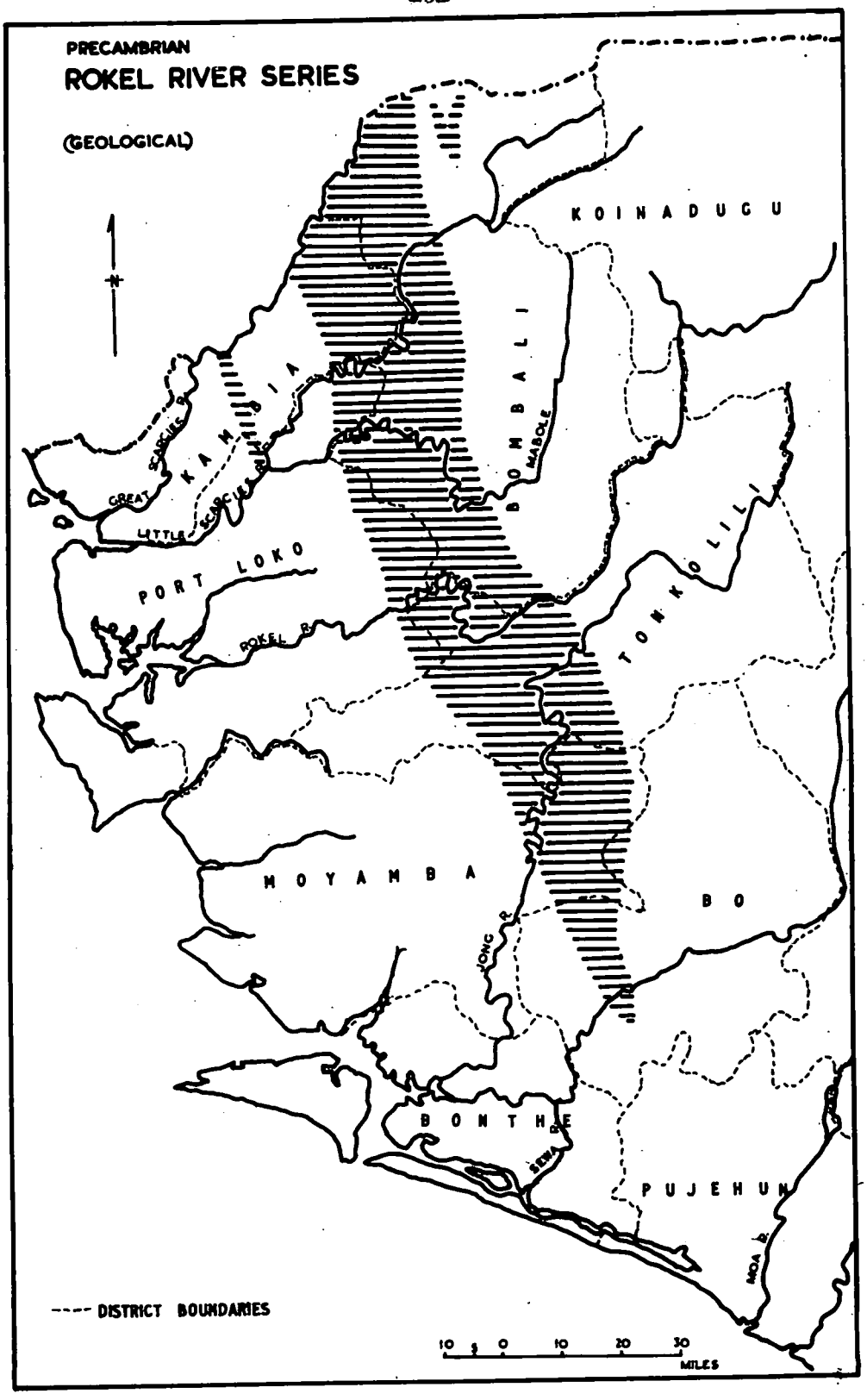
PRECAMBRIAN
ROKEL RIVER SERIES
(GEOLOGICAL)
N
KOINADUGU
BOMBALI
MASOLE
KAMBIA
SORIE
GREAT SCARCIES
LITTLE SCARCIES
PORT LOKO
ROKEL R.
TONKOLILI
MOYAMBA
BO
JONG R.
BONTHE
SEWA R.
PUJEHUN
MOA R.
DISTRICT BOUNDARIES
10 5 0 10 20 30
MILES

Fig. 16.

found to abound the banks of the upper reaches of the Little Scarcies, the Rokel and the Mabole rivers and their tributaries. A large part of the swamps of this region are aligned according to the rivers and streams, though a considerable number occupy dry valleys and depressions.

Two compact and continuous grassland swamp areas are found enjoying isolated positions associated with the upper Jong and the upper Sewa rivers in Kamajie (Moyamba District) and Bumpe (Bo District) chiefdoms, respectively.

A striking correlation is evident in the distribution of the relatively dense grassland swamp area of the Bolilands region, and the underlying geological strata which consists of weak pre-cambrian sedimentaries called the Rokel river series.(9) These extend from the Guinea border, for about 140 miles in a strip about 25 miles wide. (Fig. 16) The soils derived from the rocks of this Rokel river series, are low in nutrient status as they are inherently much poorer in minerals.(10)

Relief has played a significant role as a controlling factor of interior grassland swamps. Practically the whole region is below 250 foot elevation and constitutes a vast gently undulating plain. The sharp escarpment to the east of this region marks the abrupt eastern limit of grassland swamps.

In a larger part of the Bolilands area, rivers or streams meander aimlessly and during the wet season from May to November, when they overflow, a large expanse of land is moistened. Surface and sub-surface run-off from the surrounding uplands during the rainy season make a considerable part of the grassland swamps water-logged. Usually Bolilands are subject to sudden uncontrolled flooding from the rivers. Flooding varies in depth from one area to another. Silt deposition is generally little especially when compared to the grassland swamps of the lower courses of rivers.

A striking correlation is seen in the heavy rainfall of the eastern part of the interior grassland swamp region, and its dense concentration of grassland swamps. The relatively low rainfall of the rest of the region finds expression in the sparse and diffused distribution of grassland swamps. A greater part of the Bolilands region receives a mean annual rainfall of as high as 120 to 130 inches. (Fig. 24) Well defined wet and dry seasons are evident in the region. Variability of rainfall is relatively low being 7.5 to 10%, only the northern areas showing a slightly higher variability ranging from 10 to 15%. 90 to 95% of the total rainfall is received during the wet season. (Figs. 26 & 27) A large part of the grassland swamps dry out completely during the dry season. Due to its interior location, this swamp region experiences a relatively high seasonal range of temperature.

Grassland Swamps as Rice Lands - Their Potentialities and Limitations

Swamp grasslands offer immense potentialities in respect of rice cultivation. According to Reddan (1939), and the Sessional Paper 1 of 1951, there are about 63,360 acres of glassland swamps suitable for the cultivation of rice in the Sewa - Waanje rivers area. Reddan estimates the flooded grasslands believed suitable for rice, in the Ribi river area as 1,485 acres, Bumpe river area - 5,312 acres, Kagboro creek area - 589 acres and Titibul creek area - 794 acres.(11) (Fig. 13)

R.J.H. Church estimated 40,000 acres of potential rice land in the grassland swamps of the Scarcies rivers area.(12) Dalton in 1961 estimated 250,000 acres of grassland swamps suitable for the cultivation of rice in the north-central Bolilands region.

Thus the total grassland swamp area suitable for rice cultivation in the whole country might be 350,000 acres.

It is significant to note that of this enormous area, only a small portion has been put to any productive use. Mechanical cultivation has enabled the utilisation of a considerable area for rice cultivation.(13) The flat and low-lying nature of a large part of grassland swamps facilitate its extensive and convenient utilisation for rice cultivation. Mechanical cultivation is made feasible, especially in respect of the southern grassland swamps and the Scarcies grassland swamps. A larger part of the Bolilands

region also could be mechanically cultivated. Some of the small interior grassland swamps however, offer limitations to mechanical cultivation. But the adoption of ox-ploughing, as has been demonstrated in the Mabeli valley grassland swamps, can help considerably the judicious utilisation of these swamps also.

The soils of grassland swamps of a greater part of the country are fertile and rich in organic matter and iron. Their water retaining capacity and friable nature are other advantages from the viewpoint of rice cultivation. In the southern grassland swamps, soil is a very fertile black alluvium which is replenished by annual flooding.(14) Though dry for a part of the dry season, grassland swamp soils are usually under varying wet conditions for the rest of the year.(15) The same is true of the Scarcies rivers grassland swamp soils. Here soils are pale grey to brown clay. In the interior grassland swamps which are mainly flooded by rainwater, the soils are much darkened by humus resembling fen peat.(16) In the outer fringes of these swamps close to uplands sand may be present. Only soils on edges of main tidal swamps would appear to be salty. However, these soils could be made productive by improved drainage conditions as has been demonstrated in the Scarcies area.

The soils of the Bolilands area do not offer as much potentialities as those of the other grassland swamp regions.

The degree of fertility in this region varies from place to place.[17] The Rokel river geological series has given rise to a light and relatively poor soil here. Even the alluvial soils found in the Bolis are less fertile, being derived from the impoverished lands around.[18] Boli soils have a depth of about 18 inches or more and a texture of silty clay loam or silty clay. In the rainy season they become heavily flooded but in the dry season, dry out completely and the soil organic matter is then dehydrated and the soil becomes very light grey in colour. They are usually very deficient in nitrogen and available phosphorus and iron.[19] Nevertheless, these soils are capable of being improved by the judicious use of phosphatic fertilizers.

Climatically grassland swamps are suitable for rice production. In certain years, however, early rains and consequent early flooding have interfered with the preparation of the swamp for cultivation, whereas in others late rains have caused problems. But, instances of this nature have not been too frequent. With proper methods of water control and drainage, such problems could be resolved.

Flooding is the other important characteristic of grassland swamp enabling the drawing of a good rice crop. Most grassland swamps are directly flooded by rivers and their tributaries during the wet season, mostly backed by tides. The seasonal nature of this flooding is a great advantage from the point of view of rice

cultivation, for it avoids the necessity of drawing water from rivers by artificial methods as conducted in many South-east Asian countries. Some grassland swamps closer to rivers and creeks are deeply flooded for a considerable period of time. There are others which are subject to tidal saline water effects. These have posed problems. However, empoldering and regulating flood waters or by the use of floating rice varieties which can resist deep water conditions, these areas could be made productive. Deep flooding has been a problem more in the southern swamp grasslands than elsewhere. In the Sewa - Waanjo rivers area about 8,900 acres are subject to deep flooding.(20) In some Bali swamps, briefer periods of rapid and deep submergence have caused problems.

The problem of salinity could be overcome by improvement of drainage conditions by clearing and deepening the existing natural waterways and erecting new channels. Short duration salt-resistant rice varieties could be cultivated in these swamps.

Factors that have Inhibited the Development of Grassland Swamps for Rice Cultivation.

A multiplicity of factors both natural and cultural have in varying degrees inhibited the extensive utilisation of grassland swamps for rice cultivation. In Chapter II the general factors that have inhibited the utilisation of swamps in the country have been enumerated. Most of these factors are applicable in respect of

grassland swamps. Those directly concerned with grassland swamps are worth further amplification.

During the early years grassland swamps were sources of piassava and thatching material in some parts of the country. Piassava brought substantial income to the people of the Bonthe and Pujehun Districts. Thus their extensive clearance for rice cultivation was not resorted to. The upland farm supplied the necessary food for the people.

The inability to practice mixed cultivation as conducted in upland farms made people avoid grassland swamps.(21) Low population had been a very characteristic feature in grassland swamp areas, from very early times.(22) After the first few decades of the present century, most young men were attracted to more remunerative jobs in the mining industries and urban areas. This was especially seen in the 1950's. Moreover, the patchy rice fields(23) that were found in grassland swamps of the Southern Province before the early 1950's, did not show encouraging results.(24) The yields were low mainly due to the non-availability of high yielding floating rice varieties during this time. Moreover, people were discouraged by deep uncontrolled flooding which caused considerable damage to crops. In the Sewa - Waanje rivers area, 20 feet depth of flooding is not exceptional. In the Bolis, sudden uncontrolled flooding in the wet season and the shortage of water during the dry season have

caused serious problems.(25)

Low yields due to poor soil conditions have been an inhibitive factor in the Bolilands area.

Inaccessibility has been one of the main reasons for the non-utilisation of a large area of grassland swamps.(26) Some grassland swamp areas which have been cleared had to be abandoned due to difficulties in transport and communications.(27) (eg: the Marthyn site of the Moyamba District).

Lack of organization on the part of the Government, especially in respect of marketing, storage and milling facilities was a discouraging factor.(28)

The difficulty of clearing and preparing the swamp grassland for rice cultivation also hindered progress especially in the early days. Lack of adequate tools and implements added to this difficulty. The dense sedge or grass growth and the deep strong root system posed major problems entailing much hard work. This problem was overcome only after the introduction of mechanical cultivation. Even here deep digging has to be resorted to, in order to completely clear the sedge and to eradicate weed growth. The intrusion of weeds has been perhaps most troublesome in all grassland swamp areas that have been cleared for cultivation.(29) Weeds have made rice yields dwindle considerably. When the weed problem was great the number of seeds sown had to be increased to

compete with the weeds. Thus about 90 lbs. of seed per acre had to be sown.(30) In the Bolilands area, successful rice cultivation depends on the weeding of the young crop.

Birds, monkeys, fish and other pests have been found to be causing much damage to cultivated crops, discouraging many farmers from swamp farming.(31)

Grassland Swamp Clearance for Rice Cultivation

Government initiative and assistance primarily in the form of mechanical cultivation and seed distribution schemes directly helped to convert considerable areas of grassland swamps into productive rice lands. The introduction of floating rices, (especially the Indo China variety) enabled the utilisation of the deep flooding grassland swamps which were for long held as lands unsuitable for rice cultivation.

Grassland swamps have been used for rice cultivation as far back as 1880's, in the Scarcies rivers area.(32) A.C. Pillai refers to rice farms in cleared grassland swamps in 1922, in the Bum - Kittam - Waanje rivers area.(33) In the Bumpe river swamps, grassland swamps were those first used for rice cultivation.(34) However, all these earliest grassland swamp rice lands have been very limited in total area. In most of them crop yields have been poor and disappointing.(35)

The potentialities of grassland swamps as rice lands have been increasingly realised by the Government since 1922, and in the years that followed it tried by means of extensive propaganda to popularise the utilisation of grassland swamps for rice cultivation. In the 1930's the Indo-China floating rice variety which is resistant to deep water conditions, was introduced to the southern grassland swamps. Between 1938 and 1940 surveys were made of the existing and potential rice lands in swamp areas of the coastal region.(36) In early 1948 the West African Rice Mission toured the riverain grasslands of the Southern Province and stressed the importance in developing them for rice cultivation. However, the utilisation of these swamps was actively taken up only after about 1950. The previous lack of interest in these swamps was probably due to the greater interest and attention in mangrove swamps. But later on, difficulties that cropped up in mangrove swamp areas and mostly the rising demand for rice which was felt in the country as a whole made the Government focus its attention on grassland swamp development.

In 1949 it was realised that the adoption of mechanical methods was essential to bring wider areas of grassland swamps under cultivation. Swamp clearing, ploughing and harrowing invariably necessitate the use of machinery. The inherent nature of a large part of grassland swamps being covered with a thick growth of sedge

or grass with strong deep and dense root systems, makes mechanical methods of clearing and ploughing imperative. The eradication of wild grasses and weeds that intrude into cleared or cultivated land necessitates deep digging of 10 to 12 inches, by mechanical methods.(37) Also, the need to clear and plough the land quickly without delay during the dry season requires the adoption of mechanical methods. The sudden onset of the rains and the consequent deep flooding of rivers would otherwise make cultural practices in the swamps practically impossible. Above all, the low population and shortage of labour make the need for mechanisation more important.

Many grassland swamps at present utilised for rice cultivation have been mechanically cleared and are being mechanically ploughed and harrowed.

Difficulties were encountered in mechanical cultivation of some grassland swamps, due to very dense sedge and weed growth. In the Bolilands area clouds of dust generated by mechanical ploughing in the dry season caused preblems.(38) Also, the cost of ploughing mechanically was unduly high.(39)

It was in 1952 that development activities were centred mainly on mechanical cultivation of riverain swamps.(40) This was started on a full scale in the Bonthe District and extended to the Port Loko - Scarcies and the other Districts. From 1952 to 1958 there was a progressive increase in the area of grassland swamp ploughed and

utilised. The popularity of floating rices enabled the further extension of the area cultivated. The entry of Co-operative societies into mechanical cultivation in 1956 further extended the area cleared, particularly in the Bonthe District.

TABLE 5

MECHANICAL PLOUGHING BY THE DEPARTMENT OF AGRICULTURE

	Southern Circle (Bonthe District)	North-western Circle (Port Loko District - Scarcies area)	Northern Circle (Bombali - Tonkolili District)
1949	4	-	-
1950	69	-	-
1951	282	80	-
1952	465	645	238
1953	1,178	683	915
1954	2,278	757	2,449
1955	4,073	1,014	3,600
1956	5,530	2,008	2,819
1957	5,302	2,334	2,625
1958	4,346	320	1,504
1959	4,389	243	356
1960	5,508	592	926
1961	6,934	656	1,444
1962	7,828	676	2,296
1963	8,630	358	5,135

Source - Annual Reports of the Department of Agriculture Sierra Leone.

Mechanical cultivation of the Bolilands was started in 1952 and from 1954 to 1958 a rapid increase in the area cleared was noted. In the early years the Swamp Clearance Bonus Scheme of the Government encouraged clearance. Infertility of soils that was posing problems, led to the use of mechanical methods of drilling fertilizers with the seeds in these areas.(41) The distribution of fertilizers at subsidized rates by the Government, led to the utilisation of considerable areas of the Bolilands region.

Among the factors that led to the expansion in area of grassland swamp utilised for rice cultivation, the interest taken by the Native Administrations cannot be overlooked. They cleared swamps and rented out to farmers and were engaged in distribution of seed paddy.(42) Improvement of drainage and water control methods, particularly in the Scarcies peat swamps (interior grassland swamps) also led to the utilisation of a fair acreage.(43)

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CHAPTER V

OTHER SWAMPS OR INLAND VALLEY SWAMPS

Inland valley swamps are distributed all over Sierra Leone. Occupying usually interior locations, they are found in association with minor valleys and depressions beyond mangrove and grassland swamps, (Figs. 6 & 7) but bordering either forest or savannah land. Enclosed for the greater part by uplands, these narrow elongated valley swamps exemplify soil and water conditions peculiar to themselves. Inland valley swamps are essentially fresh water swamps.

Inland valley swamps are of particular importance today not only due to their agricultural potentialities, especially in rice cultivation, but also because of the failure of their neighbouring uplands to satisfy adequately the needs of the people. Mangrove and grassland swamps, due to their predominantly coastal location do not offer a great attraction to the farmers, as these swamps are far away from the uplands, the traditional homes of the farmers. The problem of attracting farmers to mangrove and gassland swamp areas has continued to be a problem till the present day.(1) However, the inland swamps which are situated at the foot of uplands are more accessible and therefore are more capable of attracting the upland farmer. This has been noticed especially in the remote districts of Sierra Leone such as Koinadugu, Kono, Kailahun and Kenema.

Inland Valley Swamp Vegetation

The vegetation of inland valley swamps is mostly grass. However, those found neighbouring grassland swamps and mangrove swamps, support swamp forest of the raphia palm - raphia gracilis and raphia hookeri. Some inland valley swamps are under water for a prolonged period, and form the habitats of floating vegetation. This is common in the swamps fringing mangrove and grassland swamps, in the coastal areas.(2)

Among the grasses the typical is wild rice or Oryza barthii, and the sedge Fuirena umbellata. On the margins of these swamps Panicum parvifullium and Paspalum scrobiculatum are commonly found.(3)

Vegetation of these swamps has enriched the soil by adding considerable quantities of organic matter. But vegetation has posed a negative influence on the clearance of swamps for rice cultivation. This is particularly so in respect of raphia swamps. The larger cash return which the products of raphia palm provides, compared to rice, has prevented the clearance of these swamps in the Bonthe District, particularly in the Sherbro island.(4)

The degradation of vegetation of the uplands due to bush fallow agriculture has caused the loss of an earlier abundant source of organic material for the inland valley swamp. Decline of water table and soil erosion are among the other problems that have resulted.

OTHER SWAMPS

13° W
12° W
N
9°N
8°N
7°N
GUINEA
Great Scarcies R.
KAMBIA
ROKUPR
Mabole R.
Little Scarcies R.
PORT LOKO
Port Loko
Rokel
Seli R.
FREETOWN
Ribi R.
MOYAMBA
Bumpe R.
Kagboro Cr.
Thauka Cr.
Bagru R.
BONTHE
Sherbro
Long R.
Kittam R.
Sewa R.
Waanje R.
PUJEHUN
L. MABESI
Moa R.
Mano R.
AREA UNMAPPED
- SCALE OF MILES -
10 5 0 10 20 30 40 50

Distribution of Inland Valley Swamps

Though inland valley swamps have a countrywide distribution, their main domain is the western half of the country. (Fig. 17) Large expanses of the North-central and North-eastern mountainous regions are for the greater part devoid of these swamps. Bombali, Tonkolili, Eastern Kambia and Eastern Port Loko are among the main districts where other swamps are negligible.

Inland valley swamps do not have a compact and continuous distribution pattern as mangrove and some grassland swamps. On the contrary they show a widely dispersed pattern consisting of narrow elongated stretches. A relatively slight compactness is evident in the swamps of the lower Jong river, Malon river and east of Lake Mabesi. (Fig. 17)

Dense concentrations of inland valley swamps are confined mostly to the coastal areas, within 20 miles of the coast. These fringe the upper reaches of the tributaries of rivers that drain this area. Thus the distribution pattern of these swamps well exemplify the dendritic pattern of the smaller streams. This is particularly evident in the Moyamba District.

Two distinct inland valley swamp regions are displayed in the map showing the distribution of other swamps. (Fig. 17)

(a) A coastal valley swamp area which lies within 20 miles of the coast, and

(b) the remainder which has a predominantly inland location.

Both regions are belt-like in form, trending more or less parallel to the coast in an approximately North-west - South-east direction. The coastal valley swamp belt is divisible into three minor regions.

1. The Ribi - Bumpe rivers, Kagboro, Thauka, Titibul creeks region of the Moyamba District.
2. The Jong river and Shurbro island region of the Bonthe District.
3. The Malon and Moa rivers and Lake Mabesi region of the Pujehun District.

Minor concentrations are evident associated with the Rokel river, Port Loko and Grabai creeks and the smaller streams of the Loko Masama, Kaffu Bullom and Soma chiefdoms.

The interior belt of highly diffused patches of valley swamps, extends south from eastern Moyamba District through western Bo District into north Pujehun District. In the latter district this belt takes an easterly direction into the Kenema District. (Fig. 17)

Two smaller inland valley swamp areas are found associated with the streams of the upper reaches of the Great Scarcies and the Little Scarcies. The Great Scarcies area falls within the chiefdoms

of Tonko Limba and Bramaia of the Kambia District, while the Little Scarcies area is included in the northernmost chiefdoms of Bambali District - Tambakha, Sola Limba, Sanda Loko and Kasunko. In total area, these two areas are quite small.

Factors Controlling the Distribution of Inland Valley Swamps

The factors controlling the distribution of inland valley swamps and interior grassland swamps are similar in many respects.

Relief plays a dominant role as a controlling agent. A large part of these swamps are concentrated in the region below 250 feet elevation, but within this region a larger expanse of swamps occupy the region with an elevation of less than 100 feet. Relief has given to these swamps their elongated and narrow form restricting these to the narrow low-lying valleys of streams or depressions.

Rainfall and flooding, however, have had a more dominant influence on the exact location and size of the valley swamps, which are moistened in three ways: by direct rainfall, by rainwater seepage from adjoining uplands, and by overflow of the smaller streams. Dry valleys and depressions which are remote from streams are usually waterlogged in the former two ways. A large part of the valley swamps in the coastal areas are usually flooded by overflowing streams. The latter areas for the greater part are deeply flooded, so much so that some valley swamps appear as lakes during the wet

season, normally supporting floating vegetation.

Temperature conditions of the valley swamp areas of the coastal tract, are similar to those enumerated in respect of mangrove swamps. (p. 63)

Inland valley swamp soils vary considerably in fertility. A greater part of the shallow swamps usually have sandy soils, deficient in organic matter. The deep swamps on the other hand have more fertile soils. Increased run-off and erosion from the upland farms have had adverse effects on the soils of a larger part of inland valley swamps. "As most of Sierra Leone's upland soils are light ones, so basically are most of the swamp ones, and fertility is bound to decline unless adequate supplies of organic matter are maintained."(5) Seasonal deposition of fresh soft silt is more common in the valley swamps of the coastal areas.

Inland Valley Swamps as Rice Lands: their Potentialities and Limitations

Although for the greater part composed of small scattered patches, in total area inland valley swamps form a good part of the entire swamp land of Sierra Leone. But as in the case of mangrove and grassland swamps, these swamps too have remained almost untouched for a very long time. Even today, only a very limited portion of the total area is being continuously utilised for rice cultivation.

A large part of inland valley swamps under rice are those closest to upland bush fallow farms. Cultivation of swamp takes place periodically in conjunction with the upland farm. The extent of cultivation in swamps is mostly dependent on the success or failure of the upland farming operation. In many areas early rains and inability to clear and burn the upland farm bush, or the insufficient burn of farm bush, necessitate the cultivation of swamps, (e.g. Kenema, Kailahun and Kono Districts). In some areas swamp cultivation is attempted only after the upland farm is prepared. It is thus evident, that inland valley swamp cultivation in a greater part of the country is taken up mostly as a secondary or supplementary farming activity.

The system of farming adopted in many inland valley swamps is similar to that followed in the upland farm. The swamps are followed for some years periodically, owing to the decline of soil fertility and consequent deterioration of crop yields.

In many areas of Sierra Leone, where uplands have been found suitable for cultivation, swamps have been totally neglected. There are areas where inland valley swamps are not fully used in spite of the low soil fertility of the upland farm. Even where swamps are more completely utilised as in some swamps of the Northern Province, the efficiency with which it is conducted is affected by upland farming activities, which claim priority.

A large majority of upland farmers are reluctant to adopt swamp farming as their means of livelihood, in spite of the continuous efforts of the Agricultural Department and the local administrative authorities to encourage and promote swamp cultivation. The various factors that have inhibited the use of swamps, have been already enumerated in Chapter II. (p. 35)

Relatively intensive inland swamp farming in both wet and dry seasons is common in the northern savannah areas of the country. Cultivation has been found to be fairly intensive where bush fallow has declined and particularly where population has increased. These areas are usually found around large villages and towns where pressure on the land is great, and good markets for dry season produce are available.

Patches of relatively deep flooding inland valley swamps of the coastal region, have been used from early times for rice cultivation. Tall-growing rices such as 'Pa Yoka', 'Pa Litema', and 'Pa Moba' (Temne) have been grown. Yields have been variable but generally poor. This was partly due to irregular flooding and partly to inefficient methods of cultivation. A considerable part of these deep flooding inland valley swamp areas has been brought under cultivation since about 1940. This was made possible due to the introduction of the Indo-China floating rice variety, on an extensive scale to these areas.

The widespread adoption of the transplanting method also helped in the development of such deep flooding swamps. The judicious adoption of drainage and water control methods would considerably help these swamps to overcome the climatic and resultant flood hazards to which these areas are occasionally subjected.

The narrow form and scattered distribution of inland valley swamps make the application of mechanical cultivation methods difficult. However, compared to mangrove and most grassland swamps, inland valley swamps are not difficult to clear and cultivate. Ox-ploughing had been satisfactorily adopted in the Koinadugu District, though it is at present very limited and haphazard, due to the lack of ploughs and suitable oxen.

Soil degeneration and decline of crop yields have been the greatest problems in inland valley swamps. "Permanent swamp cultivation is dependent upon the quality and quantity of vegetation growing on the neighbouring uplands."(6) In the swamps which are periodically cultivated for rice alone, organic matter is not added adequately to the soil. This has necessitated the fallowing of the swamp. In the savannah areas this problem of maintaining an adequate supply of organic matter in the swamp, has been overcome to a great extent, by the practice of both wet and dry season farming. A similar practice, with vegetables and

legumes grown in the dry season with irrigation, and the unused parts of plants dug into the soil will help considerably to enrich the soil and enable continuous utilisation of swamps. The use of artificial fertilizers such as nitrogenous and phosphorous manures will provide increased fertility to the swamp soils.(7) These have been tried in some inland valley swamps and found to be very effective. The practice of mixed farming with cattle breeding will also serve as a source of manure. The establishment of permanent tree crops in the uplands or the lengthening of the fallow period in upland farms, would further help to alleviate the problem of soil fertility.

Inland Valley Swamp Clearance for Rice Cultivation

Since 1925, Government has been taking steps to evoke interest among the upland farmers in inland swamp cultivation. Demonstration farms were opened up at various places and instructors were appointed to teach the upland farmer the transplanting method and the other cultural practices involved in swamp farming. A seed-paddy distribution scheme was inaugurated, and the high-yielding deep-flood-resistant Indo-China floating variety was among the rices that were distributed. In the early years especially in the early 1930's these attempts of the Government saw some fruitful results, for an increasing number of upland farmers took to swamp cultivation. The effects of

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this was soon felt in the gradual disappearance of the annual "hungry season" which has been common in previous years mostly towards the end of the rainy season.(8) Encouraged by the early success and compelled by the rising demands for rice, the Government took more active steps to further swamp development in 1936. However, the mining industry was drawing more and more farmers away from farms. Also, during the 1936-1937 period the high prices of cash crops such as palm kernels, ginger and piassava were making farmers more inclined towards these crops. But after 1938, prices of these cash crops fell. Meanwhile, especially after 1939, war activities were drawing a large number of farmers and many upland farms were totally neglected. Since 1946, Native Administrations have taken a keen interest on developing inland swamp farming. They cleared swamps and rented them out to the people. Seed distribution schemes and seed multiplication farms were conducted by Native Administrations. However, one cannot say that these attempts gained much success, for the swamps that were developed were limited in size and sporadic in distribution.

Since 1940 the Government has been more inclined towards developing the coastal swamps rather than the inland swamps. In the 1940's great interest was taken in mangrove clearance and after 1950 attention was diverted to the mechanical cultivation of swamp grasslands. Inland valley swamp cultivation however, did not

disappear, for the Native Administrative authorities were now engaged actively in the popularisation of inland swamp cultivation. In fact, an increase in acreage of inland swamp cultivation was noted after 1953, in the Pujehun, Moyamba and Bo Districts.(9) But in most of these swamps rice cultivation is supplementary to upland farming.

Mechanical cultivation was introduced to some inland swamps but with little success, owing to the inaccessibility and the limited size of the swamps. Even today mechanical cultivation of inland swamps is of little significance.

Though one could say that the area under cultivation in respect of inland swamps is considerably greater today than it was in the 1950's, in total area it is still only a small fraction of the swamp rice lands of Sierra Leone.

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CHAPTER VI

SWAMP RICE IN THE COASTAL REGION

The importance of swamp rice in Sierra Leone's agriculture cannot be overestimated. The significance of its development has been so constantly emphasized, that today one is tempted to speak of swamp rice as the 'glamour crop' of Sierra Leone.

Swamp rice cultivation is mostly confined to the western districts of the Northern and Southern Provinces of the country. Kambia and Port Loko Districts in the Northern Province and Moyamba and Bonthe Districts in the Southern Province contain the largest and most important swamp rice regions in Sierra Leone. The Bombali and Tonkolili Districts in the interior of the country are however noteworthy for their Bolilands rice fields. In all the other districts swamp rice is found only on a very limited scale. Among the chiefdoms important for swamp rice cultivation, Samu and Mambolo of the Kambia District, Loko Masama of the Port Loko District and Nongoba Bullom of the Bonthe District stand out prominant with their relatively large expanses of swamp rice land.

It is a significant factor to note that in spite of the availability of a large extent of swamps, only a small fraction of this potential rice land is being continuously utilised for cultivation. Though some swamp rice lands are found scattered in the interior swamp areas of the country, particularly in the Bolilands

SWAMP RICE

13°W 12°W 10°N 9°N 8°N 7°N

GUINEA

Great Scarcies R.

KAMBIA

ROKUPR

Little Scarcies R.

Maoole R.

PORT LOKO

Port Loko Cr.

Rokel or Seli R.

FREETOWN

Ribi R.

MOYAMBA

Bumpe R.

Kagboro Cr.

Thauka Cr.

Bagru R.

Sherbro

BONTHE

Jong R.

Kittam R.

Sewa R.

Waanje R.

Malen R.

L. MABESI

Moa R.

Mano R.

PUJEHUN

AREA UNMAPPED

N

- SCALE OF MILES -

10 5 0 10 20 30 40 50

DUH

region, they are insignificant in total area. The relatively extensive and predominant swamp rice lands are confined almost exclusively to the coastal region, within 22 to 24 miles from the coast.

In the coastal tract distinct swamp rice regions may be identified, which are more or less isolated from each other. These regions are predominantly associated with rivers and streams and for the greater part fringing them. (Fig. 18) Among the rice regions, the pre-eminence of the Scarcies rivers and Western Samu chiefdom region is a striking factor. Its total area is far greater than the combined area of all the other swamp rice regions of the country. (Fig. 19)

The main swamp rice regions of the coastal tract constitute:

1. Scarcies rivers and Western Samu chiefdom area
2. Port Loko creek and Rokel river area
3. Ribi - Bumpe rivers and Kagboro creek area
4. Sewa - Waanjo - Kittam - Malen rivers area.

The minor areas include:

(a) Jong river area

(b) Shorbro island area

(c) North Kaffu Bullom chiefdom area.

It is estimated that there are 110,000 acres of swamp rice land in the coastal areas of Sierra Leone. Of this area, a little

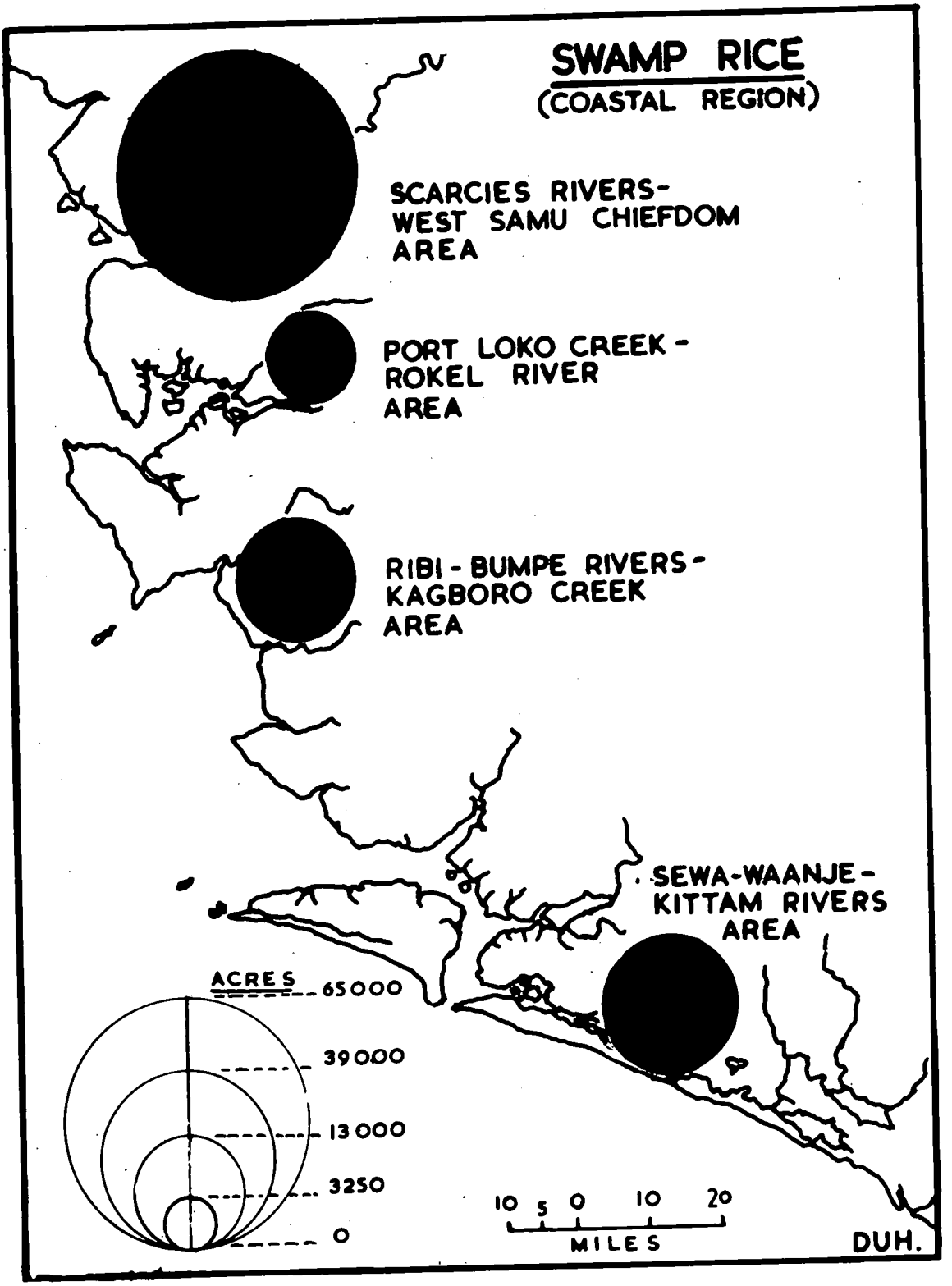
SWAMP RICE
(COASTAL REGION)
SCARCIES RIVERS-
WEST SAMU CHIEFDOM
AREA
PORT LOKO CREEK -
ROKEL RIVER
AREA
RIBI - BUMPE RIVERS -
KAGBORO CREEK
AREA
SEWA-WAANJE-
KITTAM RIVERS
AREA
ACRES
65000
39000
13000
3250
0
10 5 0 10 20
MILES
DUH.

Fig. 19.

less than 3/4 is found in the Northern Province - Kambia, Port Loko Districts and the Western area. The Scarcies rivers and Western Samu chiefdom area alone account for more than 1/2 of the total rice acreage of the coastal area. (Fig. 19) The Great and Little Scarcies rivers rice acreage is more than three times that of the Sewa - Waanje - Kittam - Malen rivers area, which is the second largest concentration of swamp rice in the country. According to the area of swamp rice associated with each of the main rivers, the Great Scarcies comes first followed by the Little Scarcies, Sewa, Bumpe, Port Loko (creek), Kittam and Ribi in that order.

Great Scarcies	-	36,104 acres
Little Scarcies	-	22,968 "
Sewa	-	9,920 "
Bumpe	-	8,071 "
Port Loko	-	6,494 "
Kittam	-	4,736 "
Ribi	-	3,250 "

History of Swamp Rice Cultivation

Swamp rice cultivation first began in the Scarcies rivers region. This region could be considered as the pioneer of the other swamp rice regions of the country, for it was its influence that

led to the emergence and development of the others. The initiative and enthusiasm of Temne farmers, who first introduced this cultivation to the Scarcies area, were mostly responsible for the steady development of the Scarcies region. In the other swamp rice regions of the country, it was dominantly Government initiative, assistance and encouragement that brought about development.

The early development of the Scarcies rivers area was most probably due to its nearness to Guinea, where swamp rice cultivation has been practised from very early times. H.D. Jordan observes that the fairly complex cultural practices adopted in swamp rice cultivation in the Scarcies rivers area, were introduced from French Guinea (now the Republic of Guinea).(1) Some of the varieties of rice grown in the Scarcies region in early times had been introduced from French Guinea. R.R. Glanville says that the Temne people of Sierra Leone who went to assist the Susus in their tribal quarrels in French Guinea, became acquainted with the method of transplanting rice and introduced it to the Scarcies area.(2) While this external influence must be accorded a place in the history of the development of this region, it cannot be denied that the favourability of the physical environment for rice production coupled with the concern of the people of the area for rice cultivation helped advance the steady expansion of cultivation in the region.

It was around 1880, that swamp rice cultivation first commenced in the Scarcies rivers region. Evidence is conflicting as to where the first rice fields were made. H.D. Jordan holds it that it was around the mouth of the Little Scarcies.(3) According to A.C. Pillai, it was on cleared mangrove swamp at Mambolo near the Great Scarcies river.(4) However, R.R. Glanville suggests that in the Great Scarcies banks, the first rice field was made at Matantu opposite Rokupr. This had been a grassland swamp, behind mangrove. In respect of the Little Scarcies area, he holds that the first farm was made in a tidal raphia palm swamp island, between Makasi and Tumbu, and subsequently spread to Bisan and Rosint raphia and sedge swamp land in the mainland. According to Glanville the first mangrove swamp rice farm was made around 1885 near Tumbu.(5)

The rices that were first used in swamp fields were upland varieties and even the method of cultivation that was adopted was very similar to that of the uplands. At first, seeds were broadcast.(6) The cultivation of swamp rice as such however, became more common later on as more and more mangrove were felled to make farms. The transplanting method was subsequently adopted, with the rice nurseries in the upland.

By 1920 the area under swamp rice cultivation had increased considerably, and the Government then took active steps to introduce and popularise this type of rice cultivation in the other swamp areas

of the country. An Indian rice expert A.C. Pillai was commissioned by the Government in 1921 to investigate and report on the rice industry in the swamps. More detailed surveys were made by R.R. Glanville and G.M. Roddan in the 1930's. These reports provided the Government with important background or basic information enabling it to take more positive steps towards further development of swamp rice cultivation. In 1934 a Government rice station was opened at Rokupr. Demonstration farms were conducted in many parts of the country, with Temne instructors from the Scarcies area, showing how swamp rice should be cultivated. Temne rice farmers who migrated to the southern swamp areas of the country especially the Bumpe river area, helped to bring considerable expanses of swamp land under rice cultivation. Here as well as in the Ribi river area, the first rice fields were developed on cleared raphia and sedge swamps, and later on spread to mangrove land. (Fig. 13) In a greater part of southern swamp areas, seed was first broadcast, and it was not till later on that the transplanting technique was attempted.(7) However, in the southern swamp areas, in spite of the availability of very extensive stretches of swamp land, rice cultivation did not expand to the extent that it did in the Scarcies rivers area. By 1930, the latter area had as much as 40,563 acres under swamp rice:(8)

TABLE 4.

SWAMP RICE ACREAGE OF THE SCARCIES AREA - 1930

	Little Scarcies	Great Scarcies	Total
Rice planted tidal	12,608	25,005	37,613
Rice planted non-tidal	1,216	1,062	2,278
Rice sown tidal	422	250	672
	14,246	26,317	40,563
Abandoned farmland	512	2,246	2,758
New clearings	-	173	173

By 1950 in the Scarcies area, all swamp land that was readily available for cultivation was utilised.(9) This led to the region emerging as the largest single concentration of swamp rice land in the whole of Sierra Leone. The taking up of the less favourable and problematic swamps for cultivation was a subsequent development. This was mainly seen in the Samu chiefdom area, where farmers on their own initiative empoldered saline swamp land and badly drained land with a view to improving their water and soil conditions. A new

accelerated phase in the development of the Scarcies rice area began after 1950 with the Government making a large contribution in money and effort towards expanding the rice area to include the less favourable swamp areas. A drainage and water control scheme enabled the clearance for utilisation of an extensive area, and considerable areas were empoldered. Some of these empoldering schemes in some areas however failed and the Government was obliged to start a scheme of deepening and clearing the existing natural streams and creeks, and cutting new channels to improve drainage conditions of the swamp. The vast expanses of rice lands of Luti, Rosino, Funkedeh and Bakapat have emerged particularly due to Government initiative.

Substantial areas of deep flooding swamp land, which had earlier been considered unsuitable for cultivation of rice, were made productive by the introduction of the Indo-China and other floating-rice varieties, which are capable of withstanding deep water conditions. The influence of these varieties were particularly noted in the southern swamp regions, where appreciable areas of grassland swamps were made use of. The elevation of the Government Rice Station at Rokupr to a Rice Research Station gave an added impetus to the development of swamp rice. It helped in providing necessary information and material which generally made farmers conscious of the need to apply method to their work.

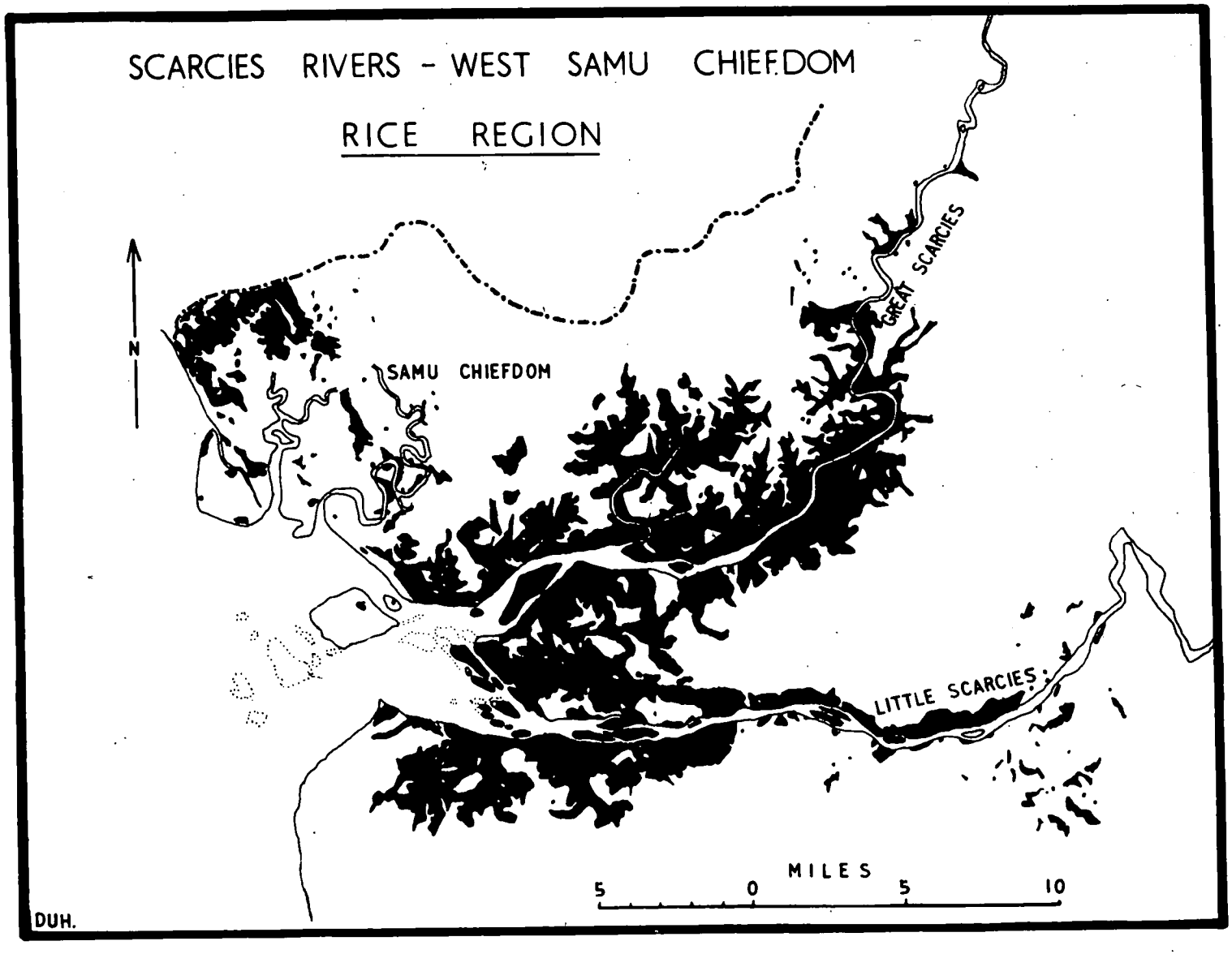
SCARCIES RIVERS - WEST SAMU CHIEFDOM
RICE REGION
N
SAMU CHIEFDOM
GREAT SCARCIES
LITTLE SCARCIES
MILES
5 0 5 10
DUH.

Fig. 20.

The introduction of mechanical cultivation, first in the southern grassland swamps and later elsewhere, enabled the clearance and cultivation of still larger expanses of swamp. This was particularly so in the grassland swamps of the Bonthe District (Fig.29)

Distribution of Swamp Rice

1. Scarcies Rivers and Western Samu chiefdom Area. (Fig. 20)

There are about 59,072 acres of swamp rice land on the lower banks of the Great and Little Scarcies rivers. About 3/4 of this total acreage is associated with the Great Scarcies river. Western Samu chiefdom area has approximately 5,000 acres under rice. A fair estimate is that within the entire Scarcies rivers and Western Samu chiefdom area, there are over 64,000 acres devoted to swamp rice.(Fig.19)

The main rice fields of this region fringe the Great and Little Scarcies and the common estuary of these two rivers. From these areas, limbs of rice land protrude inland along the many creeks and tributaries of the main rivers. The tributary creeks - Kipimp, Kichom, Bubuya of the Great Scarcies, and Bali, Makawbo, Kayinti and Gbinti creeks of the Little Scarcies are some of the more important ones that serve to extend the rice lands inland. Excluding Kortimaw and Yeligbungo islands, all the other riverain islands are almost completely covered with rice fields. The more significant of these include Gbantuk, Yelbi, Karabu, Bankapia and the three islands south of the mouth of the Bali creek.

Within this region, towards the upper reaches of the two rivers and their associated creeks are found isolated patches of rice land. These are particularly evident in the Little Scarcies river region east of the road from Mabundulai to Katonga. In the Great Scarcies river area this phenomenon is observed north of the Maseba creek. However, in total area these rice lands do not account for much.

The Western Samu chiefdom rice region is more or less separated from the main Scarcies rivers rice region by a vast stretch of undeveloped swamp. In Western Samu chiefdom a compact rice habitat is found towards the North-west. Unlike the Scarcies rivers rice region, this region is predominantly associated with small streams especially those of upper Mahela creek. This region appears to merge with the Guinea rice region found in its neighbourhood to the north. The total rice area of Western Samu chiefdom is about 1/12 of that of the Scarcies rivers region.

Between the main Scarcies rivers rice region and the North-west Samu rice region, are found small patches of paddy fields of irregular shapes and varying sizes. These are associated with the Mahela and Sasiyek creeks and their tributaries. (Fig. 6)

The Great Scarcies rice region extends almost unbroken, fringing the river closely for about 24 miles upstream along the river. The Little Scarcies principal rice land is found mainly

around its estuary, and for about 10 miles inland along the banks of the river. The region exhibits a more or less triangular aspect, narrowing as it extends inland. Beyond this major rice concentration the region reduces to a narrow belt running continuously parallel to the river on its right bank, for a distance of another 10 miles. South of this belt, along the left bank of the river are found scattered patches of rice fields.

Though mangrove swamps, grassland swamps as well as inland valley swamps have been utilised for rice cultivation in the Scarcies rivers and Western Samu chiefdom area, the mangrove swamp has been the predominant habitat of rice in the area. On the Great and Little Scarcies river banks, all available mangrove lands have been converted to paddy fields. The rice lands found towards the interior of the region, away from the principal rivers and mainly associated with the upper and middle reaches of the tributary creeks of the two rivers, were originally grassland swamps. The scattered patches of rice land on the banks of the rivers are also developed on grassland swamps. Rice lands in inland valley swamps are not as extensive as in the mangrove and grassland swamps. In the Samu chiefdom, on the right bank of the Great Scarcies, rice plots are found developed on inland valley swamps. These account for a small total area.

Surveys have now been completed to probe into possibilities of converting the Rhombe swamp area on the left bank of the Little Scarcies, into productive land.

2. Port Loko Creek and Rokel River Area

The main rice fields of this area are along the lower banks of the Port Loko creek and its tributaries. (Fig. 18) These cover an area of about 6,494 acres. The Rokel river has about 2,716 acres dispersed along its banks.

Fringing the Port Loko creek on its right bank a narrow belt of rice land runs inland for almost nine miles from the mouth of the creek around Kirima. From this belt limbs of rice land project inland and exhibit a dendritic pattern. This pattern is maintained on the left bank too, but here the rice belt immediately adjoining the main creek is not continuous as in the case of the right bank. (Fig. 18) Tributary creeks act as backbones to the projections of rice land that extend inland on both banks of the Port Loko creek.

The small rice area associated with the Rokel river is in the form of irregular patches, highly diffused in distribution towards the mouth and lower banks of the river. These generally fringe the tributary creeks of the river such as the Grabai and those found to its west and east. (Fig. 18) Some rice fields are found in the riverain islands of Hagbeli and Tumbu. The banks of the upper reaches of both the Port Loko creek and Rokel river support isolated plots of rice lands.

A large part of the rice land of this region was originally mangrove swamp. Grassland swamps have also been converted to rice fields on the banks of the upper reaches of the Port Loko creek and Rokel river. In limited places rice lands have encroached into inland valley swamps.

3. Ribi - Bumpe Rivers and Kagbaro Creek Rice Area

Excluding the few fields found on the right bank of the Ribi river, the rice lands of this vast region fall entirely within the district of Moyamba. The total rice acreage of the region is about 14,115. (Fig. 19)

Within the region there are three distinct rice areas, more or less isolated from each other. The first region starts from the estuarine area of the Ribi river and runs southwards more or less parallel to the coast. (Fig. 18) Though not continuous this region consists of elongated stretches of rice lands roughly in a belt pattern. It extends up to the estuary of the Kagboro creek. This rice region is predominantly associated with small streams of the Ribi and Bumpe rivers and the Kagboro creek. The total acreage of this litteral rice region is about 7,056 which is almost 1/2 the area of the entire Ribi - Bumpe - Kagboro creek area.

The second rice region is very prominant at the upper reaches of the Bumpe river, and constitutes about 5,401 acres in area, which is twice the rice acreage of the Rokel river. This

region starts about 14 miles up the Bumpe river and extends inland along the river banks in the form of two elongated stretches with a multiplicity of finger-like smaller protrusions along minor streams. (Fig. 18) The whole of this rice region falls within the Bumpe chiefdom.

The third of these rice regions is in the upper Ribi river area, where rice fields are highly dispersed. The latter are associated only partly with the river but more with the numerous tributaries of the river. In total area they constitute about 1,658 acres.

A large part of the rice land of the Ribi - Bumpe rivers - Kagboro creek area, had been originally mangrove swamps. (Fig. 9) A considerable area of grassland swamp adjoining mangrove land have also been utilised for rice cultivation. The upper Bumpe river rice lands have been developed predominantly on grassland swamps. Here as well as in the upper Ribi river and Kamaranka creek areas, rice fields have spread into inland valley swamps.

4. Sewa - Waanje - Kittam - Malen Rivers Area. (Fig. 21)

The total acreage of this rice region is approximately 19,264. The important rice lands within this region closely fringe the Sewa and Kittam rivers. The pattern of distribution of rice lands tends to follow the alignment of the rivers and the dendritic pattern which is so common in other swamp rice regions such as the

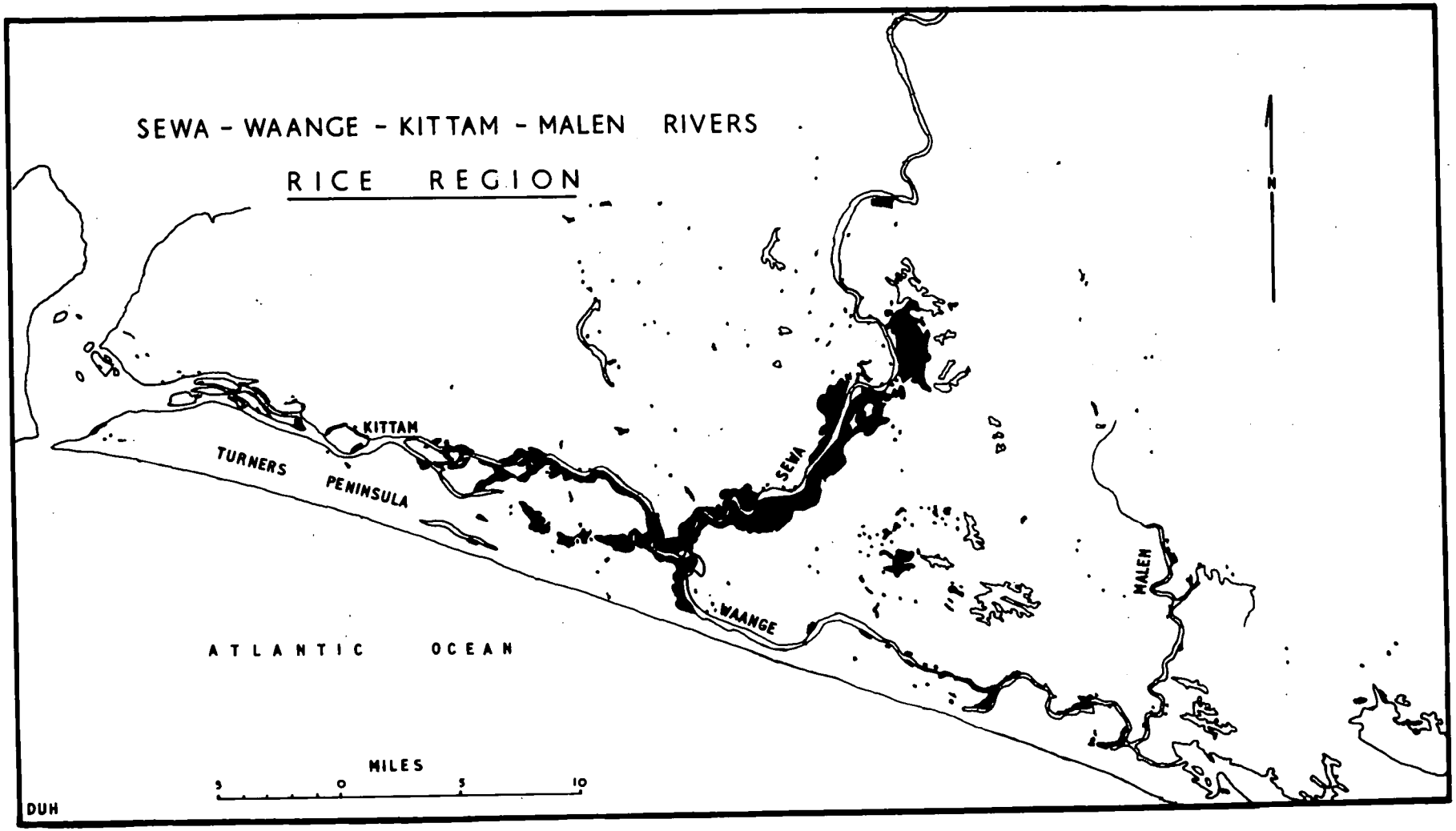
SEWA - WAANGE - KITTAM - MALEN RIVERS
RICE REGION
N
KITTAM
TURNERS PENINSULA
SEWA
WAANGE
MALEN
ATLANTIC OCEAN
MILES
5 0 5 10
DUH

Fig. 21.

Scarcies rivers, Port Loko creek, upper Bumpe river, is absent in this region. Instead a compact belted pattern is observed. (Fig. 21)

The Sewa river banks support the largest area of rice land within this region. It accounts for about 9,920 acres being a little more than 1/2 the rice area of the Waanje, Kittam and Malen rivers combined. The Sewa river rice region runs inland along the river banks, closely hinged to the river for a distance of about 18 miles, from the place where the Sewa river falls into the Waanje river. The rice belt on the left bank of the river is more continuous and extensive than that on the right bank. Small patches of rice land are found particularly on the right bank of the upper reaches of the river.

The Kittam and Waanje rivers are bordered by narrow belts of rice land. On the left bank of the Kittam river rice land continuously extend for a distance of about 16 miles along the river, from the junction of the Kittam and Sewa rivers. (Fig. 21) Elsewhere there are elongated stretches of rice land hugging the river and streams. The Waanje river banks do not support as much rice land as the Kittam. Elongated patches of rice land run along the river.

The region between the Sewa, Waanje and the lakes Baiama, Kwako and Kamasan, includes a multiplicity of small compact plots

of rice land, highly dispersed in distribution. To the west of lake Kwako a fairly large plot is found.

The banks of the Malen river and the upper reaches of the Bende creek support a few patches of rice land. The same is true of the banks of lakes Mape and Mabesi. Since 1964, about 1,700 acres of grassland swamp have been cleared on the Malen banks for cultivation.

The Sewa - Waanje - Kittam - Malen rivers rice region is distinct from others as it has been developed almost exclusively on swamp grasslands. Patches of mangrove swamps have been utilised on the Kittam banks. The same is true of some rice lands between the Sewa river, Waanje river and the lakes. All these however, account for a meagre area compared to the large expanses of grassland swamps which have been utilised particularly in the Sewa and Kittam banks. The utilisation of inland valley swamps for rice growth has been negligible in this area.

5. Minor Areas

(a) Jong river area - Scattered small patches of rice lands, mostly developed on mangrove swamps, are found on the banks of the river and its tributaries, particularly lower Teso, Mongeri, Mobubu, Bende, Yaigini, Monaia, Wombe and Mogi. The total area of this rice region is about 1,900 acres.

(b) Sherbro Island area - Compared to its great expanse of swamp land, the island's existing rice area is negligible, being only about 940 acres. This area forms largely a collection of tiny plots dispersed especially in the west-central parts of the island. A relatively compact plot of 390 acres is found in the extreme west, in the Dema chiefdom. This plot has been developed on mangrove swamp. A large part of the rest of the rice fields had originally been grassland swamps. Small streams border most of these rice lands though some are found remote from streams.

(c) North Kaffu Bullom chiefdom area - Scattered patches of rice fields developed mainly on inland valley swamps moistened by small streams particularly of the Kipulun creek are found in this region. In total area these form about 437 acres.

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(3) H.D. JORDAN, op. cit., pp. 27-32

(4) A.C. PILLAI, "A Report on Rice Cultivation in Scarcies Area (January 1922)", West African Rice Research Station, Rokupr, Sierra Leone, Bulletin No.4, 1958, pp. 2-10

(5) R.R. GLANVILLE, op. cit.

(6) A.C. PILLAI, op. cit.;
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CHAPTER VII

PHYSICAL FACTORS AFFECTING DISTRIBUTION OF SWAMP RICE

Physical factors have played and continue to play a dominant role in the distribution of swamp rice cultivation in coastal Sierra Leone. What is clearly manifest is the relatively insignificant role man plays in controlling and moulding the forces of nature to suit his needs and the needs of his crops. Mostly economic and social reasons have made man surrender to the forces of nature. Thus, determinism is seen holding sway.

Geology

Geology has little effect on the distribution of swamp rice cultivation in Sierra Leone, other than enabling the conservation of water underground at certain places. Almost the entire coastal swamp rice region of the country falls within the belt of Pleistocene sediments known as the Bullom Series, which consist of alternating bands of clays, sands and gravels.

Aspect of Land

Flat or gently undulating lands are eminently suited for rice cultivation. They enable the retention of water in the field, which rice cultivation demands. Moreover, the extensive utilisation of mechanical and other modern methods of cultivation are made

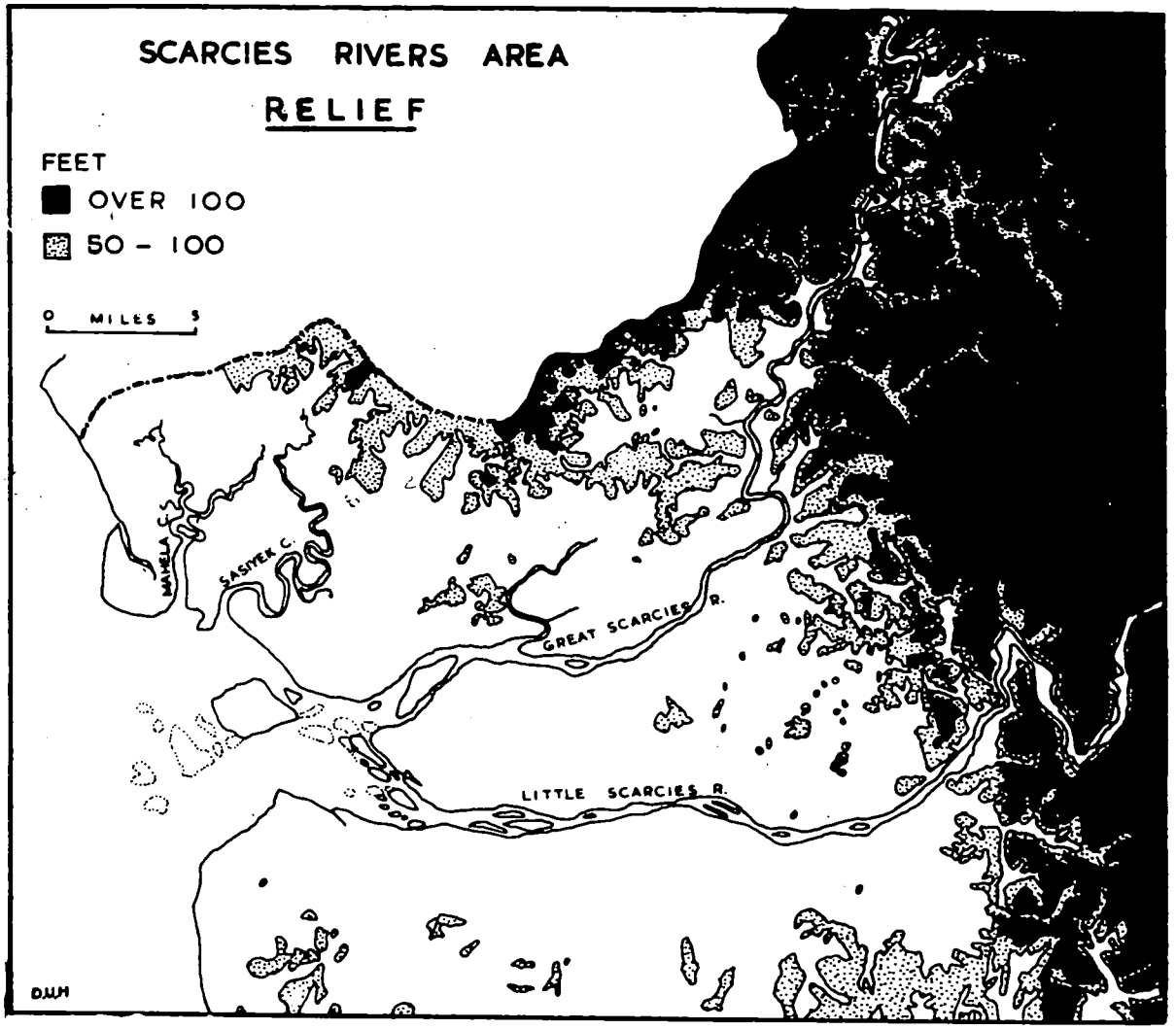
SCARCIES RIVERS AREA
RELIEF
FEET
OVER 100
50 - 100
0 MILES 5
MAHELA C.
SASIYEK C.
GREAT SCARCIES R.
LITTLE SCARCIES R.
D.N.M

Fig. 22.

feasible. This aspect of land facilitates the profitable adoption of irrigation and water control methods. From the view point of the development of the cultural environment, especially in the form of transport and communication networks and settlements around the rice lands, a flat or gently undulating land is favourable. The development of these features is a stimulus to the progress of rice cultivation.

The aspect of swamp land enables extensive flooding of rivers and streams. This helps not only to moisten rice lands but also to provide them with a layer of fertile silt. Also, it has enabled the influence of tide water to be felt over wide areas inland, offering advantages as well as problems in respect of rice cultivation. (see p. 59)

All swamp rice regions of coastal Sierra Leone are confined to the region below 100 feet elevation, but most are below 50 feet. (Figs. 11 & 22) The fact that most of these regions are located in river basins, enables the derivation of the physical requirements of the rice plant, particularly water and fertile silt. Their predominantly coastal and riverain location is further advantageous from the view point of water transport.

Climatic Factors[1]

Climate has a dominating influence on swamp rice cultivation in coastal Sierra Leone. Apart from the commanding influence of the

moisture factor, temperature and sunlight are perhaps the principal climatic factors affecting the distribution of swamp rice cultivation. The sharp dual seasonal aspect of the climate of Sierra Leone, has particularly influenced the rhythm of swamp rice culture in the country, with a wet growing season and a dry maturing and harvesting season.

a) Temperature

All varieties of rice require high temperature for their growth. "Wet rices characteristically require at least two and preferably three months of temperature of 68°F or higher."(2) D.H. Grist observes that "The average temperature required throughout the life of the plant, ranges from 68° to 100°F."(3) The mean temperatures of rice lands of coastal Sierra Leone, do not fall below 76°F. (Figs. 12 & 23) Lower temperatures in the early growth stages of the rice plant, retard the development of seedlings, delay transplanting and reduce tiller formation. Also, plant heights and the number of leaves are affected adversely, causing delay in heading. Moreover, lower temperatures after heading, cause a decrease in the number of fertilised rice kernels and in their weight.(4) In the swamp rice areas of Sierra Leone, the growing season (i.e. nursery period up to harvest) starts in May - June in the Scarcies rivers, Port Loko creek, the Ribi - Bumpe rivers Kagbere creek areas, and around April, in the Sewa - Waanje - Kittam - Malen rivers area.

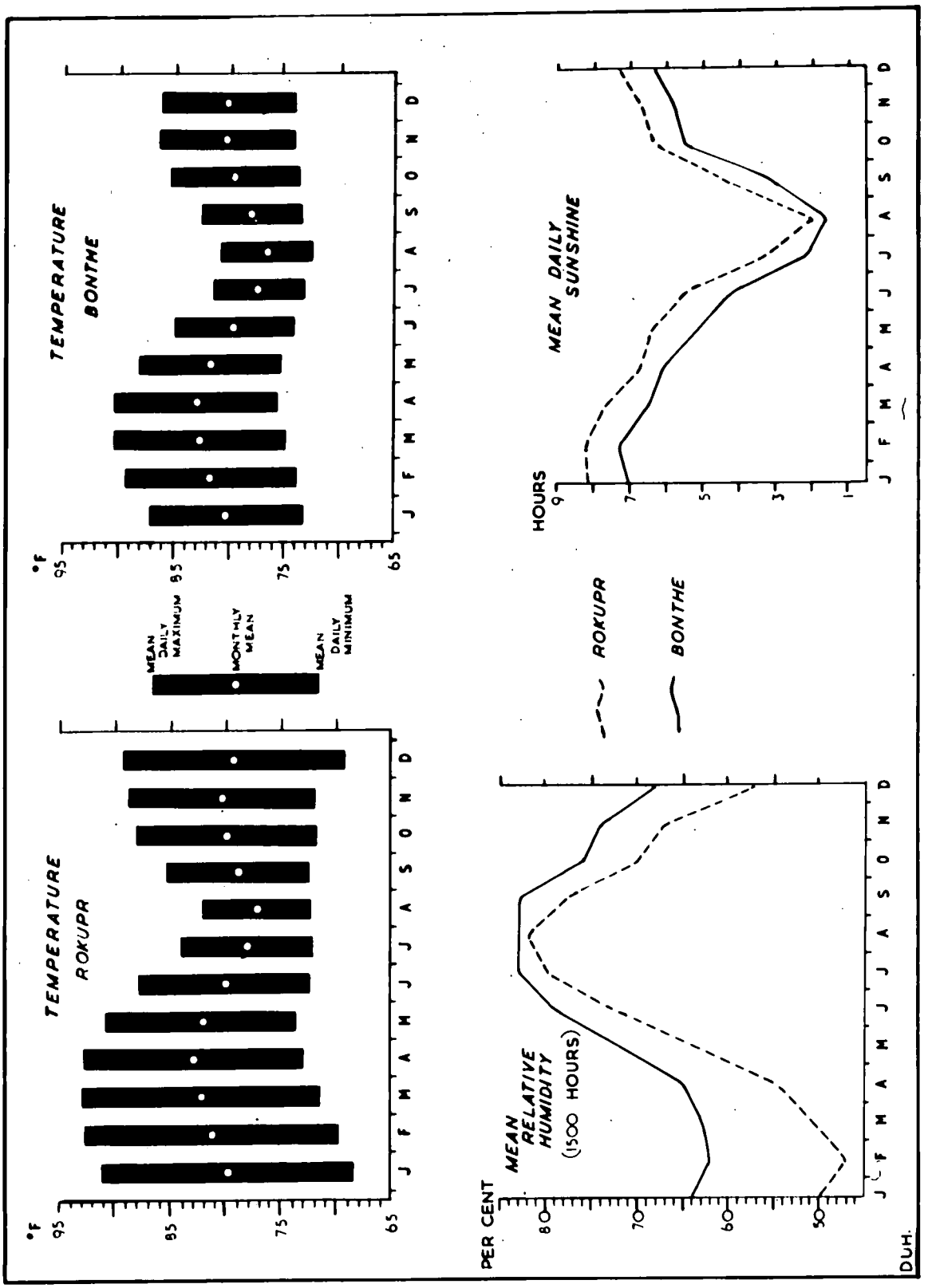
TEMPERATURE
ROKUPR
°F
95
85
75
65
J F M A M J J A S O N D
TEMPERATURE
BONTHE
MEAN DAILY MAXIMUM
MONTHLY MEAN
MEAN DAILY MINIMUM
MEAN DAILY SUNSHINE
HOURS
9
7
5
3
1
ROKUPR
BONTHE
MEAN RELATIVE HUMIDITY
(1500 HOURS)
PER CENT
80
70
60
50

Fig. 23.

These rice lands experience the necessary high temperatures of more than 79°F during the growing season. In the Scarcies area during the transplanting period (July - August), an adequate mean temperature for the growth of seedlings of 77°F is available. (Fig. 23) In the Sewa - Waanje - Kittam - Malon rivers area, during the whole of the early growth period a mean temperature of more than 76°F is maintained. (Fig. 23) The maturing season of swamp rice, during the later months of the year, is also marked by favourable high temperatures.

Usually in the Scarcies areas, a second crop of rice is planted after the harvest of the main crop in the December - January period. This crop however, suffers from a greater range of mean daily temperatures, which has adverse effects on the satisfactory growth of the crop. For example the daily range in December in Rokupr (Scarcies rivers area) is 20°F and in January 22.7°F, and in February it increases to 22.9°F. The Sewa - Waanje - Kittam - Malon rivers area usually has a lower daily range. (Fig. 23)

These relatively high temperatures of the coastal areas have an indirect influence on rice cultivation. They make river waters warm, which especially during the young ear stage or in the heading stage of rice plants, help in improving yields considerably.(5)

b) Sunlight

Sunlight in respect of its influence on plant growth, is

normally referred to as the photoperiod. The latter means the optimum length of day as it affects the amount of light received by a plant for normal growth and development.

For the satisfactory growth of the rice plant ample sunlight or a relatively long photoperiod is essential. "Light ..... may influence plant behaviour by its intensity, its composition and by its continuity or duration for any twenty four hour period."(6) This factor is particularly significant in areas with high rainfall and humidity, where isolation tends to be reduced by cloudiness.

The growth rate and the consequent duration of rice (time taken from sowing to harvest) are considerably affected by light intensity. Temperature coupled with the amount of light radiation determine the accumulation of food reserves by the rice plant. Duration of sunlight further affects the time of flowering. The heavier the shade the greater the delay in flowering. Shade decreases the rate of tiller formation and consequently affects yields adversely.(7) Experiments conducted at the Rice Research Station Rekapr, with a number of rice varieties to understand the effect of temperature and photoperiod on rice growth, revealed that the growth of the rice plant was poor in the $8\frac{1}{2}$ hour photoperiod. The best photoperiod was found to be $11\frac{1}{2}$ hours, but satisfactory results were also obtained in the $10\frac{1}{2}$ hour period.(8)

Between June and September, the short duration of sunlight affects the growth of the main rice crop. (Fig. 25) This period coincides with the period of heavy rainfall, high humidity and dense cloud cover. (Figs. 23 & 25) At Rokupr (the Scarcies rivers area) the mean relative humidity (at 1500 hours) from May to November ranges from 64% to 82%, August showing the highest of 82%. Duration of mean daily sunshine from June to September ranges from 2 to 5.5 hours. (Fig. 23) Thus photoperiod is considerably reduced during this period.

In Bonthe, (the Sewa - Waanje - Kittam - Malen rivers area) the period of low duration of mean daily sunshine is longer - May to September - and the mean daily duration ranges from 1.6 to 5.2 hours. (Fig. 23) The effect of cloud cover during this period on the duration of sunshine and consequently on the duration of sunlight, is evident from the following figures.

MEAN AMOUNT OF CLOUD (IN TENTHS)

BONTHE											
J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
4.2	4.0	5.3	6.1	7.2	7.9	8.8	9.0	8.3	7.3	6.8	5.0

Compared to the Sewa - Waanje - Kittam - Malen rivers rice region, the Scarcies rivers rice region enjoys a more prolonged period of mean daily sunshine, particularly during the early months of the year. However, in both regions, from October to May the

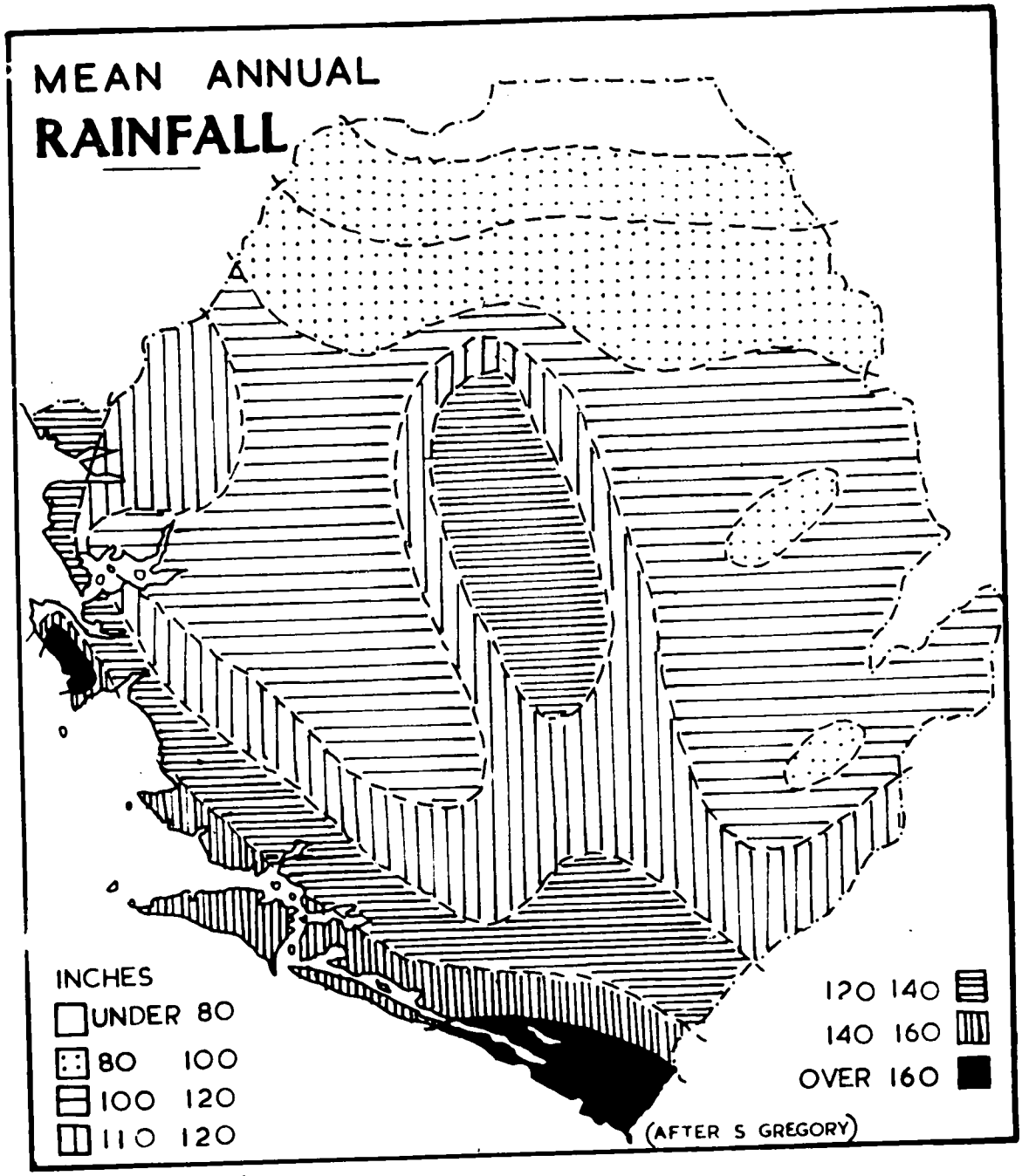
MEAN ANNUAL
RAINFALL
INCHES
UNDER 80
80 100
100 120
110 120
120 140
140 160
OVER 160
(AFTER S GREGORY)

Fig. 24.

duration of sunshine is relatively long. This period coincides with the latter part of the growth period of the main rice crop. Therefore, it is seen that in the early stages of growth the rice plant suffers from inadequate sunlight.

The longer duration of sunlight during the January to April period, which is usually the off season for rice cultivation, has beneficial effects on the soil. Drying the land during this season is considered to improve soil conditions and thereby increase crop yields.(9)

The inability to control natural factors such as sunlight and temperature has necessitated the breeding of rice varieties to the prevalent photoperiod and temperature conditions. Photoperiod insensitive varieties have been bred at the Rokupr Rice Research Station. Alteration of normal growth period by delaying planting by eight weeks has also been found useful to overcome the ill effects of low sunlight during a greater part of the growth period. However, the wide adaptability of the varieties insensitive to photoperiod have been found possible to be grown out of season, under a range of light and temperature conditions and at all seasons of sowing giving good yields.(10)

c) Rainfall

Rainfall is undoubtedly the most important factor controlling swamp rice cultivation in Sierra Leone, though in

coastal areas its influence is indirect rather than direct, for natural river and stream flooding forms the primary source of water supply for these rice fields. But direct rainfall forms the main source of water to an appreciable part of the non-tidal interior swamp rice regions of the coastal tract, which are mostly associated with inland valley swamps. Direct rainfall moreover assists in the washing away of saline conditions of the soils of tidal swamps before land is prepared for rice cultivation. Salinity of soil results from the tide water inundation during the dry season.

A knowledge of the regional distribution of rainfall in respect of catchment areas of rivers which serve swamp rice regions, is necessary to understand the effects of rainfall on river flow, flooding and consequently on rice cultivation which is dependent on the former. A large part of catchment areas of all the rivers that drain the main swamp rice region of the coastal area, receives more than 100 inches average annual rainfall. (Figs. 15 & 24) A considerable part of the Sowa river catchment area and those of the Kittam, Waanje, Ribi and Bumpe rivers, receive as much as 110 to 150 inches of average annual rainfall. The rivers of the Southern Province are thus fed with great volumes of rainfall, resulting in relatively deep flooding.

All varieties of rice require high temperatures and

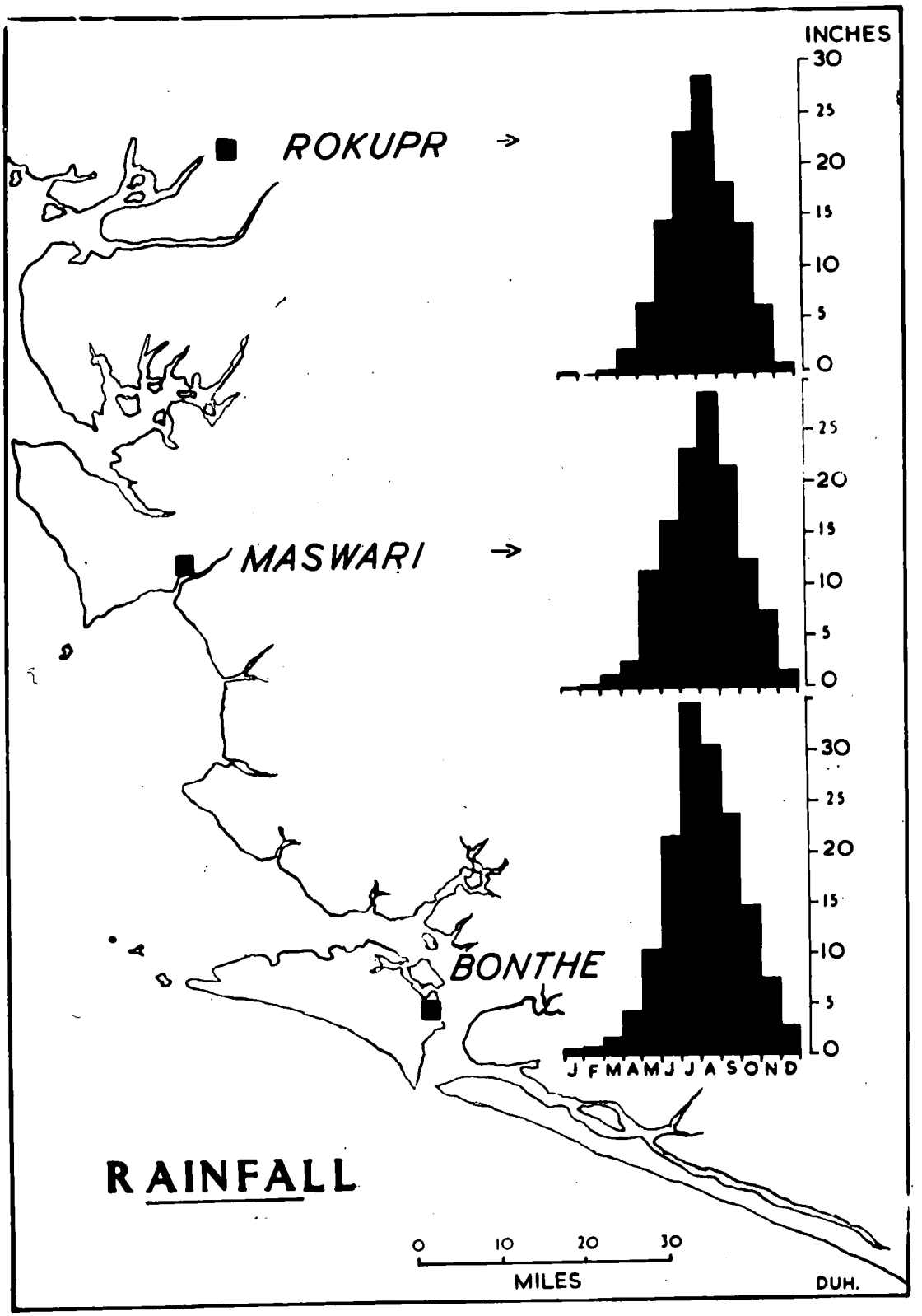
INCHES
30
25
20
15
10
5
0
ROKUPR
MASWARI
BONTHE
J F M A M J J A S O N D
RAINFALL
0 10 20 30
MILES
DUH.

Fig. 25.

abundant moisture, during the growing period. "Where rice is dependent on rainfall, wet rice requires some 40 to 60 inches during the growing season."(11) Rainfall should be well distributed during this period. The growth period of swamp rice in the coastal region of Sierra Leone which is usually between April/May and December/January, is well served with normally high rainfall of over 98 inches. The Scarcies area receives a total of as much as 106 inches during the period from transplanting to maturing, i.e. from June to December. (Fig. 25) The coastal swamp rice regions of the Southern Province receive much higher rainfall during the growing season. Bonthe shows a total of 146 inches for the period April to November which coincides with the general growing period of the southern regions. (Fig. 25) It is noteworthy that the coastal swamp rice regions are well served in regard to the quantity of rainfall required for the growth of the rice plant. Moreover, this rainfall is distributed advantageously throughout the growing period. The Scarcies rivers area receives more than 95% of its annual rainfall during this period while the other coastal swamp rice regions receive 90% to 95% of their annual rainfall during this period. (Figs. 25, 26 & 27) Anomalies in the normal seasonal distribution of rainfall are seen to affect rice cultivation adversely in some areas of the coastal zone. Early rains and consequent early flooding can result in the loss for cultivation

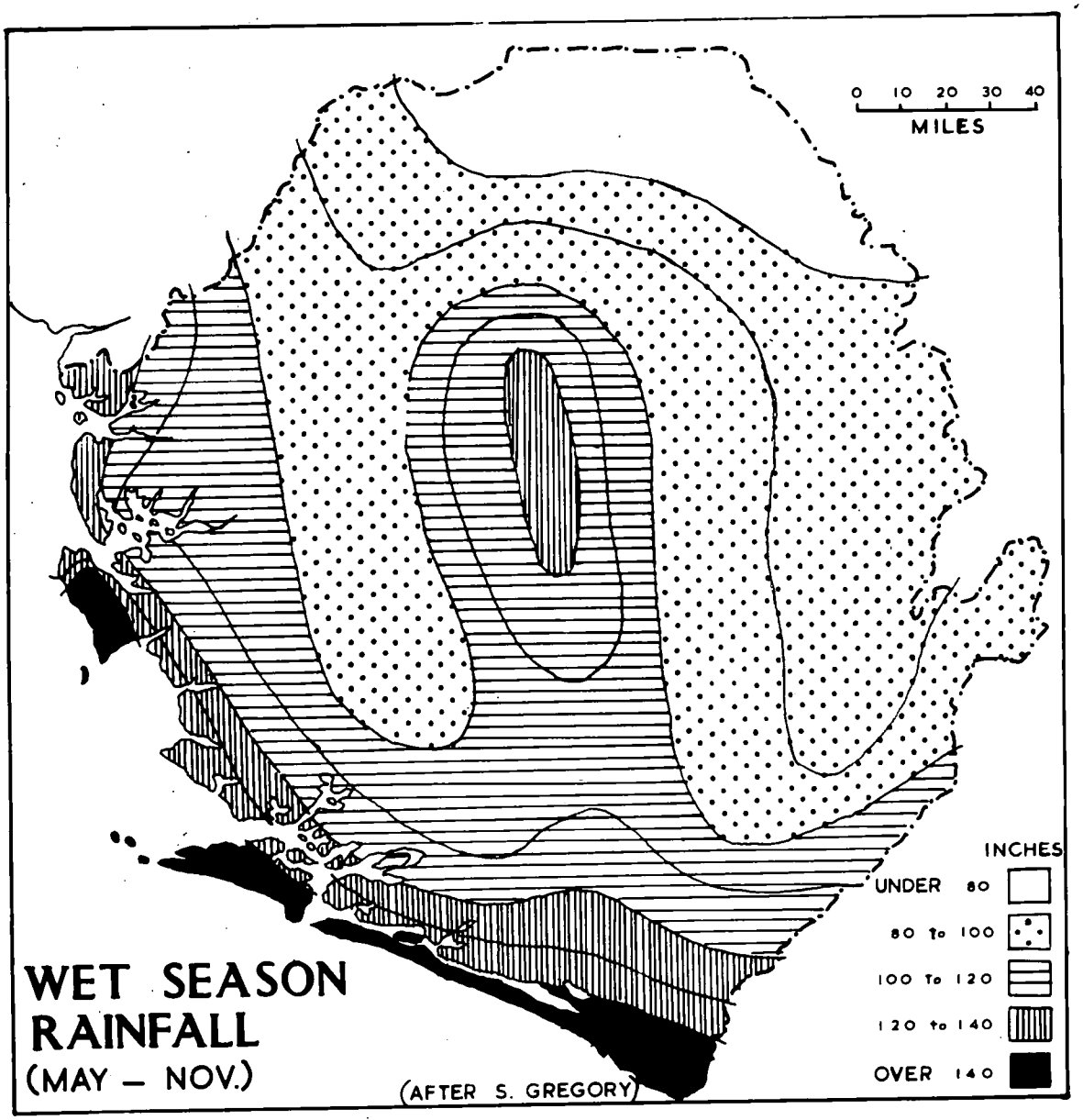
0 10 20 30 40
MILES
INCHES
UNDER 80
80 To 100
100 To 120
120 to 140
OVER 140
WET SEASON
RAINFALL
(MAY – NOV.)
(AFTER S. GREGORY)

Fig. 26.

of a considerable area of rice land in the Bonthe and Port Loko Districts.(12) Failure of rainfall during the normal period of its occurrence led to severe problems in 1957 and 1958.(13) Late rains mean prolonged dry season which results in greater accumulation of salinity in the soil of tidal swamp rice areas.

During the period December to April the coastal areas receive a less reliable low rainfall of under 10 inches, the Scarcies areas having less than 5 inches. (Figs. 28 & 25) Thus during this season rain-fed rice cultivation is practically impossible.

"The most successful production of rice takes place where there is a concentration of the annual rainfall during the growing season, but with a relatively dry season at the time the crop matures."(14) The dry season facilitates the proper maturing of the rice grain and enables convenient and successful harvesting. The rhythm of rainfall of coastal Sierra Leone is thus seen to be generally favourable for the propagation of rice culture. A consideration of potential evapo-transpiration is necessary to understand the agricultural value of the rainfall received. It enables an understanding of the magnitude of run-off and the extent of soil moisture utilisation. These factors are of particular significance with regard to swamp rice cultivation in the coastal region of Sierra Leone, because here, water supply

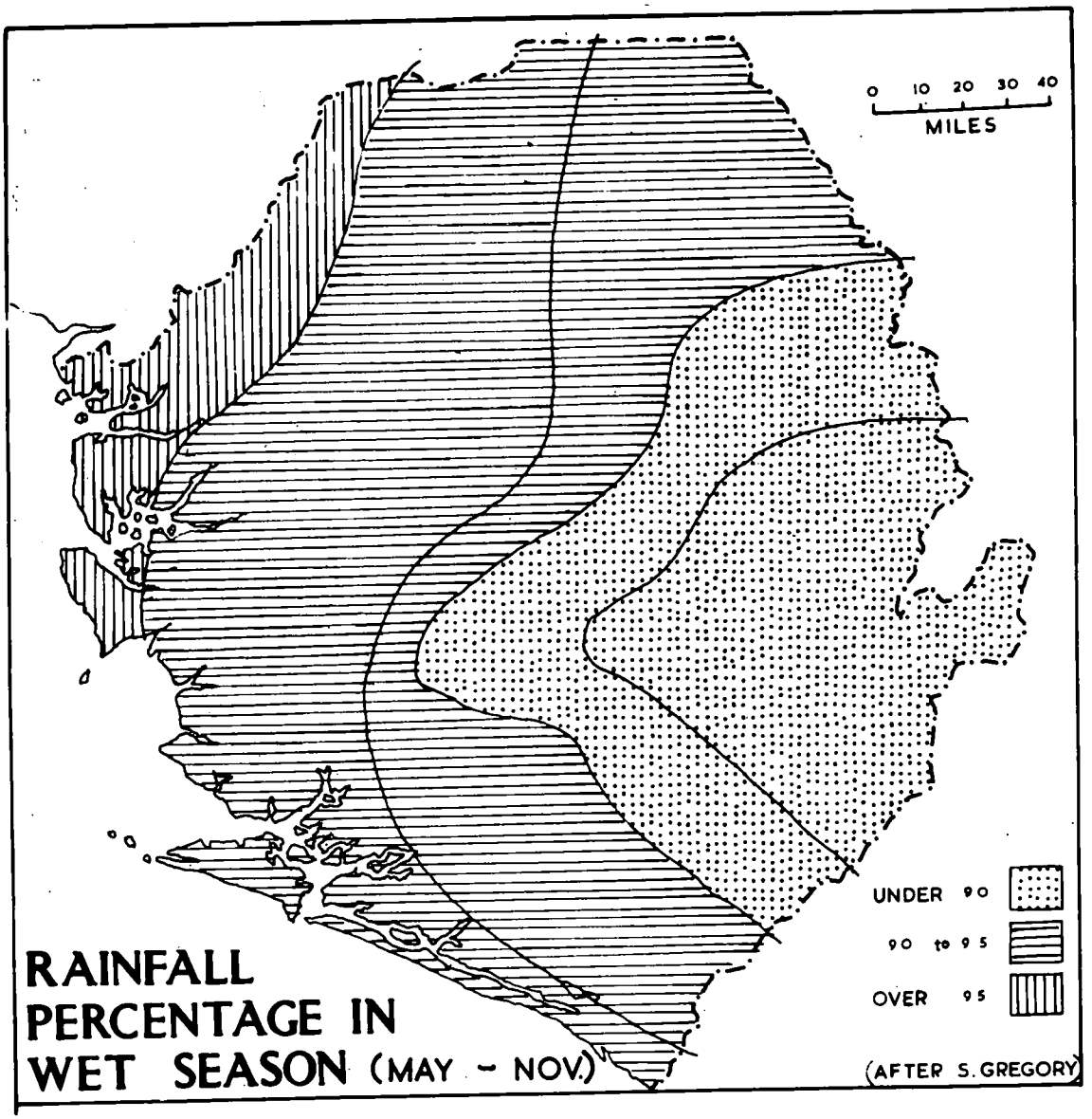
0 10 20 30 40
MILES
UNDER 90
90 to 95
OVER 95
RAINFALL
PERCENTAGE IN
WET SEASON (MAY ~ NOV.)
(AFTER S. GREGORY)

Fig. 27.

for cultivation is mostly derived from river flooding. Generally it could be discerned that the annual total potential evapo-transpiration of a greater part of the coastal area of Sierra Leone ranges from 50-55 inches.(15) The total annual mean rainfall of the coastal area is in the neighbourhood of 110 inches.(Fig. 24) This shows well the magnitude of run-off. Even in the interior areas of the country, run-off is much more than the total evapo-transpiration rate.(16) What is significant to note is that run-off is greatest during the period of highest rainfall - June to October. This is the season when potential evapo-transpiration levels are low. On the other hand during the December to April period rainfall is so low that evapo-transpiration falls below potential. River levels fall considerably during this period. Plant growth is affected, and needs to depend largely on soil moisture utilisation. In the Scarcies rivers area, it has been found that water deficiency and soil moisture utilisation is greatest during December.(17)

Water Supply and Control Factors

The large volumes of fresh water carried seasonally by rivers and streams have been a great advantage to rice cultivation. "Yields of paddy depends to a great extent on the quality of water used for irrigation. Water may have a considerable fertilising

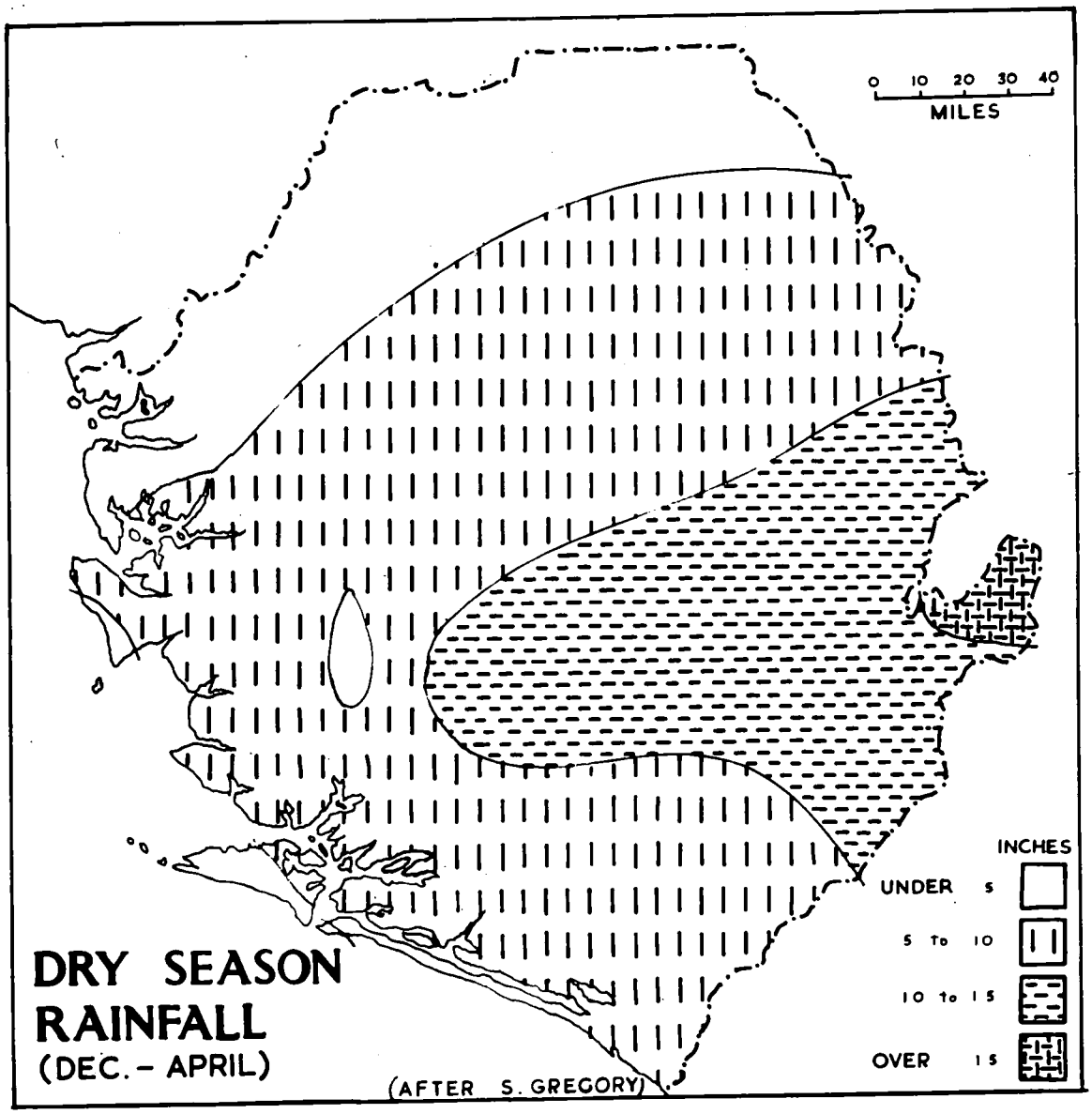
0 10 20 30 40
MILES
INCHES
UNDER 5
5 To 10
10 To 15
OVER 15
DRY SEASON
RAINFALL
(DEC. – APRIL)
(AFTER S. GREGORY)

Fig. 28.

value because of its mineral nutrients ....." "Quality of water is dependent on its origin. River water is generally preferable to that from other sources. In addition to the fertilising elements dissolved in such water it carries silt and clay."(18) The generally warm nature of river water due to the usually high temperatures of the country, is another favourable factor in respect of paddy cultivation. River waters are moreover generally well aerated which consequently is another advantage, considering the needs of the paddy plant.(19) In the main swamp rice growing areas of the country, the multiplicity of meandering streams and tributaries of main rivers and the vast flatness of the river banks enable the moistening of extensive tracts for cultivation purposes.

River waters however, are not generally derived by means of canals and water-ways as in the case of the rice regions of the river basins of South-East Asia. In fact, artificial irrigation is negligible. Paddy lands in Sierra Leone are subject to natural flooding of rivers. This occurs seasonally and is thus, favourable for rice cultivation. River flooding is controlled by two main factors. One of these is the amount of rainfall received by the catchment area of the river. The depth and extent of flooding depend to a great extent on the volume of water thus collected by the

river and its tributaries. The second factor controlling floods is the ocean tide. High tidal backing especially during the wet season leads to the overflow of the river. The duration and depth of flooding is to a considerable extent controlled by the level of the tide and its duration.

Thus, it is important to note that in the paddy growing areas of coastal Sierra Leone, there is almost complete surrender to natural conditions of flooding owing to the lack of water control. Irregularities in the distribution and amount of rainfall have their direct repercussion on river volume and flooding and consequently directly affect rice cultivation as the farming system is completely adapted to fit in with natural water conditions.

The pre-requisite of efficient and economic paddy production is adequate control of drainage and irrigation throughout the growing season. During this period water should be available for the field as soon as it is ready for planting. If floods come too early the crop may not be sufficiently grown to withstand inundation. If floods are too deep they inhibit tillering or damage the crop. If inundation is delayed the crop may be too far advanced to take full advantage of water. An exceedingly late flooding may affect flowering or interfere with harvest. Water control is therefore essential if the growing

crop is to be provided with adequate supplies as needed. "Small quantities of water given at frequent intervals are more conducive to high yields than are larger quantities given at less frequent intervals." "..... given an adequate and well controlled water supply the crop will grow in a wide range of soils and in many climates."(20) Water control is therefore seen to be a primary factor enabling successful rice cultivation.

In the coastal areas of Sierra Leone large tracts could be easily made productive by adopting water control and irrigation methods. It is mostly economic rather than physical factors that inhibit the inauguration of such methods. Moreover, the initial attempts at water control and improvement of water conditions for rice growing in tidal (Rhizophora) mangrove swamp areas led to detrimental soil changes which discouraged attempting such schemes. However, simple and inexpensive measures of amelioration of natural water conditions can be of great value in certain areas.

Tidal flooding and the effect of high tides on the natural flow of rivers also affect rice cultivation. Some rivers of Sierra Leone are more subject to tidal effects than others. The predominantly tidal rivers cause problems of salinity. The extent of salinity in river water depends mostly on the volume of fresh water the river carries. Rivers with large volumes of

fresh water such as the Little Scarcies and the Sewa are relatively little affected by tidal saline water effects. Hence, those river waters are more favourable for paddy cultivation. Rivers are greatly affected by tides during the dry season when the river water levels are low and brackish a considerable distance away from the river mouth. Thus, rice cultivation with river waters is made practically impossible during this period. It is seen that the possibility of planting rice is dependent on the rate at which salt enters the river and the length of the salt-free period. A prolonged dry season due to failure of rainfall during the normal periods of its occurrence leads to higher salinity of tide water.

In many mangrove swamp areas where there are no large rivers to maintain fresh water conditions during the rainy season, the salt concentration of tidal waters is too high for rice growth. The exclusion of salt water and the holding of rainwater were attempted in some swamps, by means of empoldering the land. But it has been found that some mangrove soils undergo chemical changes when they are empoldered, and that conditions inimical to the growth of rice develop. Hence, some of these schemes have been abandoned and instead the clearing and deepening of the existing natural streams and creeks and the cutting of new channels to properly flood and drain these lands

have been effected with success. However, in limited areas empoldering/and the exclusion of tidal saline water flooding ha. had good results.

Saline water flooding during the dry season has some beneficial influence on rice cultivation as it controls the growth of weeds in paddy fields.

In conformity with the period of rainfall of the country, generally rivers begin to rise around May and flooding starts by July or August. However, this is variable depending on the seasonality of the rainfall. Flooding usually declines towards October in most of the rivers. For the rest of the year river levels are generally low. "It has frequently been asserted that owing to shifting cultivation and subsequent erosion on the uplands, the rivers now contain less water in the dry season and floods are more severe in the rains than formerly."(21)

The Searcies rivers area is subject to excessive flooding which though variable, ranges from about one to three feet above the marginal land level. But, in limited areas particularly closer to the river, flood waters rise much more. Usually flooding starts by July or August and continues until October. During this period rice fields are flooded daily. Water recedes from the farms when the tide ebbs. The multiplicity of streams associated with the two rivers help to

flood and drain an extensive area. A number of streams run dry during the dry season.

Despite the fact that the two rivers are neighbours the Great and the Little Scarcies are very different in character. The Great Scarcies is relatively more tidal and saline in the dry season and has low banks. The Little Scarcies on the contrary is mostly a fresh water river and due to the great volume it carries especially during the wet season, salinity is much reduced. Its banks are usually high, overtopped mainly in the middle of the rainy season.

The Little Scarcies river is tidal as far as Mange which is about 28 miles from the mouth of the river. Here the tidal rise in water in April during the dry season, when the river is at its lowest is about $2\frac{1}{2}$ feet. At Katonga it is 4 feet and Probu $7\frac{1}{2}$ feet during the same period. But the tidal effects are greatly restricted during the rainy season, especially from August to October.(22) Salinity during the dry season is most pronounced however from the river mouth up to Konta,(23) (which is 14 miles from the mouth). During the dry season spring-tides, the remote parts of the rice region are left unaffected and get dried up from about January to May. The river begins to rise in June and from July to October is in flood. The latter reaches its maximum in September and sometimes causes much

damage to crops. For a period of three to five weeks the low-lying land particularly between Makasi and Mange is deeply flooded - up to three feet - and sometimes acts as a limiting factor to rice growth. However, the fresh water period of this river is relatively long, being from August to October. Brackish water effects come into the scene in December and are felt in Tumbu in January. In very dry years during high-tides in April and May a trace of salt may be evident even as far up as Katonga.

The Great Scarcies is a smaller river than the Little Scarcies, and is subject to great tidal effects. It is tidal as far as Kambia, 32 miles from the river mouth. The tidal rise in April is about 4 feet 5 inches in Kambia, in Mambolo (9 miles from mouth) it is 6 feet 10 inches and in Kaikonki (one mile from mouth) it is 7 feet 6 inches. Throughout the tidal section the river banks are low and the tide waters overflow them at high water. In the dry season the high tide usually floods only the lands close to the river and creeks but in the rainy season large parts of the rice land are flooded to some extent daily. Unlike the Little Scarcies, damage to rice crop due to deep flooding is rare in respect of the Great Scarcies. The extremely tidal nature of the river prevents continuous flooding. From Kaikonki upwards the river is fresh at all stages of the tide from July to November. Along the West coast of the Samu Chiefdom the

creeks are fresh usually from August to October. The Great Scarcies is salty at high tides in February, and by April salt reaches Bumbo and Kupr.

The large size of the catchment area and the high annual rainfall which it receives have resulted in the Sewa river being one with the largest volume of fresh water in the country. (Figs. 24 & 26) For the greater part cut off from the direct influence of ocean tides, this river is predominantly a fresh water river. Though not altogether absent, tidal influence is not a major factor controlling flooding of the Sewa. The controlling influence of rainfall is explicitly seen in the depth and duration of flooding of this river. Usually the flood season is from June to October. The difference between the dry season and wet season river levels is considerable being about 50 to 60 feet in some places.(24) The normal depth of flooding of the Sewa river is greater than most of the other rivers of the country. At some places a depth of 20 feet is not uncommon. At Terma Bum normal flooding is from four to six feet and a peak of up to fifteen feet of slow-moving flood is experienced in August, at the height of the rainy season.(25) Deep flooding has been the most important limiting factor in regard to rice cultivation in the Sewa river region from very early times. Even today some of the deeply flooded areas are incapable of utilisation. But

after the introduction of the floating rice varieties which can resist and withstand deep water conditions, it was possible to bring under the plough a substantial portion of the river valley. Proper methods of water control and drainage would enable an extensive area to be converted into prosperous rice land, as the other physical conditions, especially soil have been found to be very suitable for rice growth. The banks of the Kittam and Waanjo rivers are to a great extent very low and are thus subject to extensive flooding. Turners peninsula acts as a barrier to the overflow of flood waters to the sea. The Kittam is subject to tidal effects which act as a barrier forcing the overflow of the river waters. However, salt problem is not acute due perhaps to the large volume of fresh water. Considering the rivers and creeks associated with the rice regions of the Southern Province, with the possible exception of the Bagru, the other rivers are not tidal to the extent of the Great Scarcies. The Ribi river is tidal from Mabang to the sea during the rainy season. At the height of the tide the rice lands on either sides of the river are flooded. The tidal effects are noticed in the bigger tributaries of the river. Though dry season cultivation is affected by brackish water, salt trouble is not as pronounced as in the northern rivers. The Bumpe being extremely tidal, is devoid of the danger of continuous flooding. The river overflows a short distance on either side. A sufficiently

long salt-free period is found for the successful growth of rice. The rice region between the Ribi and Bumpe rivers and the Kagboro creek, is mostly flooded by smaller streams and the overflow of the main rivers during the wet season. Here, the use of short-duration rices would enable the utilisation of considerable areas of swamp for rice, as the period of fresh water flooding is not long. The Kagboro creek carries a considerable amount of fresh water during the wet season and moistens the rice lands on its right bank near its estuary. Here the salt-free period is sufficiently long for the taking of a rice crop. The Port Loko creek and Rokel river are subject to tidal effects to a considerable extent inland. Salinity has inhibited cultivation of a greater part of the swamps of the lower parts of the two drainage lines. The upper and middle parts of their banks however, have a sufficiently long period to take a successful crop of rice. The period of flooding is similar to that of the Scarcies rivers. The banks of the Port Loko creek are sometimes subject to deep flooding causing damage to the crop. Sherbro Island rice lands and the Kaffu Bullom Chiefdom rice lands are usually drained by small streams and by direct rainfall. Sherbro Island is greatly subject to saline conditions as the tidal influence on the island is quite great. The effect of the Jong, Kittam and Sewa rivers is to dam the salt water up against

Sherbro island, so that more salty conditions prevail on the island than on the mainland. But water becomes salt-free about the end of July and this condition lasts till about December. The problem of salt is not grave towards the interior of the island where rice cultivation is possible fairly extensively. The River Molen and the lakes region in its neighbourhood are subject generally to deep flooding at the peak of the rainy season. Floating rice varieties would prove satisfactory for these lands as has been demonstrated in some limited regions within the area.

Edaphic Factors

The distribution of rice cultivation is mostly governed by considerations of water supply and climate than by the nature of the soil. D.H. Grist maintains that " ..... paddy apparently makes no special demand regarding soil," though " ..... paddy have been found particularly suited to certain types of soil ....." "Provided that the water supply is adequate, paddy cultivation is possible on a wide range of soils. Many unpromising soils may be built into good paddy-producing soils by cultivation and suitable manuring." (26)

The paddy plant receives part of its nutrient requirements from soils and part from irrigation water, either in solution or in suspended solids such as silt. The important requirements of the paddy plant are nitrogen and phosphorous, which are mostly

derived from decomposed organic matter under anaerobic conditions. Calcium, sulphur, potash, iron, manganese and minor 'trace elements' form other requirements of the plant. These nutrients are not required in equal proportion by the paddy plant. But a well balanced soil with all these nutrients will result in good yields and resistance to plant disease. Deficiencies of these nutrients can be overcome by means of systematic and scientific manuring.(27) These plant nutrient requirements have been found to be present to a large extent in the alluvial clay soils associated with the swamps of coastal Sierra Leone. These are rich in great quantities of organic matter and with a seasonally renewed coating of soft fertile silt. "The fibrous mud associated with Rhizophora mangrove swamps has a higher pH value, a higher content of oxidisable sulphur, nitrogen and phosphorous, a higher carbon-nitrogen ratio, and a larger water holding capacity."(28) The bulk of undecomposed organic matter in the fibrous mud is also found to be great.

The need to retain water in and on the soil necessitates a heavy soil preferably with 40% or more of clay and an impermeable hard pan.(29) D.H. Grist says "..... there appears to be direct evidence that it grows better on heavy clay soil than upon the lighter soils containing a high proportion of sand."(30) It has also been found that good paddy soils are almost invariably acid

in reaction.(31) In this respect, a greater part of Sierra Leone's coastal swamp soils are favourable though problems of lower pH values have been encountered in some mangrove areas.

Empoldering of Rhizophora mangrove swamps and the resultant soil conditions which were inimical to rice growth, have already been referred to. (p. 67) This is particularly due to the chemical changes in the soil which is subject to desiccation during the dry season. "The Rhizophora bearing soils are sulphidic and highly fibrous in nature and one of the major effects of empoldering is the production of sulphate in quantities sufficient to result in soil conditions toxic to rice."(32) The pH value of empoldered soils have been found to decline as low as 2.9 in many areas. The limiting soil acidity for good rice growth is pH 5.(33) For the successful cultivation of rice, toxic substances found in empoldered saline Rhizophora mangrove swamps have to be leached out. Experiments at Wellington saline mangrove swamps have shown that liming and leaching independently, reduce soil acidity. However, liming is prohibitively expensive as large quantities are required, and leaching is a slow process taking at least two to three years.(34)

Among the other problems relating to soils in rice areas of coastal Sierra Leone have been the low nitrogen content of

some soils,[35] and the sandy nature of the soils of some parts of the coastal areas of the Southern Province.

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CHAPTER VIII

TECHNIQUES AND METHODS OF SWAMP RICE CULTIVATION

Apart from the recent introduction in some areas of mechanical ploughing and harrowing, the cultural practices observed in swamp rice cultivation in coastal Sierra Leone have been backward and primitive, due partly no doubt to the fact that swamp rice cultivation is a relatively recent development in the country. The methods of farming prevalent in Sierra Leone, cannot be compared with the traditional simple but efficient methods of cultivation which the Asian farmer has evolved through centuries of experimentation. In Sierra Leone, these practices have no indigenous tradition to give them strength. However, it is not only the time factor that is important here, but also the attitude and disposition of the farmer himself. The apathy and general reluctance of the farmer to accept innovation and his deep-rooted conservatism have made him more or less stagnant with his primitive inefficient cultural practices. Moreover, most farmers appear to be contented with what they acquire from the land with the minimum of effort. They seem unable to appreciate the value of that extra toil which better cultural practices involve. The economic instability of the farmer can also be cited as an important factor restricting

innovation. Most farmers lack the capital to enable them to adopt new and more desirable methods.

The evolution of better and more productive methods of cultivation is inhibited to a great extent by the sheer dependence on natural factors and very little attempt that is made to control and adjust them. In this respect, the lack of any form of efficient water control is of primary importance.

Land Ownership and Labour

Land is communally held though it is not unusual for the head of each family group to regard the plots allocated to him by the community as his own and passing to the head of the family on his decease. The amount of land held by each farmer varies considerably. Generally it is one to two acres. In some of the recently developed swamp areas of the Southern Province, two to four acre plots are not uncommon. The native land tenure system and pledging of land have complicated the pattern of land holding. The total area of land held by any single farmer does not however indicate the total area farmed by him. The area of land farmed often depends on the size of the family and the availability of farm labour. The greater part of the cultural practices involved in swamp rice cultivation is accomplished by the farmer and his family, though the richer farmer sometimes appears to employ outside labour.

There are no fixed wage rates for hired labour, and money payment is not necessarily the normal practice. Free food and payment in kind is the customary arrangement in some part of the Scarcies region. There are also working societies - 'Ka Botho', 'A Kofo' and 'An Kump', which offer services to the farmer during the farming season. These are especially found in the Scarcies area. Communal labour is occasionally resorted to in the Scarcies region as well as in parts of the Ribi river and the Bonthe District areas. In the Scarcies area it is not uncommon for the bigger farmer to allot small plots of land to his relatives in exchange for their services in the cultivation of his larger personal holding.

Single and Double Cropping

Within the coastal rice region, there are little variations in farming methods. These variations are brought about mainly by differences in water and soil conditions of the area concerned.

Usually, one main rice crop is grown. Very limited areas practise double cropping in some years. The second crop which is normally a short duration crop is taken in areas which are damp and free from dry season salt conditions. The second crop ripens very irregularly and the harvest extends over a long period. Among the factors inhibiting the successful practise of double cropping is the low photoperiod under which the second crop will have to grow.

At the Rice Research Station in Rokupr an experiment on double cropping, using varieties of short maturation and with low sensitivity to photoperiod, gave a total yield (both crops) greater than that obtained by cultivation of a single long duration variety.(1)

TABLE 5.

DOUBLE CROPPING

(Mean Yield in lbs.per acre)

Variety	1st crop	2nd crop	Total
52 M. 4.3	2500	850	3350
52 M. 6.1	2120	930	3050
51 M. 4.1	2020	880	2900
52 M. 3.6	2020	1070	3090
52 M. 8.1	2010	1100	3110
DISSI HATIF	1950	870	2820
52 M. 6.4	1910	1040	2924
52 M. 4.3	1510	900	2410
RADIN CHINA 4	SINGLE CROP		2340

While it is not possible to discount the possibilities of double cropping with the use of suitable varieties of seed, still the greater cost of production involved in double cropping as compared with a single crop is an inhibitive factor. It appears that at the present time, in coastal Sierra Leone, the best course

would be to plant a long duration single crop, which if properly grown would give a heavier yield.(2)

Rotation of Crops

Only in very limited areas in the swamp land of Sierra Leone, that rotation of crops is practised. Rice is usually rotated with sweet potatoes, cassava and vegetables. This not only helps to enrich the soil, but also to keep down weeds. It has been found, that " ..... continuous cultivation of paddy reduces yield owing to defective soil aeration and consequent disturbance of the micro-biological balance of the soil."(3) A rotation of a grass would enable the development of livestock farming especially cattle. However, rotation of crops in most areas is again dependent on water and soil conditions, because salinity in the dry season for example, could inhibit the cultivation of any crop in the swamp.

Preparation of Land

The initial preparation of land for the cultivation of paddy is slight when compared to those methods used in East and South-east Asia. In the tidal areas of the Scarcies rivers, initial preparation of land is almost non-existant. Land is neither ploughed nor dug. In some areas where weed growth is widespread,

hoeing and brushing are practised. These areas are normally the non-tidal swamps. Usually, hoeing is shallow. Where weed growth is well established, two hoeings are given to the land - an early hoeing during the dry season and a late one before planting. In most areas, hoeing is perhaps unnecessary as the land is soft enough for direct transplanting. In some farms, wide meshed fences of interwoven sticks are made before cultivation, to exclude the intrusion of weeds floating in tide water. Weed problem is acute in the southern grasslands area and thus hoeing as an initial practice has become essential. Weeds are generally 'cutlassed' and the brushings are heaped up and left to rot. Before planting, these heaps are burnt in the Sewa river grassland swamp area.

The commonly used implement to cut grass and wood is the cutlas or matchet. There is a native hoe which is also used. This is wedge shaped in outline with a curved flat blade. A large bladed hoe is used for heavier work. But now, larger areas of the grasslands in the south are mechanically ploughed. In some parts of the Port Loko creek rice region, heeling of weeds into the soil is practised, which helps as a source of organic matter to the soil. In some rice lands of the Scarcies rivers and Western Samu chiefdom area, repairing and cleaning of bunds of fields are done as an initial practice. These bunds are made to exclude the ingress of saline tide-water into the farm. They also help to accumulate silt

within their precincts, when the field is submerged with fresh river water flooding. However, this type of bunding is only found in limited areas.

Mechanical Cultivation

Mechanical cultivation is a relatively recent introduction to Sierra Leone. This practice is now fairly widespread in the grassland swamps of the Southern Province. Its introduction has also led to the emergence of large extents of rice land in other parts of the country. Mechanical ploughing is done in grassland and inland swamps, but has been found to be unsuited to mangrove swamps. Most grassland swamp fields of the Sewa, Waanje, Kittam, Malon, Little Scarcies rivers, Port Loko creek and the South-west Pujehun District, are ploughed mechanically once each year before the land is inundated by the overflowing rivers and streams in the rainy season. In the recent past a relatively large are of Boli-lands has been opened up for rice planting with the help of mechanical methods.

Mechanical cultivation is generally conducted by the Agricultural Department. A few Co-operative Societies in the Bonthe District have recently taken up the practice and have been quite successful. The Government of Sierra Leone hopes to transfer the entire work of mechanical cultivation ultimately to

Co-operative Societies. Both Government and Co-operative Society machines plough and harrow the swamp during the latter part of the dry season - i.e. January to April, - the farmer paying a fee of 6 Leones (£3) per acre for the services. Farmers having a cash stake in the crop by reason of the payment of ploughing fees, have shown a relatively greater interest in the cultivation thereafter. Mechanical cultivation has helped to bring about an increase in yields per acre and per man mostly due to the efficient eradication of weeds and better preparation of the seed bed. The small population in the greater part of swamp areas of the country indicate that mechanical cultivation is all the more necessary for developing the potential swamp rice lands both in the coastal tract and the interior. However, there are certain technical problems particularly the inadequacy of servicing facilities for the maintainance and repair of machinery still to be solved and till this problem is tackled, the practice perhaps cannot be completely integrated with the local farming system. Nevertheless, in most areas of the southern grasslands, mechanical ploughing has become an established part of the farming cycle.

The costs of mechanical cultivation consisting of operation, depreciation and general supervision costs are borne solely by the owners of the machinery, whether Government or Co-operatives. Each tractor unit found in the important grassland and inland swamp

regions consists of about 10 to 25 tractors.

The tractors used by the Mechanical Co-operative Societies are generally of a lighter type which have been found cheaper to operate. These tractors have been obtained under a five year Government loan to the societies. The Government tractors are usually crawler tractors, wheel tractors and garden tractors.

Generally it is observed that tractors are incompletely used mainly due to the fact that they are made use of only during one season. However, this does not make their utilisation less justified, as their use promotes a greater output of work in a limited period and also in the final result, a relatively heavier yield. In the case of the deep-flooding grassland swamps of the Bonthe District and parts of the North-central Bolilands, early and quick preparation of land being necessary, mechanical cultivation is an attractive proposition to the farmer and readily resorted to.

The adoption of mechanical cultivation has in turn helped the farmer giving him more time to engage in other productive activities which can help to make his life more varied and interesting, thus assuring him of the opportunity of greater social and cultural intercourse. Mechanical cultivation has reduced the drudgery involved especially in weed clearing which has for a long time been the most time-consuming operation in the period of preparation

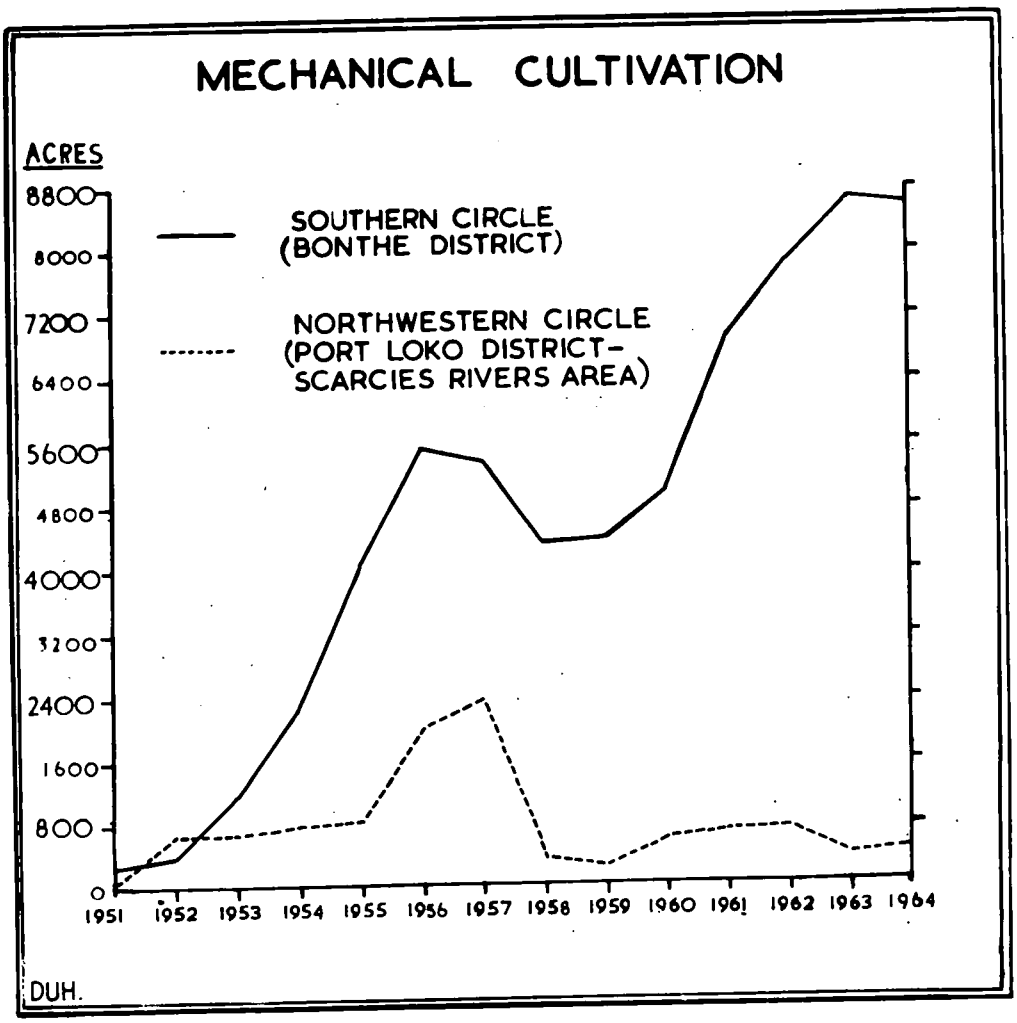
MECHANICAL CULTIVATION
ACRES
8800
8000
7200
6400
5600
4800
4000
3200
2400
1600
800
0
SOUTHERN CIRCLE
(BONTHE DISTRICT)
NORTHWESTERN CIRCLE
(PORT LOKO DISTRICT-
SCARCIES RIVERS AREA)
1951
1952
1953
1954
1955
1956
1957
1958
1959
1960
1961
1962
1963
1964
DUH.

Fig. 29.

for the sowing of swamp grasslands. These factors coupled with the higher yields they enable, have made cultivation in grassland swamps an attractive pursuit, and are now gradually restricting the flow of people to towns and mining areas.

Mechanical cultivation started in Sierra Leone in 1949 with four acres cultivated in the Bonthe District swamp grasslands. The acreage mechanically cultivated increased appreciably in 1952 and after until 1958 in which year an overall decline in acreage cultivated was noticed. (Fig. 29) This was mainly due to the change in policy of the Government regarding the payment of ploughing fees in advance. A rejuvanation was however observed in 1960 with a notable increase in acreage cultivated particularly in the Bonthe District. In 1963, as much as 8,630 acres and in 1964, 8,552 acres were cultivated mechanically in the latter district. In the Little Scarcies river, Port Loko District and Pujehun District areas, the largest acreage mechanically cultivated was in 1957. In the Little Scarcies and Port Loko District areas, soil and water problems as well as the lack of interest by farmers have resulted in the slow progress of mechanical cultivation. In the entire coastal swamp rice region of Sierra Leone, a total of 9,212 acres were mechanically cultivated in 1964. In the Bonthe District, mechanical cultivation appears to be most popular in the Nongoba Bullom chiefdom where 5,195 acres were cultivated

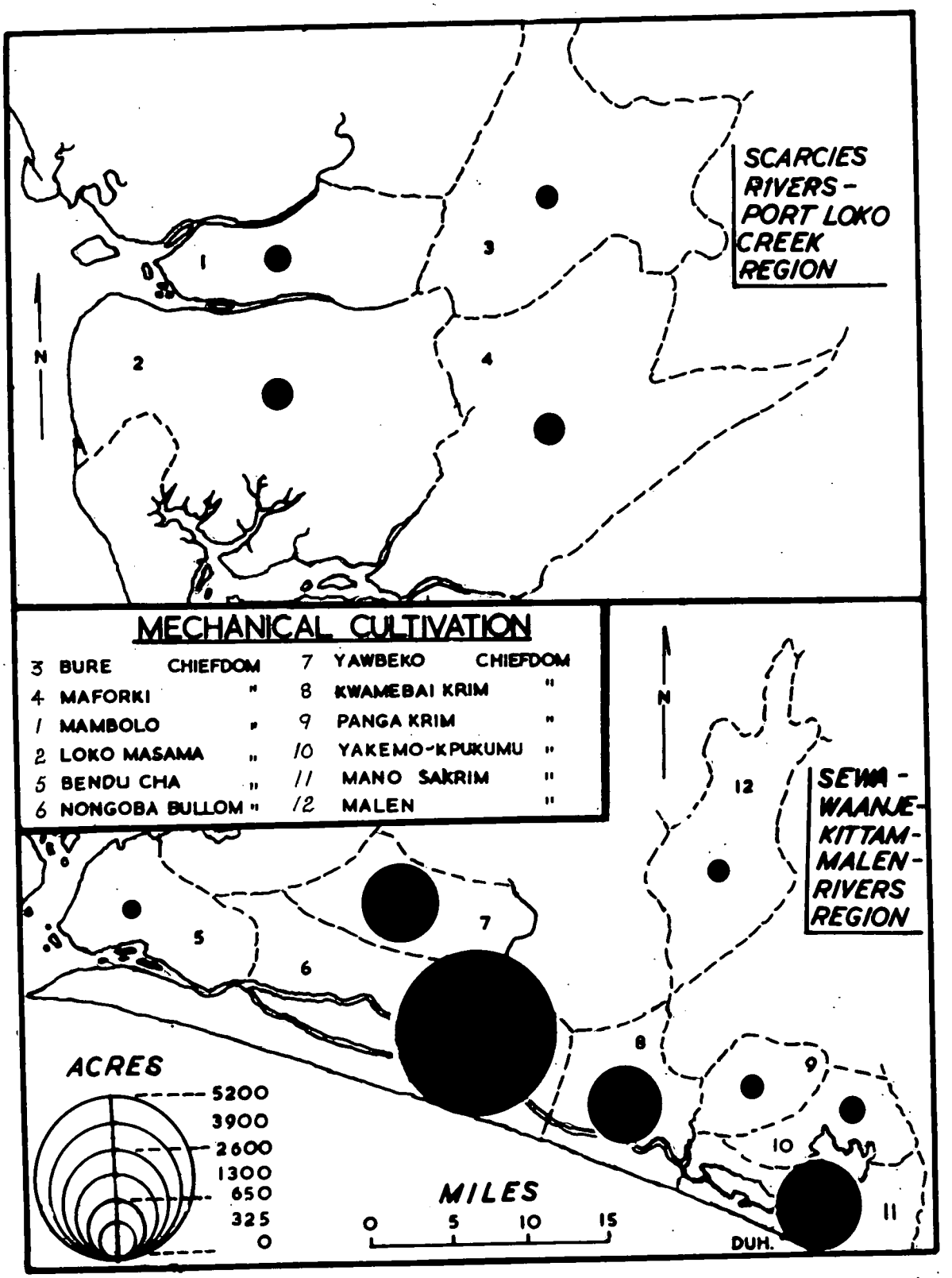
SCARCIES RIVERS - PORT LOKO CREEK REGION
N
1
2
3
4
MECHANICAL CULTIVATION
3 BURE CHIEFDOM
4 MAFORKI "
1 MAMBOLO "
2 LOKO MASAMA "
5 BENDU CHA "
6 NONGOBA BULLOM "
7 YAWBEKO CHIEFDOM
8 KWAMEBAI KRIM "
9 PANGA KRIM "
10 YAKEMO-KPUKUMU "
11 MANO SAKRIM "
12 MALEN "
SEWA - WAANJE - KITTAM - MALEN - RIVERS REGION
5
6
7
8
9
10
11
12
ACRES
5200
3900
2600
1300
650
325
0
MILES
0 5 10 15
DUH.

Fig. 30.

mechanically in 1964. (Figs. 29 & 30)

TABLE 6.

1964

MECHANICAL CULTIVATION IN THE COASTAL REGION

(By Chiefdoms)

BONTHE DISTRICT	ACRES
Nengoba Bullom	5195.3
Mano Skrim	1332.8
Kwambai Krim	998.5
Yawbeko	987.2
Bendu cha	38.4
	8552.2
PORT LOKO-SCARCIES	
Maforki	119.5
Buro	66
Loko Masama	118
Mambolo	100
	403.5
SOUTH-WEST PUJEHUN DISTRICT	
Malen	64.5
Panga Krim	86
Yakama-Kpukama Krim	106
	256.5
TOTAL	9212.2

SOURCE - DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES, SIERRA LEONE.

Nursery Culture

In the greater part of the coastal swamp areas of the Southern Province, after the preparation of land, direct broadcast sowing of seed is practised. Though in deep-flooding grassland swamp areas this is the predominant practice, it is also characteristic of mangrove swamp rice lands associated with the Ribi-Bumpe rivers and the Kagbere creek. In the Scarcies rivers area though direct sowing is conducted in some areas, it is fast disappearing due to the farmer realising the greater productivity of the transplated crop. Transplanting is seen gradually spreading to the swamp fields of the Southern Province. Weed problem becomes acute with broadcast sowing and results in low crop yields.

In the Scarcies rivers and the Port Loko District rice areas more common is the practice of transplanting of seedlings grown in nurseries usually away from the swamp fields. In these areas, the initial work of the farmer is concerned with the preparation of the nursery bed. The most common practice is to prepare the nursery around settlements, paths and roads. However, nurseries are also made on cleared upland bush, sometimes a considerable distance away from the swamp rice field. These nurseries are commonly referred to as "dry nurseries." Increasingly evident is a third type of nursery developed in inland valley and grassland swamps found in the neighbourhood of tidal

mangrove swamp. The exhaustion of most of the uplands in the neighbourhood of swamp fields, has led to the increasing use of such fresh-water swamp nurseries in the upper reaches of rivers and streams. Thus, transport of seedlings from nursery to the swamp field has been at times a limiting factor to production. Boats, canoes and sometimes lorries are employed to transport seedlings. More often, considerable time elapses between pulling and replanting, making conditions detrimental to the seedlings and consequently to the rice crop.

Nursery lands are very rarely ploughed or manured. Those around settlements are planted with sweet potatoes, cassava and vegetables after rice seedlings have been removed. Generally, a greater part of the land used for nurseries, is in a low state of fertility, and is apt to decline as they are more continuously utilised. This is particularly noticeable in the Searcies rivers area. The adoption of improved cultural practices in the nursery, especially the proper application of artificial fertilizers and compost are urgently required to alleviate the problem. However, it would be more desirable to use for nurseries the more fertile fresh water inland valley and grassland swamps.

The dry nursery is usually made in light friable soils. Normally when bush areas are utilised, they are first cleared and burnt, and the seed is sown broadcast. Around settlements, paths

and roads nurseries are generally lightly hoed before sowing. In fresh-water swamp nurseries, vegetation is either cutlassed or uprooted and burnt. Sometimes rice straw is burnt on the nursery ground to enrich the soil. This is more common in areas where shortage of land has compelled the farmer to use the same plot year after year. Burning helps to reduce the soil to a fine state of division and destroys weed seeds.

Nurseries are usually sown in May and June during the early rains. Seedlings are left in the nursery for six to eight weeks depending on the variety sown. Some are left for as long as two to three months by which time they are often found badly overgrown. It has been found that seedlings with a short period in fertile nursery give high crop yields. Experiments in the Rice Research Station at Rokupr have revealed that the combined effect of high fertility and short nursery period gave double yields over a low fertility and longer nursery period. This was in respect of the photoperiod-sensitive variety Radin China.(4)

The normal seed rate of the nursery is found commonly to be high, being 500 lbs or more per acre. In the infertile nursery, this high seed rate results in waste of seed, weak growth of seedlings and conditions which favour plant diseases. The shortage of rich and extensive nursery land in the neighbourhood of swamp fields, coupled with the apathy and general lethargy of the

farmer have resulted in the adoption of a high seed rate in the nursery. But experiments in the Rokupr Rice Research Station have shown that a seed rate as high 700 to 900 lbs. per acre could be fabourably used without adverse effects on seedlings or yields, provided a fertile nursery is used and the nursery period is reduced.(5)

Seedlings are uprooted when they are found fit for transplanting. Plants are generally nine to twelve inches tall when they are uprooted and tied into small bundles. The seedlings are shaken after uprooting to shed the soil from the roots. Some farmers rinse the roots in water to remove mud and soil. Seedlings are also trimmed down at their tips, with a small knife or cutlass. This trimming has been found to be necessary if the growth of seedlings has been vigorous in the nursery as it checks transpiration whilst the roots become established in the field. It gives rigidity to the plant so that when transplanted the leaves do not bend over into the water but stand erect. It also prevents seedlings from being beaten down into the mud by heavy rains or tidal flooding.

The small handful bundles of seedlings are usually tied into bigger ones capable of being carried on the head. About ten days or a fortnight may usually elapse from the day of uprooting to the day of transplanting. It is not the practice in Sierra Leone

as in many South-east Asian countries to keep seedlings in water for a night before planting. This is known to be beneficial, for it helps to destroy eggs and insect pests by fermentation.

Transplanting

Transplanting seedlings from seed beds to the field proper has been found essential in many tidal swamp areas, due to the fact that at the beginning of the rainy season, rice planted directly in the swamp would encounter salinity greater than the rice plant can tolerate. Furthermore, it has been found that transplanted seedlings are better able to withstand submergence and water movement on the tidal swamps. Moreover, it facilitates weed control. While enabling a uniform field, transplanting has been found to induce a higher yield, though it involves considerable hand labour.

Transplanting is usually done during the very wet months of July and August when the flush of river water moisten fields. In tidal swamp fields, soil salinity is washed by this time and fresh conditions are available. Planting spreads down river as the salt becomes washed out. Test plots are planted in advance in the more saline areas at intervals of a week, until their survival reveals favourable conditions.

Transplanting is done by men, women and children, unlike in most South-east Asian countries where it is a women's job. In the

Scarcies areas a forked stick (normally consisting of a piece of bamboo about nine inches long with a blunt 'V' shaped notch at the planting end,) or piece of iron is used for transplanting. Usually five to ten seedlings are thrust into the mud with the help of this transplanting tool. The distance between 'hills' of plants is usually nine to eighteen inches apart. On heavily rich mud, twelve by twelve inches is common, but on light and less fertile soil, seedlings are planted about six inches apart.

If the seedlings are poor, the number per clump is increased. As many as twenty to thirty seedlings per hill is not uncommon. Closer planting and fewer seedlings to a clump give better results. The native farmer is inclined to plant a large number of seedlings in each stand and spaces these stands widely. This is mostly due to carelessness and also as a compensatory measure for crab damage. Experiments in the Rice Research Station at Rokupr have shown positive advantages in a spacing of six to nine inches and the placing of two to three seedlings in each stand.(6) However, in areas where crab damage of seedlings is great, larger number of seedlings to the stand may be advisable.

Wherever wet and dry season swamp cultivation is intensive, rice is always found to be transplanted. In swamps which are subject to sudden and deep flooding or to rapid flow of water as evident in parts of the grassland swamps of the south, newly transplanted

seedlings are liable to be washed away. Therefore, in these areas the practice of establishing the crop early by direct broadcast sowing has continued.

Compared to Asian standards, Sierra Leone's nursery culture and transplanting methods are generally unsatisfactory. Haphazard transplanting has inhibited the proper growth of seedlings. In most Asian countries nurseries are carefully made with proper manuring and regulated water conditions. Seedlings are transplanted in regular rows usually eight to ten inches apart. Normal plant spacing is four to six inches in the row. About three to four seedlings are planted erect at each point. This method has enabled not only the vigorous growth of the plant with large earheads, but also has eased the clearance of weeds which rob the rice plant of light, air, water and food that would have gone to increase rice yields.

Weeding

After transplanting, the farmer usually leaves the field for natural conditions to have their full impact on the plant. Weeding is done very haphazardly but in many areas it is completely absent. The weed problem however, is less in tidal area, as the flush of saline water during the dry season controls weed growth. In the rest of the swamp fields weeds pose a difficult problem and is one

of the main reasons for the inability to raise good yields in most swamp fields. Preparatory tillage, impounding water, harrowing the growing rice and systematic transplanting, as conducted in most Asian countries, may be interpreted largely as measures of weed suppression, and adoption of these methods with an increase in efficiency would result in better weed control, and would enable the taking of better crops. In the tidal swamp area, as the crop is almost entirely transplanted, a long period is available for the farmer to do preparatory tillage of the swamp field. But this practice is almost completely absent. Thus weeds that lie dormant in the dry season appear luxuriantly along with the transplanted rice during the wet season.

In Asian countries the fields are sub-divided by low bunds which help to impound and regulate water. Standing water in the field helps to control weed growth. Some farmers in the Scarcies area do one weeding about six weeks after transplanting. Weeding being an unattractive and tedious job in the soaked swamp field during the peak of the rainy season, has made the people loathe this practice and where it is done, it is haphazardly and incompletely done.

In some grassland swamp fields of the Southern Province, where direct broadcast sowing is practised, weeding is accomplished along with sowing of seed. Usually, while some men sow, others

are seen uprooting weeds generally with the help of a hoe. Women normally collect the uprooted weeds and grass and pile them up along the field boundaries.

As a rule, during the greater part of the period from September to December, the farmer does hardly any work in the paddy field. When earheads appear children are seen in some areas, engaged in bird scaring.

Manuring

Manuring of fields is negligible in the swamp rice areas of coastal Sierra Leone. In most fields it is completely absent. Natural fertility of a substantial part of the coastal swamp rice land does not necessitate the use of fertilizers. Manuring, especially with artificial fertilizers such as superphosphates has been tried in some limited areas and found to give very satisfactory results.(7) However, in spite of the government subsidy on fertilizers, their utilisation is restricted owing to their relatively high prices which farmers cannot afford. The judicious application of fertilizers before planting and particularly before the heading of plants has been found to boost rice yields, in certain areas. Poor drainage conditions due to the absence of water regulation, inhibits the derivation of proper benefits from fertilization, as the real

effects of fertilizers on the plant, depend mostly on water conditions of the field.

Harvesting

Towards the end of the year, as the rains decline and floods subside, the period of harvesting arrives. December and January are the main harvesting months. During this period small houses are sometimes built for the harvestors in the swamp on small raised platforms. Harvesting method is simple but entails much labour. Usually, the panicles are cut with a short length of stem about six inches, the greater part of the straw being left standing in the field. The harvested crop is stacked in circular heaps on raised mounds in the fields, being tied in small bundles. These bundles are left on the field to dry for eight to ten days. Some farmers make rectangular stacks on wooden platforms to stack the harvested crop. These help to keep the crop out of high-tide flood waters. If the farmer's house is close-by the rice is stacked in his compound. The stacks are normally covered with mats or dry grass or rice stalks to protect the grain from birds.

To restrict the breakage of grains in milling, it has been found that harvesting should be done earlier than the traditional time. Experiments in the Rokupr Rice Research Station have revealed that yields are not affected by an early harvest.(8)

Women, men and children, all take part in harvesting unlike in most Asian countries where it is mainly a womens' job. The implement used in harvesting is a small knife. The method of harvesting is tedious as only one or few heads are harvested at a time. This is especially so when the rice plant lie flat on the ground due to effects of floods. In this case, the tangled mass becomes difficult to harvest. This is particularly seen in the swamp field of the south. Also in this area, there are sections where the floating rice varieties have to be harvested on boats, as the fields are flooded even during this period.

After Harvest

Stacking in the field and exposure to direct sunlight have disadvantages, as the heating and mild fermentation of the grain that sometimes result, affect the viability and milling quantity of the grain.(9) The stacked bundles are carried on head or transported usually in baskets to the settlements, and placed in granaries. When the settlements are some distance away from the field, canoes and Bullom boats are used.

In some rice fields, after harvest the soil is piled in heaps with the rice stubble buried beneath. In some swamps which are continuously cultivated rice straw is burnt before the land is

heaped. On this land later on, sweet potatoes, yams, vegetables and tobacco are grown by some farmers. In the neighbourhood of settlements, household refuse is seen scattered over this growing crop. However, this practice of mixed cropping is found on a very limited scale. The usual practice is to leave the farm unattended immediately after harvest.

Threshing

Threshing to separate the grain from the stalk is done whenever convenient. However, March and April are months when the practice is commonly noticed. Unlike in most Asian countries where threshing is done by driving buffaloes slowly around on the rice stalk to trample out the grain, in Sierra Leone due to the absence of draught animals, threshing is done by the farmer and his family usually beating the rice with sticks. Normally the sheaves are heaped between two upright posts, and the farmer beat out the rice from the heap with sticks about three to four feet long. Women subsequently complete the work by beating the sheaves with long slender sticks, to separate the remaining grains from the stalks. This is a tedious practice involving much time. When the crop is small, some farmers thresh the crop with their feet. This method is effective though very slow, and it prevents scattering of seeds which is common in beaten rice. The operator generally

supports himself on a long stick held upright in one hand. This method is evident in the Great Scarcies area.

Winnowing

Threshing is usually followed by winnowing. The latter is done with the help of wind and winnowing trays. It is done normally by men standing on top of boxes or upturned rice mortars. The unwinnowed rice is collected in trays and the farmer holding the tray in front of him at shoulder level or higher, gently shakes the tray shedding the paddy from the tray. Wind separates the husk and chaff from the grain. Sometimes the unwinnowed rice is collected in trays and is shaken and tossed with a twist of the wrists. Here the tray is held low. Some farmers fan the fallen rice with winnowing trays and separate the chaff from the grain.

Farming Calendar

The swamp rice farmer's calendar of work is simple, and except for a few variations, is found to be generally similar in all parts of the coastal region.

March to April is usually the period of shallow hoeing and weeding. However, this is not universal as in most swamp rice areas no hoeing and weeding are done. In few swamp rice areas, nurseries are sown in late March. In some grass swamps of the south, burning of grass is done during this period. More important

however, is the mechanical ploughing of grassland and inland swamps during this period.

In some grassland swamp fields of the south, the dry season short duration crop is harvested during March and April. In some of the Little Scarcies swamp fields, and in some parts of the Sewa and Jong rivers swamp rice areas, broadcasting of seeds is done in April and continued until May. This is particularly seen in inland valley swamps.

The preparation of rice nurseries for long-duration main rice crop takes place from May onwards. This continues until June and early July. In the greater part of southern grassland swamp rice area, broadcast sowing is in progress from May onwards and is commonly seen in June.

Harvesting of cassava and sweet potatoes grown as dry season crops in some swamp fields also takes place during this time. Farm digging and weeding are also seen in some limited places in the Scarcies area. In some limited areas planting of short-duration varieties starts in May. The harvesting of this crop which commences around late July is usually seen to continue until August. However, July and August are more important as the period of transplanting of the main rice crop. Transplanting sometimes continues until September.

September, October and November are usually months without much work for the farmers. In some inland valley swamps and grassland swamps, short-duration early rice are generally harvested during this period. December and January form the main harvesting season, which is sometimes continued up to early February. During this period sweet potatoes, yams and cassava are planted in the harvested swamp fields in some areas. Mechanical cultivation commences usually in January and proceeds up to about April. In some places during the early part of the year, dry season short-duration rice varieties are planted.

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(1) Annual Report of the West African Rice Research Station. (Rokupr, Sierra Leone) 1963, p.8

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(4) Annual Report ..... op. cit., 1962, p.11

(5) H.D. JORDAN, "Development of Rice Research in Sierra Leone", Tropical Agriculture, Vol.XXXI, January 1954, p.27

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(8) Annual Report ..... op. cit., 1961, p. 18

(9) D.R.E. JACKSON, "Extracts from a Report on a Visit to Sierra Leone to Study the Cultivation of Swamp Rice, December 1950 to October 1951", West African Rice Research Station, Rokupr, Sierra Leone, Bulletin No.4, 1958, pp.35-52.

CHAPTER IX

PRODUCTION AND YIELDS

Sierra Leone usually produces about 315,000 metric tons of rice per year.[1] This includes swamp as well as upland rice. Though accurate data are not available it could be discerned that a substantial part of the annual production comes from the swamp fields of the coastal region. It is in these swamps that excess rice production on a commercial cum subsistance scale is seen to a great extent. In this respect the main areas of production include the Scarcies rivers and the Sewa - Waanjo - Kittam rivers areas.

In the recent past, the increase in local production of rice is particularly due to the steady development of swamp rice cultivation especially in the coastal tract.

TABLE 7.

RICE PRODUCTION, 1957/58 - 1962/63[2]

Year	Metric tons
1957/58	255,000
1958/59	264,000
1959/60	264,000
1960/61	264,000
1961/62	264,000
1962/63	315,000

TABLE 8.

1962/63 PRODUCTION(3)

Crop	Metric tons
Rice	315,000
Cassava	54,000
Sorghum	12,000
Millet	12,000
Maize	9,000
Sweet potatoes and yams	9,000
Ground nuts	8,000

Though large quantities of rice are locally produced, still they have been found insufficient to meet the demands of the country. This has necessitated the importation of considerable quantities from foreign countries particularly Burma and Spain. (See Table 2, p. 22)

Though a decline in imports of rice was noticed in 1963, rice came first in the list of agricultural imports, both in quantity and value. The main reasons for the huge imports of rice are the increasing demand from the mining and urban areas, and the inadequacy of milling and storage facilities within the country. Before 1954 the quantities of rice imported were negligible. In fact in 1953 Sierra Leone exported as much as 663 tons of rice.

Considering the rate at which population is rising in the country, urbanisation, and rising incomes it may be estimated that in five years, a doubling of the quantity of rice now imported would be necessary to meet the needs of the country, if home production and milling facilities do not simultaneously improve.

RICE YIELDS

Yields in swamp rice lands vary considerably according to the season, region and variety used. Anomalies of climate are seen to have their direct impact on rice yields. However, soil conditions appear to bring about greater differences in yields. Mangrove lands closer to rivers yield as much as 3000 lbs. per acre, mostly due to their great fertility. Yields are seen to decline as one goes inland away from these areas. The average yield of mangrove areas could be taken as 1200 lbs per acre. In the swamp grasslands of the Southern Province yields average 1600 lbs per acre. But there are areas providing 1800 to 2000 lbs and others less than 1000 lbs per acre. The grassland swamps of the Scarcies area generally do not yield as much as the mangrove swamp rice fields which adjoin them. But recent experiments of Chinese rice experts on grassland swamps at Mange on the banks of the Little Scarcies have given almost

double the yield generally obtained from such land. Yields of inland valley swamp rice areas within the coastal region are generally low ranging from 700 to 800 lbs per acre.

The huge yields obtained by the Chinese at Mange and the Rice Research Station at Rokupr show explicitly that the general yields derived by the ordinary farmer from the swamp areas of coastal Sierra Leone are far below their potential.

The expansion of normal production and yield of swamp rice would necessitate the increase of productivity of the swamp field and the utilisation of the presently unused swamp lands for rice production. Expansion of rice land is especially possible in the Southern Province. Grassland and inland valley swamps of northern areas also offer possibilities of development.

Factors Affecting Yields and Production

Many factors have offered a combined influence to bring about relatively low yields in a greater part of swamps of coastal Sierra Leone.

Among the primary factors is the almost complete submission to natural conditions and little attempt at controlling them to suit cultivation.

a) Water control

Lack of water control has resulted not only in poor

yields but also in the inability to bring under cultivation large tracts of swamps. The latter areas are either deeply flooded, inadequately flooded or poorly drained. Anomalies in the rainfall climate have direct effect on river flooding on which a large part of cultivation rests. Grassland swamps in the Scarcies rivers area found beyond mangrove swamps are particularly capable of producing good crops, if some form of water control, irrigation and drainage are adopted. Saline-water flooding inhibits cultivation of large extents of mangrove land. Improved water conditions would enable cultivation of these swamps. Adverse soil conditions that have resulted in attempts at water control in some mangrove areas could be overcome by adopting the method successfully experimented at Wellington by the Rokupr Rice Research Station (p. 68) The land-forms of the coastal areas facilitate impounding of water and the construction of irrigation and drainage channels. The large volumes of water that flow unutilised into the ocean especially during the wet season could be harnessed by impounding. The geology of the coastal areas has been found to offer little obstacle to impounding and conservation of water. Though large schemes of irrigation and drainage, perhaps would not be economically feasible at the moment, smaller schemes would be of great benefit.

b) Soil fertility

Soil fertility is seen to affect rice yields considerably. Fertility of soil declines as one goes away from the river. Presently there is almost complete absence of fertilisation in the swamp fields of the farmer. The high yields that have been derived by the Chinese at Mange and the Rice Research Station at Rokupr have been primarily due to the scientific application of fertilizers. Though fertilizers would not be necessary for the swamp areas closest to the rivers due to the natural fertilisation which these areas receive by seasonal deposition of silt, swamp areas in the background need fertilisation if yields are to be improved and maintained. Continuous cultivation of rice on the same land has led to decreasing of yields in many fields in the Scarcies rivers area. Not only the rice field, but the nursery on which the seedlings are brought up should be fertile if yields are to be improved. The upland dry nursery that is predominantly used by the rice farmer is for the greater part infertile and does not provide healthy seedlings. The Rokupr Rice Research Station has demonstrated that an improved nursery by fertilisation results in a large number of ears after proper transplanting. Experiments by the Research Station in mangrove as well as in inland valley swamp areas with phosphates and nitrogen fertilizers, have shown considerable increases in yields. The inland valley swamps particularly require

fertilization if satisfactory yields are to be obtained from them. Fertilizers should be applied at the correct time and in the correct proportion to derive complete benefits.

c) Rice varieties

Unsatisfactory yields in most swamp areas may be attributed to the use of poor and mixed varieties of seed paddy. The improved high-yielding seed varieties are not available to a large number of farmers mainly of the remoter areas. Moreover, sufficient quantities are not multiplied to satisfy the needs of the farmers. Varieties have to be multiplied to suit the particular locality. The Rekapr Rice Research Station has greatly contributed in hybridising and multiplying a number of varieties to suit different water, soil and climatic conditions. In mangrove land, the latest introduction by the Rice Research Station - Radin China 4-is giving substantial yields. It has given farmers who used it a yield 30 per cent over that of other farmers. The variety is gaining popularity and is greatly in demand in some areas. This variety has been found to be yielding well even in deeply flooding areas of the Sewa river and in inland valley swamps of reasonable fertility. With late sowing associated with a fertile nursery and proper transplanting, remarkable increases in yield have been possible.(4)

S.R. 26 is another newly introduced variety, with considerable resistance to salt-water and with a short duration. This variety has been found to be better yielding than the presently grown Lead and Soro salt-tolerant varieties. The use of S.R. 26 would enable the utilisation of a large extent of saline swamps presently unused.

Indo-Chine Blanc, a floating rice variety, has been found to be particularly suited to all deep-flooding grassland sites and has been found to grow well even in flood waters 15 feet deep. It is believed that in the future, this variety would replace the presently used Indo Chine 53, in swamp grasslands.

Gantang is yet another outstanding long-duration variety whose yield have been quite high. This variety has been highly recommended by the Rekapr Rice Research Station for all mangrove swamps away from tidal salt water influence and also for inland valley swamps. Gantang is expected to replace the presently used Kav 12, India Pa lit 46 and Ngasein 57. However, its long duration is considered a disadvantage by some farmers due to their preference for short-duration varieties which enable an early harvest. This is particularly marked amongst the poorer farmers. Usually the long-duration rices have a larger yield but this fact is not appreciated by many farmers. Among those farming saline mangrove swamps S.R. 26 (145 days duration) is apt

to be more popular, due to its short duration and high yields.

It is proposed to conduct a rapid improved seed-multiplication and distribution scheme, throughout the swamp areas of Sierra Leone in 1966. All high-yielding improved varieties are to be multiplied and extensively distributed to exclude the planting of low-yielding, poor and mixed varieties. This would enable a considerable increase in production.

d) Cultural practices

Not only natural factors and seed variety, but cultural practices adopted in production, have a great impact on the yields of rice. The primitive and inefficient techniques of cultivation adopted by the farmer have already been enumerated in Chapter VIII. In the Scarcies rivers area, yields could be greatly increased by improved nursery culture and transplanting methods. In some swamps digging before transplanting has been found to enable luxuriant growth of the rice plant with a large number of ears. This practice is almost completely absent in the Scarcies rivers area. Mechanical cultivation has enabled the development of large expanses of land for rice planting in the southern riverain grasslands. In these areas, due to the better preparation of the seed-bed by mechanical methods, increased yields have resulted, especially when compared with grassland swamp areas in which mechanical cultivation has

not been used. In most mangrove swamp areas mechanical cultivation is not possible, due to their extremely soft nature. Weeding is negligible and almost absent in the greater part of swamp rice areas. In some fields a few days after transplanting a weeding is given to the field. But this is haphazardly done. In grassland swamps, weeding is essential if improved yields are desired as weeds compete strongly with rice in these areas. As weeds absorb a large part of the soil nutrients beneficial to the rice plant, the growth of the latter as well as its number of ear-heads are reduced. The proper control of rice plant diseases and pests is also necessary to ensure high yields. In a greater part of coastal Sierra Leone, plant diseases and pests have not been a strong limiting factor in respect of yields.

The improvement of harvesting and post harvest cultural practices would also cause the reduction in the loss and damage of grain. The practices that are adopted presently, are inefficient and time-consuming.

c) Other factors

Rice milling, marketing, transport, storage and the improvement of the economic and social conditions of the farmer are among the other varied factors that affect rice production. Their modernisation and improvement would have a very beneficial impact on rice production in Sierra Leone.

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CHAPTER X

PROCESSING OF RICE

Processing of rice involves mainly the removal of the glumes or husks that enclose the rice grain. This process is referred to as hulling. The white appearance of rice is obtained by 'polishing' - removing the outer coats that cover the white grain. The native processing method in Sierra Leone is devised particularly to hull paddy. Polishing of rice is done usually in rice mills.

Native Processing Method

Pounding of paddy in the wooden mortar is the commonest method of processing seen in the swamp growing areas. This is exclusively done by women. In the evening paddy is left to soak in a large pot of water. In the morning the water is removed and a little fresh water is added. Subsequently the pot is kept on fire and the paddy is boiled till the husk gape open. The paddy is then spread out on the ground or on mats around houses, and is sun dried. When dry the husk is readily removed by pounding. Pounding is done in a wooden mortar with a wooden staff (pestle) about five to six feet long. In this way the husk is removed from the grain. The pounded rice is collected in round trays and by winnowing the grain is

separated from the husk. Though pounding results in great quantities of kernels being broken, this method of processing does not rob rice of its nutritive value as happens in milling rice. Pounding does not polish the grain completely and the rice is usually brown in colour with a large part of the nutritive bran remaining. But pounding of paddy consumes a lot of time and energy.

A very large part of rice consumed by a swamp farmer is pounded or native cleaned. Milled rice is usually bought by the farmer when he has exhausted his pounded rice. The inclination of the farmer towards native cleaned rice is not only due to its better taste but also due to the expenses involved in milling rice. Also, many farmers have no alternative as milling facilities are not available in the neighbourhood.

Rice Milling

Rice mills found in the coastal areas of Sierra Leone are of two kinds - Government owned large mills and private or co-operative owned small mills.

Government Owned Large Mills:

The four Government mills are located in the following places :-

One at Mambolo (Kambia District)

One at Terma Bum (Bonthe District)

Two at Kissy (Western Area)

The mill at Mambolo serves mainly the Scarcies rivers area while that at Terma processes rice produced in the southern riverain grasslands. The two mills at Kissy are fed by paddy from both the Scarcies rivers and the Sewa - Waanjo rivers areas. The greater bulk however, is supplied to these mills from the Scarcies area. Both mills at Mambolo and Terma and one of the mills at Kissy have an input capacity of 25 tons of paddy per day. The second mill at Kissy which was installed recently, has an input capacity of 75 tons per day. The mills at Mambolo and Terma are worked by diesel engines whereas those at Kissy use electricity. However, the boilers and rice driers at Kissy use oil as fuel. All the mills process husk rice as well as native cleaned rice. A large part of the rice purchased by the Government is processed in Government mills. Numerous farmers and traders too process their rice in Government mills. Native cleaned rice is milled because milled rice has a better market.

The output of Government rice mills has considerably increased during the past decade. The 1953 output of 1975 tons was increased to 3416 tons in 1956 and this was almost doubled in 1959 due to the setting up of the new mills at Terma and Kissy.

In 1963 as much as 7887 tons were processed. Paddy and native cleaned rice that enter Government mills are mainly from the coastal swamp areas.

TABLE 9

RICE MILLING - 1963 - IN GOVERNMENT RICE MILLS.(1)

(IN TONS)

MONTHS	TOTAL INPUT		MILLED OUTPUT
	HUSK	NATIVE CLEANED	
January	658	-	414
February	255	507	605
March	241	574	643
April	378	631	790
May	457	847	1011
June	204	762	772
July	891	20	600
August	723	-	456
September	946	-	610
October	1257	-	794
November	1074	-	671
December	830	-	521
TOTALS	7894	3341	7887

The Terma mill and the larger mill at Kissy are modern plants. Parboiling of rice is done in all Government Mills. Drying after parboiling has been a problem during the rainy season, but the installation of artificial drying plants has enabled the overcoming of this difficulty.

The delivery of rice to mills is usually done by farmers directly, or by Co-operation Societies, private traders and by persons authorised by the Government to buy rice. A large part of the supplies are collected by means of water transport - river and coastwise. Some of the rice processed at Kissy is transported there by lorries.

The initial preparation of paddy for milling includes parboiling. First, paddy is cleaned of straw in the paddy cleaning unit and subsequently transferred into large concrete tanks containing water. In these paddy is soaked and placed in large steel drums to be parboiled by steam. After boiling paddy is spread on the drying floor in the sun to dry. The artificial drying unit is also used where hot air dries the grain. Subsequently paddy is heaped up and is stored in a silo ready to be milled.

There are several advantages in parboiling paddy. The result of parboiling is to make it easier to remove the husk, and for this reason less broken rice is obtained in milling and also the amount of milling necessary is less than for non-parboiled rice. Parboiling gives to rice a superior keeping quality and more important, it helps the grain to retain most of its nutrients during milling, washing and cooking. As a result, a large saving of rice and of valuable vitamins and minerals

could be obtained from parboiled rice. Also it has been found that parboiled rice has a greater resistance to insect and fungus infestation.(2)

After parboiling rice, to obtain good results from milling, rice should be dried under slight shade rather than in full sunlight. This helps to reduce breakage in the mill.(3) To obtain best milling results under local conditions the moisture content of paddy should be between 11 to 12 percent.(4)

In the mill the husk is separated from the grain. The husk is blown off into the husk room. It is used to feed the furnace of the drying plant. The grain is now polished being transferred again and again in various cones. The bran is thereby removed from the grain.

Another machine separates the finished rice from the broken rice and they are separately stored, ready for disposal.

The degree of milling and polishing determines the amount of nutrients removed. The bran comprising the pericarp contains most of the vitamins and proteins of the grain. Complete polishing that is done in most mills in Sierra Leone, results in the loss of a large quantity of the grain nutrients. The losses on polishing rice have been estimated generally as 29 per cent of the protein, 79 per cent of fat, 84 per cent of lime and 67 per cent of iron.(5)

Where parboiling is not practised the milling quality depends upon the stage of ripeness of the crop at harvest, the method of final drying and the eventual moisture content reached.(6) It has been found that early harvest leads to the restriction of internal cracking of grain.(7)

Small Native-Owned Mills:

Processing of paddy in small mills which are more common in the country, is not as complex as in Government mills. Parboiling and drying of rice are almost completely absent. These mills only perform the function of removing the husk from the grain, and polishing the grain. The rice bran and husk are not separated. Neither the husk nor the bran is used for any useful purpose, whereas in the Government mills at Kissy, the bran is bagged and sold as animal food. The amount of breakage of grain is excessive, mainly due to the milling of non-parboiled rice. This is seen especially during the wet season when the stocked rice is milled to be sold back to the farmer. Mixing of different varieties of rices takes place in the small mills. Milling of mixed varieties results in much breakage of grain. This is well seen from the fact that for every two bushels of paddy milled the general output of milled rice is only one and a quarter bushels. The farmer loses fairly considerably by milling his rice in small mills. The mill owners usually collect these 'brokens' and sell them back to the poor

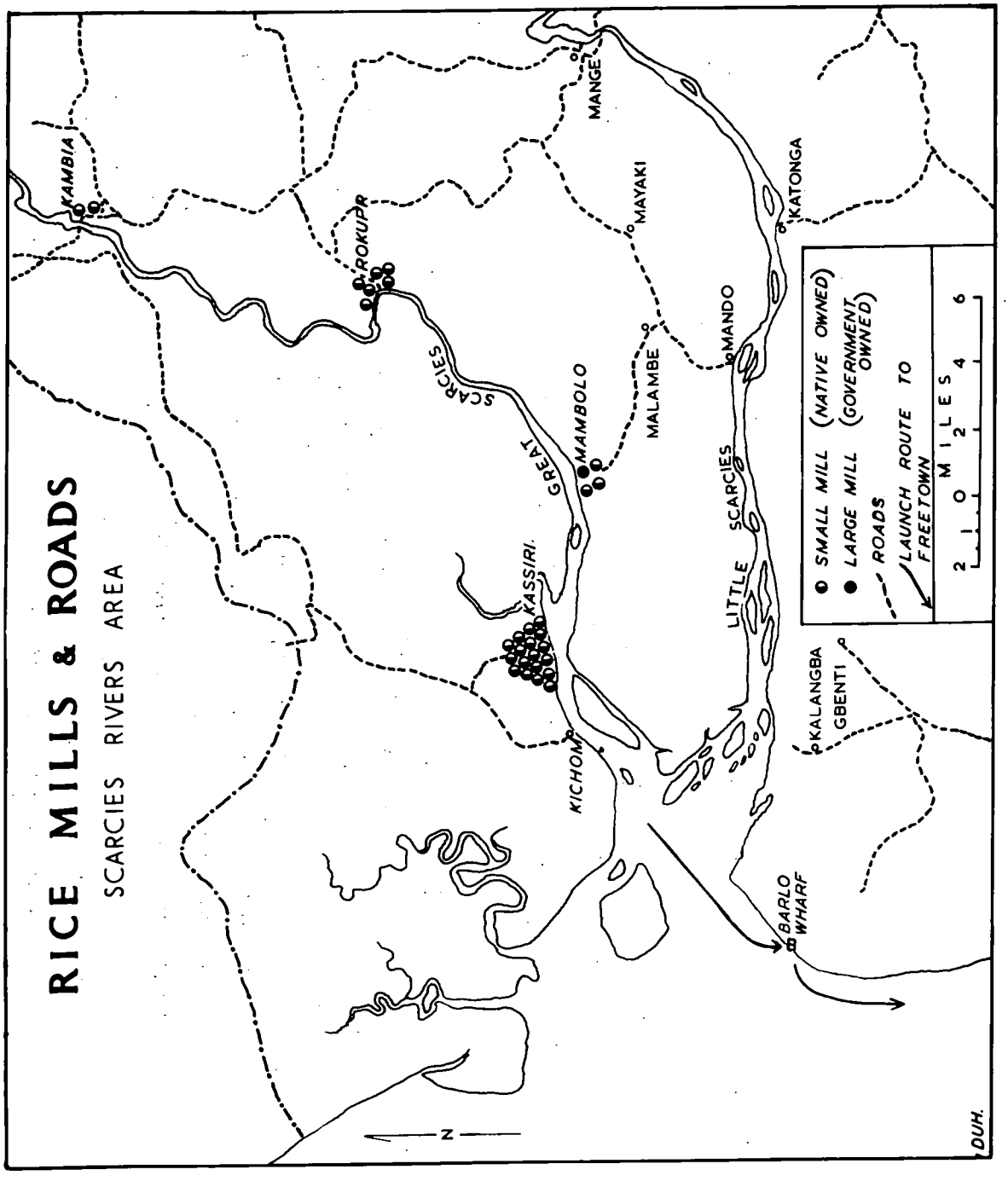

RICE MILLS & ROADS
SCARCIES RIVERS AREA
KAMBIA
ROKUPR
SCARCIES
GREAT
MAMBOLO
KASSIRI.
KICHOM
MANGE
MAYAKI
MALAMBE
MANDO
LITTLE SCARCIES
KATONGA
KALANGBA GBENTI
BARLO WHARF
SMALL MILL (NATIVE OWNED)
LARGE MILL (GOVERNMENT OWNED)
ROADS
LAUNCH ROUTE TO FREETOWN
2 1 0 2 4 6 MILES
N
DUH.

Fig. 31.

farmers at 1/= Leone a bushel during the 'hungry season'. This is also sold as a poultry feed.

The largest concentration of small native owned mills is in the Scarcies rivers area. (Fig. 31) Presently there are twenty nine such mills and a number of others are proposed to be installed in the near future, by private individuals and Co-operative Societies. In the Southern Province in the smaller towns around the main rice growing areas a few small mills are found. In Port Loko two mills are found.

In the Scarcies rivers are, rice mills are concentrated in Kassiri, Rokupr, Mambolo and Kambia. (Fig. 31) Kassiri is the most important of these places with eighteen native-owned small mills. Rokupr has six, Mambolo has three, and two mills are found in Kambia. Except two mills (one in Kambia and one in Rokupr) which use electricity, the other mills are petrol or diesel operated. Usually three to five men work in one mill, the number depending on the supply of rice for milling.

The main milling period is from February to May, during the dry season. The prolonged dry season following the harvest of the crop in December, enables convenient sun-drying of paddy after parboiling. The slackening of milling activity in the rainy season especially from June to September is not only due to the exhaustion of rice stocks among the farmers, but also because they

are unable to satisfactorily dry paddy after parboiling. The latter however, applies in particular to Government rice mills.

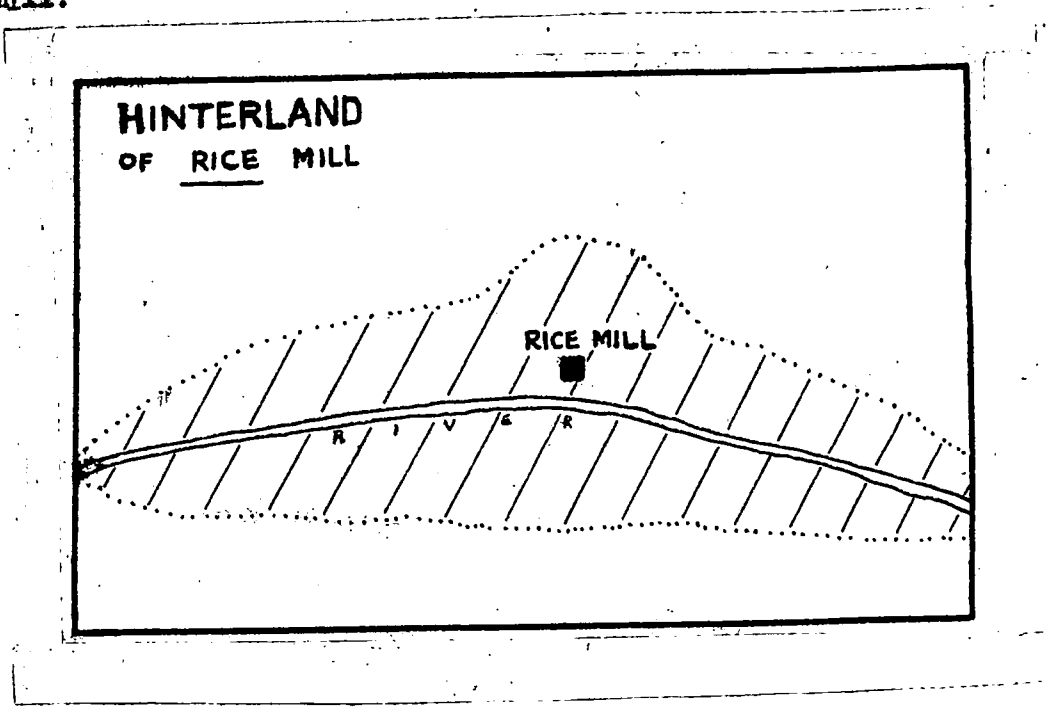
Each mill has an adjacent store to stock paddy and milled rice. Some have a capacity of 200 bushels. Paddy is either heaped up or kept in bags.

The average output of a mill ranges from 50-75 bushels per day particularly during the dry season. However, this varies according to its supplies which depend to a great extent on the location of the mill in the rice producing area. Immediately after harvest, when there is a steady supply of large quantities of rice to the mill, the normal output per day reaches as much as a hundred bushels.

Factors Affecting Location of Mills

Factors of transport, raw material and marketing have offered the strongest influence on the location of rice mills. It is interesting to note that all milling centres of the Searcies rivers area are located on the banks of the two rivers. (Fig. 31) The Sewa has been the localising factor in respect of the Terma mill. These rivers form the main means of conveyance of both paddy and milled rice. As paddy is a bulky and heavy commodity water transport is cheap and convenient though it is relatively slow. The effect of river transport on the location of mills is seen when one examines the sources of paddy to the mills. It is evident that a

large part of the supplies of any single mill comes from the fields adjoining the river with which the mill is associated. Thus, the hinterland of the mill appears elongated extending a considerable distance along the banks of the river, and a few miles around the mill.



The location of the mill in respect of the river has also been determined by the facility which the river provides to transport milled rice to Freetown.

Road transport has considerably influenced the location of the Port Loko and Kissy mills, though the market has been the more dominant localising factor. In Kissy easy coastwise launch transport has enabled convenient collection of supplies of paddy from the North from the Scarcies area and from the south from Bonthe District.

It is seen that the location of milling and rice purchasing centres have a great impact on the development of rice cultivation in the Scarcies areas. The swamp areas remotely located in relation to mills and purchasing centres are either undeveloped or haphazardly developed for rice cultivation. The mill and the purchasing centre is an incentive to the farmer as he can conveniently sell his crop at these places. The lack of roads and transport facilities make conditions worse for the farmer. Thus it is seen that the location of mills and the development of rice lands have reciprocal influences upon each other.

Marketing is the other most important localising factor of rice mills. In fact, the location of the mill at Kissy is governed primarily by the market factor. This has also strongly influenced the location of mills at Kambia and Port Loko as well as in some towns of the Southern Province. Usually milling centres are important nuclei of commerce and trade. Paddy as well as milled rice find a good market in these places. The large market for rice, broken rice and bran in the Western area and especially Freetown has been the primary localising factor, of Kissy mills. Kissy also has the readily available supply of electricity and labour, as well as sufficient space for expansion.

Apart from Kissy, almost all the other important milling centres are within the main rice growing areas. This shows the importance of the source of raw material in the location of mills.

Inadequacy of Milling Facilities and Prospects for Future

The large stocks of paddy that have accumulated in Government stores and mills year after year, and the need to import large quantities of polished rice from abroad show explicitly the great inadequacy of milling facilities within the country.(8)

STOCKS OF HUSK RICE AT THE END OF THE YEAR (TONS)

1954	-	254
1955	-	2880
1956	-	8309
1957	-	13792
1963	-	19727

This is an important factor limiting rice production in Sierra Leone. Milling capacity has failed to keep pace with the large supplies available. Since 1951 it has been the policy of the Government to purchase all swamp paddy or native-cleaned rice offered to it by farmers. However, a large part of this was lying in stores despite an increasing demand for rice in the country. The problem of stocks reached such a climax in the 1950's that ultimately the Government had to curtail its paddy purchases owing to lack of storage capacity. The latter problem is an outcome of the inability of the mills to handle the supplies that accumulate. Milling will have to be accelerated and made to keep pace with increase in rice production

for in the future an increasing demand for rice is inevitable.

The installation of more modern mills, especially in the rice growing areas, would enable not only the steady milling of all the supplies but also lessening the losses and problems incurred in small scale native milling. The output of the existing mills could be increased. Modern mills would further enable the utilisation of rice bran and the development of livestock industry particularly poultry in the farming areas, which would have a very beneficial influence on the economic progress of the farming community. In small mills, rice husk which is generally thrown away could be more usefully diverted to furnaces to facilitate artificial drying of parboiled rice. Moreover, the practices of other countries especially Asia, of using the husk as a raw material for various industries, could be adopted. Light weight concrete briquettes, paper, hardboard and various building materials could be manufactured out of the husk.

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CHAPTER XI

SOME ECONOMIC AND SOCIAL FACTORS

Marketing

Rice, being an essential commodity, has an expanding market in Sierra Leone. Not only the rise of population, but also that of living standards and urbanisation have great impact on the rice market. The large amounts of rice imported every year into Sierra Leone, and the progressively increasing amounts of rice milled and sold, show beyond doubt, the continuously stretching market for rice within the country.

The main areas of consumption of rice exported from the coastal rice regions of the Scarcies rivers and the Bonthe - Pujehun Districts include Freetown and its outskirts and the predominantly non-rice producing districts such as Bo, Kenema, Kono and Kailahun. The mining areas especially draw vast quantities of locally produced swamp rice.

Rice is purchased for marketing in these areas and others in various ways. It is purchased by the Government directly at the Government rice mills and at the various rice purchasing centres. Government also authorises various persons to buy rice from farmers and supply Government mills. Foreigners are forbidden to trade

in rice. There are private individuals usually traders engaged in the purchasing of rice for sale.

Important Government rice purchasing centres include Mambolo, Terma, Kissy, Bonthe, and Pujehun. Magburaka is the main centre in the Bolilands region.

The total amount of paddy and native-cleaned rice purchased by the Government during the year 1963 amounted to 13,377 tons.(1) Of this 11,174 tons were purchased at Government rice mills:

Mambolo	-	3212 tons
Terma	-	4068 "
Kissy	-	3894 "
Total		11,174 "

The total quantity of paddy purchased by Government in other centres amounted to only 1065 tons:

Bonthe	-	507 tons
Pujehun	-	500 "
Magburaka	-	58 "
Total		1065 "

The usual period during which the Government purchases local swamp rice is from February to June.

Government purchases not only husk rice and native-cleaned rice but also foreign rice. Native-cleaned rice comes usually from the Scarcies area, and is purchased mainly at Kissy. Bulk

importation of foreign rice normally takes place towards the latter part of the year starting generally in September. This is particularly due to the scarcity of rice that is felt during this period. In 1963 as much as 17,785 tons were imported.(2)

A large number of private individuals both local and foreign, (in spite of the fact that foreigners are forbiddon to trade in rice) are engaged in the purchase of paddy from farmers. Private purchases are made in places where Government purchasing is done, as well as in smaller towns and settlements. In the Scarcies rivers area, Kassiri, Kichom, Rokupr and Mambolo are the major purchasing centres of private buyers.

Recently, Co-operative societies have taken up purchasing, milling and selling of rice. In the Scarcies rivers area there are 24 Rice Marketing societies, and in the southern grasslands region there are 20. The Port Loko creek rice region and the Bolilands region have 12 societies. (Fig. 32)

Financial entanglements of most farmers do not permit them to sell their rice to the person of their preference. Most farmers are forced to share a substantial part of their harvest with particular traders especially Lebanese as the repayment in kind of financial and other assistance the farmers have received from these traders during the wet season. Most farmers buy their food particularly rice, and other household necessities from such traders

during the wet season or the so called 'hungry season'. These traders collect rice and either send to Freetown and to the eastern districts for sale, or store it to be sold back to farmers during the following wet season.

Government normally buys all rice offered to it by the farmer at a guaranteed price which is usually declared at the beginning of the season. Initially the aim of this scheme was to promote more orderly marketing and to ensure to the farmer a constant source of income. It was thought that this scheme would protect the farmer from any possible fluctuations in the price of rice. In 1964/65 rice buying arrangements were as follows:(3)

Dried raw husk rice - Le.4.48 cts. per bag of 168 lbs. net. (£2-4s-9d)

Dried native-cleaned rice - Le.7.10 per bag of 168 lbs. net. (£3-11s)

These prices suggest that native cleaning of rice is encouraged by the Government. This is perhaps so because of the progressively expanding quantities of husk rice stocks that are accumulating in Government stores, and the inability of mills to handle all the stocks. The problem of storage of the purchased husk rice has also become acute. Though native-cleaning of rice is encouraged, it is paradoxical that the consumer preference is usually for milled rice.

The selling prices of rice which have been in force for the past decade in Freetown are as follows:(4)

Milled parboiled rice - Le.8.90 cts. per bag of 168 lbs. (£4-9s)

Milled raw rice - Le.9.35 cts. per bag of 168 lbs. (£4-13s-6d)

Dried native-cleaned rice - Le.8.00 cts. per bag of 168 lbs. (£4)

The higher prices of milled rice appear to have an inhibitive influence on its market and therefore on rice milling. In the provinces, the selling prices of rice are higher owing to transport costs.

TABLE 10

PRICES OF LOCALLY PARBOILED AND MILLED RICE INCLUSIVE OF TRANSPORT COSTS

1964/65

(per bag of 168 lbs.)

Town	Le.	cts.	Town	Le.	cts
Freetown	8	90	Kenema	9	33
Torma	8	90	Segbwema	9	48
Mambolo	8	90	Daru	9	50
Kambia	9	10	Pujehun	9	50
Magburaka	9	25	Pendembu	9	53
Bo	9	25	Baiima	9	53
Makeni	9	28	Gandorhun	9	80
Bonthe	9	30	Kailahun	9	83

(Le.2 = £1)
(10 cts.= 1/-)

Source - Government Rice Department, Sierra Leone.

One is inclined to think that the control of price that is being effected is by no means an encouragement of the market, whichhas a direct bearing on the production of rice. Any improvement in market conditions as well as production of rice in Sierra Leone necessarily require the setting up of a number of rice mills and increasing the capacity of the existing ones. Consumer preference should receive proper heed to improve market conditions.

Transport

Rice that is purchased by the Government and milled at Government mills is sold to authorised persons who transport it to the provinces for sale. Hence it is seen that in respect of buying rice as well as selling rice, Government is dependent on middlemen. This is particularly due to the lack of adequate and satisfactory Government transport facilities. A part of the rice is transported in Government lorries from rice mills to the selling centres. But the bulk of the milled rice is handled by contractors and private traders who use their own lorries for transport.

The lack of a satisfactory network of roads particularly in the interior districts, makes it difficult for the Government to undertake any efficient system of rice marketing throughout the country. Thus, it has been found necessary to make use of the middlemen to distribute rice to the remote inaccessible areas.

In some of those areas, especially in the eastern districts, rice is thus sold at prices which are considerably higher than necessary. It could be said that no single factor will contribute to better marketing conditions and thereby to increased production than the extension of the road system.

The system of transport found in the swamp rice growing areas is both inefficient and time-consuming. The road network is very sparse, (Fig. 31) and the layout for the greater part is unsatisfactory.

In the Scarcies as well as in the Sewa-Waanje rivers areas, the rivers have been the main highways for transporation of goods and people since early times. Canoe and boat transport is common, and is used mostly to transport paddy to rice mills and to purchasing centres. The tremendous influence of river transport on the location of rice purchasing centres is clearly seen from the fact that almost all these are in river-side location, e.g. Kassiri, Kichom, Mambolo, Rokupr. (Fig. 31)

The greater part of paddy comes to Freetown by launch transport. It takes more than half a day (12 hours) for a launch from Mambolo to reach Freetown. The delay is mainly due to the dependence of launch transport on tides. Launches delay at Barlo (Fig. 31) for the high tide, as the latter helps navigation, facilitating easy mobility of the launch. Low tide transport is said

to be expensive as it involves greater consumption of fuel, usually due to the fact that launches have to move against the tide. Though launch transport is both slow and inadequate, it would continue to be an important means of conveyance not only because of its favourability for bulk transportation of rice, but also due to the poor state of the road transport system of the rice growing areas.

The lack of a good transport system has had an inhibitive influence not only on marketing and milling of rice, but also on the development of the vast potential rice lands that are available. This is particularly seen when one studies the transport and rice distribution maps. Most of the undeveloped swamp lands lie away from roads and rivers. Important rice centres such as Mambolo, Kichom, Kassiri and Rokupr have developed to a large extent due to their accessibility by road and river.(Fig. 31) The development of roads is particularly felt in the swamp grassland region of the Southern Province and in the West Sama chiefdom area, where thousands of acres of potential rice lands are available for development but lie unutilised owing mostly to inaccessibility. The development of road transport facilities would enable the farmer to draw more know-how and material to increase the productivity of his field and improve his conditions. Higher yields would bring down cost of production and encourage increased production.

Improvement in roads and communication would lead to the expansion of existing rice markets and the emergence of new ones.

It would strengthen the bargaining position of the producer farmer in relation to the local trader and middleman, and would make it possible for the farmer to be more aware of market conditions.

Rice Storage

The farmer stores his rice for domestic needs usually in the roofs of kitchens. The heat and smoke from the kitchen fire below, helps to keep the paddy free from damage by insects and rats. Paddy is normally kept with straw. Occasionally bundles of paddy are taken when required and threshed for consumption.

In some areas in the Southern Province, special huts are made to store paddy. Also, rice is stored under water in special baskets. Seed rice, however, is usually stored in the dwelling houses. Farm house barn, cribs such as baskets and mats, pots, wooden boxes are among the other ways adopted by the farmer to store paddy. The richer farmers have a store room in their houses to keep paddy. However, on the whole, storage conditions and methods are backward amongst the majority of farmers, causing considerable loss of paddy by rat and insect damage. The farmer generally disposes of a greater part of his harvest at the earliest opportunity and thus the stocks held by him for domestic needs are usually small. This is perhaps a primary reason for the absence of satisfactory storage conditions among farmers.

All rice mills both Government and private owned, have stores attached to them to stock paddy as well as milled rice. Those associated with small native owned mills are defective, and considerable losses of grain have occurred owing to rats. In Government mills, storage facilities though relatively satisfactory, are generally inadequate to cope with the large quantities of rice handled. This has led to the restriction of purchase of husk rice.

Much of the damage caused to grain in store is not apparent until husking or hulling, when it may be found that there are large numbers of empty glumes. Practically all the destructive agents of stored paddy arise from excess of moisture. Paddy should be stored in a reasonably dry condition. In rat-proofed and well ventilated conditions it has been found that paddy could be stored for almost two years.

The need to expand the capacity of the existing stores especially those associated with Government rice mills, and the setting up of larger stores particularly in the paddy purchasing centres, is an urgent requirement.

For the average farmer, the ideal storage conditions are perhaps wooden chests or old oil-drums where rice could be stored under safe dry conditions.

Parboiled rice when correctly dried stores much better than raw rice, and insect infestation is very much reduced.

The hermetic storage technique is acclaimed by many agriculturists as the most useful development in the techniques of storage. This method could be adopted by the Government as it would help in saving of rice from damage in store, and also improve the quality of rice. These stores could also be set up by farmers through their Co-operative societies. Good storage would enable a constant supply to the mills and would ensure to the consumer a continuous supply of grain throughout the greater part of the year. It would indirectly have a beneficial influence on rice production.

Finance, Credit and Subsidies

The economic insecurity of a large majority of farmers is a primary factor preventing the improvement of farming conditions. Financial instability has continued to keep living conditions of the farmers at a low level. This state of affairs cannot be attributed only to the relatively low income the farmer draws from his crop. It is perhaps more accountable to the general thriftlessness, improvidence and individualism of the average farmer.

Most farmers especially in the Scarcies rivers area, are in debt at the time of harvest, and thus a good part of their crop

goes as payment of debts. During the dry season after harvest, when rice is available, the farmer usually eats three meals of rice a day and thereby exhausts a large part of the stocks that he keeps for home consumption. Thus, invariably he has no rice during the wet season and is compelled to buy food on credit or to seek loans to be paid from the forthcoming harvest.

The inadequacy of proper credit facilities for the farmer and in many remote places, the complete absence of any credit facilities make the farmer depend entirely on the Lebanese or Syrian trader who makes use of the situation to his own advantage. The Lebanese or Syrian shop has thus become ubiquitious in towns and bigger settlements in the rice areas.

Co-operative Thrift and Credit societies have in some areas assisted the farmer by providing credit. But most farmers complain about the inadequacy of the credit that can be drawn from such societies.

The poverty and wretchedness of the farmers are well seen when one examines their dwellings, which are for the most part empty without any worthwhile material belongings in them. In most houses, a few pots, pans and plates, mats, a small kerosene oil lamp, and a few primitive farm implements constitute all the household goods. In others a few clothes hung on a string, and a bed or two made out of straw and sticks and a hammock or two are seen.

To most farmers the only wealth that they possess is their land. Thus when badly in need of credit, they pledge their land. This is a common occurrence in most swamp rice growing areas, leading to further deterioration of economic and social conditions of the farmers.

Thrift and a desire to improve conditions are greatly needed. Most farmers appear contented with their method of living. Little effort is taken to seek additional sources of income to improve their conditions. There is a considerably long slack period which could be used for other productive activities. However, most of this is spent leisurely either in their dwellings or in the towns in the neighbourhood.

The dependence on a solitary crop of rice has resulted to a great extent in the low economic status of the farmer. Concern with the normal pre harvest shortage of rice prompts farmers to plant crops with a short growing season but poor yields. Thus, the result is that full benefit is not derived even from the only productive activity in which they are involved.

It is interesting to note that most of the farmers who claim to be relatively stable financially, are those holding the fertile and more productive rice lands closer to the rivers. Here again it is more the natural factors than man's own initiative and effort that have helped the farmer to better his conditions.

It is a fact that the salvation of a great majority of paddy cultivators depends on themselves, on their own initiative and effort. They should seek sources of income and try to free themselves from financial embarrassment.

The spread of education, the eradication of illiteracy and the adoption of Co-operative society system would help the farmers to a large extent. But the Co-operative system will have limited success if the cultivator does not learn thrift and desire improvement of his conditions by collective effort.

Government has attempted to assist the farmer by means of subsidy schemes for improved seed paddy, fertilizers and mechanical cultivation. These schemes attempt to bring to the farmer improved methods which could be made use of by him according to his means. However, poverty and inaccessibility prevent many farmers from benefiting. This is particularly seen in the West Sama chiefdom, the Ribi-Bumpe rivers area and in some regions in the Southern Province.

Upland cultivation especially of oil palm and other useful tree crops, livestock farming particularly dairy cattle and poultry, mixed cropping of the swamp field, and the development of cottage industries would help to a great extent to better the economic conditions of the farmer. Livestock farming is particularly possible and easy, making use of the great quantities of

straw that are almost completely wasted. Rice bran is used in many Asian countries to make cattle feed such as poonac. Livestock would provide not only an additional source of income by way of meat, milk, eggs etc., but also would help the farmer as draught animals and in addition would provide manure for his fields. Under-nourishment and malnutrition which are prevalent abundantly among the farming communities could be greatly reduced by the consumption of the nutritive food which cattle and poultry would provide.

Rice straw could be made use of to make hats, mats, baskets, hardboard, paper and other building materials as done in some Asian countries. Ceylon's paper industry is almost entirely based on rice straw. Co-operative societies can help considerably in the development of these secondary activities. The Chinese experts have demonstrated on the swamp fields at Mango (Little Scarcies) that a variety of upland crops and vegetables can be cultivated in the swamp during the dry season and early wet season. Household compounds could be better utilised for the cultivation of vegetables and yams.

With the extension of roads and marketing facilities, and particularly with the development of urban centres, the demand for better foodstuffs, for luxury food such as vegetables, fruits, eggs, meat, milk etc., is apt to rise. Hence, the development of

livestock farming coupled with mixed cropping incorporating vegetables and fruits, would serve as a good source of income to the farmer in the future.

Education

The need to raise the standard of literacy of the farmer is vital if any attempt is to be made at increasing production and improving farming conditions. Proper general educational facilities to the farming communities should aim at making the farmer realise and appreciate the benefits of better farming by way of modern improved techniques and methods of rice production. It would greatly facilitate the farmer to shed off inhibitive traditions and primitive farming practices which are retarding development of farming today. "Traditions which are strongest in their influence are traditions which tend to impede rather than promote new development."(5)

A problem that is increasingly cropping up, and apt to cause serious concern in the near future, is that of traditional land inheritance in swamp areas. Fragmentation of land that is taking place as a consequence of the division of the farmland among the various members of the family, is something that has to be curtailed immediately. These customs and traditions are difficult to suppress unless the farmer is made to realise through

education, and is convinced of the fact that they lead to the lowering of productivity.

The realisation of the tremendous economic benefits that can be derived from the Co-operative system, is possible only if the number farmers of the societies are at least generally literate. Moreover, the social conditions of the farmer, which have a great effect on farm production directly and indirectly could be improved substantially. The general apathy, indifference, improvidence and reluctance of the farmer to depart from the customary mode of life can be eliminated by bringing about a complete change of attitude towards his system of life and activities, by proper education. If this change of attitude is delayed, any improvements resulting from new methods of cultivation, better post-harvest cultural practices and efficient marketing and milling arrangements will only add to the prosperity of the middlemen and trader.

With the spread of education the farmer's prestige should be elevated by laying proper emphasis on agricultural education. Agricultural education and particularly demonstration are necessary to teach farmers modern methods and to make them incorporate scientific techniques in their farming programme. The Rice Research Station at Rokupr in the midst of the largest swamp rice region of the country, has attempted to disseminate

among the farmers the methods that have been evolved in the station. The station consists of a 66 acre swamp rice farm, contiguous with the Great Scarcies river, and also small areas in other parts of the country. In these farms the attention of the station is concentrated on investigation of the rice plant in relation to its habitat, and on the production of rice varieties to suit natural conditions. Research work on soils and insect pests is also being conducted. It is indisputable that the work in the station is providing an excellent scientific base upon which rice production can be expanded effectively. However, it is clear to anyone who travels about in the swamp rice areas, that the results of research and demonstrational studies of the station are not well disseminated. Improved rice varieties bred in the station and collected from many parts of the world are being multiplied at the station. These varieties are seen making their way only to the accessible and better rice growing areas. It is perhaps due to the limited sphere of influence of the station that has made some farmers in the Scarcies rivers area feel that the station serves hardly any purpose to the ordinary farmer.

The elevation of the Njala Agricultural Training College to that of an integrated Agricultural and Educational University College, is expected to spear-head the agricultural and educational revolution.

Health, Sanitation and Living Conditions

Health and sanitary conditions of the farming community are at a low ebb, and is impeding the development of farming. The main swamp rice regions have continued to be malarial. Poor housing and unsatisfactory living conditions of the great majority of the farmers have to a large extent brought about sickness, disease and malnutrition. Active steps have to be taken by the Government to improve health and sanitary conditions of the farmers.

A scheme of housing loans could be inaugurated to help the farmers to construct proper dwelling places in keeping with health and sanitary requirements. The gloomy, ill ventilated and unhygienic dwellings of the farmers appear to provide more shelter to diseases and germs. The installation of a proper water supply is another necessity to improve sanitary conditions in the farming village. At present the farmer is dependent mostly on river water for all purposes.

Rural electrification has had considerable influence on the improvement of living conditions of the farming community in many Asian countries. India and Ceylon may be cited as typical examples. This also facilitates the development of cottage industries, small scale and medium scale industries. The type of colonisation schemes as found in Ceylon, in the rice growing areas, where the Government provides irrigation, domestic water, electricity, housing, and other social services including agricultural services and

subsidies, would perhaps enable the conversion of large areas of swamp land into prosperous farm land. Better conditions of living that these schemes provide would be an incentive to the people to engage in farming. It would help considerably, as has been demonstrated in Ceylon, to elevate the economic and social status of the farmer.

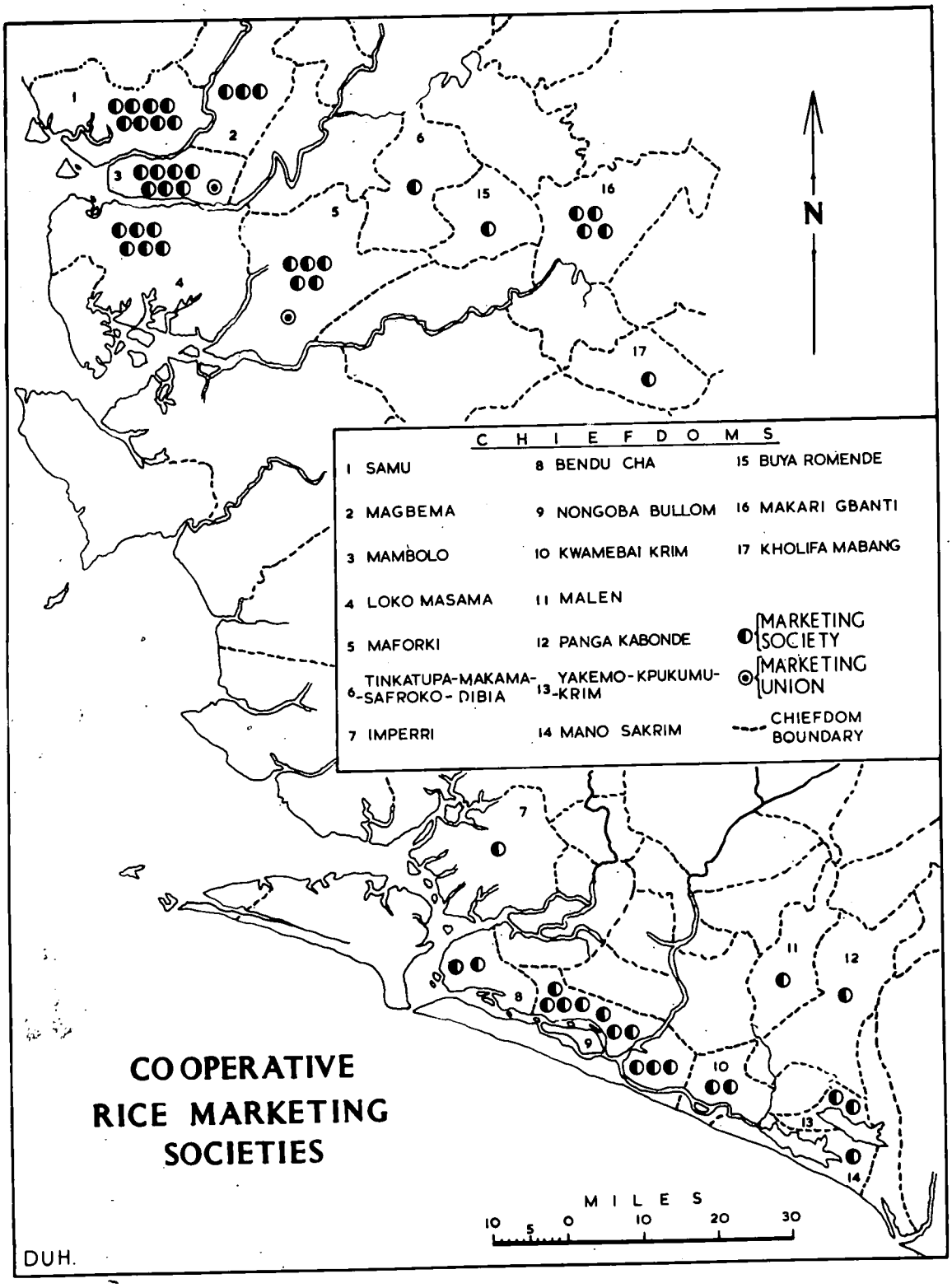
Any attempt at improving the conditions of the farmer and increasing production invariably require the active support and initiative of the Government and people at large. "A full responsibility rests, indeed, upon the Government to provide the essential structure of the territorial economy, comprising an efficient communication system, adequate research institutions, lively field staffs showing the way to improved methods of production, sound and equitable marketing arrangements, and an administration which is in all respects well-equipped and progressive. Given all this, however, the interstices of the structure have still to be filled in, and this can only be done by the people of Sierra Leone themselves acting through vigorous local institutions. If the fruits of development are to be attained there must be self-exertion and willingness to adopt new techniques and methods ....."(6)

The Co-operative System

The solution to most of the socio-economic problems facing the swamp rice farmer lies in the Co-operative society system.

A well organised Co-operative system could satisfactory tackle the difficulties encountered by the farmer as a result of the lack of proper marketing, milling, transport, storage, finance, agricultural services, improved seed paddy, fertilizers etc. The inadequacy or the absence of some of these facilities and services has enabled the middleman to show himself well and in fact in many rice growing areas, he has been found to be almost indispensable by the poor farmer. Thus, a considerable portion of the income of the producer farmer is drawn by the middleman. The Co-operative society system, especially Thrift and Credit societies, is perhaps best suited to exclude this middleman exploitation. At present, the middleman is in a good bargaining position as Co-operative societies have not developed sufficiently to oust him.

Co-operative system would not only help the farmer to solve his problems, but also it would assist in fostering the activities of the farmer. By taking up such schemes as mechanical cultivation, fertilizer and improved seed-paddy distribution and other modern and more productive methods of cultivation, Co-operative societies are capable of helping the farmer to bring more land under cultivation and increasing the productivity of the existing lands. The tremendous benefits that could be derived by joint action via Co-operative societies in respect of


CHIEFDOMS
1 SAMU
2 MAGBEMA
3 MAMBOLO
4 LOKO MASAMA
5 MAFORKI
6 TINKATUPA-MAKAMA-SAFROKO-DIBIA
7 IMPERRI
8 BENDU CHA
9 NONGOBA BULLOM
10 KWAMEBAI KRIM
11 MALEN
12 PANGA KABONDE
13 YAKEMO-KPUKUMU-KRIM
14 MANO SAKRIM
15 BUYA ROMENDE
16 MAKARI GBANTI
17 KHOLIFA MABANG
MARKETING SOCIETY
MARKETING UNION
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N
MILES
10 5 0 10 20 30
CO OPERATIVE RICE MARKETING SOCIETIES
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Fig. 32.

developing secondary activities such as cottage industries, livestock farming and mixed cropping have already been hinted at. Housing and living conditions could be improved by means of the Co-operative method, by taking up the construction of housing schemes, water supply schemes, and other services.

The Co-operative society scheme is a relatively recent introduction to Sierra Leone. However, it should be said that it has had an appreciable sphere of influence in the swamp rice regions of the country, particularly during the past few years. Marketing, Thrift and Credit and Mechanical cultivation societies are the main avenues through which the Co-operative movement is helping the farmer. Apart from these societies, there are Co-operative rice mills and a scheme of cash advances to selected societies by the Co-operative Department - R.C.S. loan fund. These loans are offered for specific purposes and projects.

There are 56 Rice Marketing Societies in the country, all dealing with swamp rice marketing. The main swamp rice areas of the coastal tract have 51 of these societies. (Fig. 32)

Kambia district		18
Bonthe	"	15
Port Loko	"	13
Pujehun	"	5
Bombali	"	4
Tonkolili	"	1

These societies collect paddy from all their members at harvest time, mill it mostly in Government rice mills, and sell it to the Government, in Freetown. Since 1955, Rice Marketing societies have so developed that in 1963 they were able to supply 43% of the local purchases of the Government Rice Department, and in 1964 it is known to have increased further. This is an encouraging sign.

Transportation of husk rice direct to Freetown is effected by some societies. Conveyance is normally done in private launches or in lorries.

Thrift and Credit societies are more numerous. There are 162 societies in the coastal swamp rice districts, mainly serving the swamp rice farmer. In the interior swamp rice districts of Bombali and Tonkolili there are 45 societies. Credit is usually given during the wet season when the farmer is in need of money. The amount of credit depends on the financial resources of the society. In the Scarcies rivers area, most farmers complain that the credit that may be drawn from Co-operative societies is inadequate and that they are still compelled to seek the help of private traders. However, what is abundantly seen is that most farmers do not make proper use of the credit they obtain. Very few are seen investing the credit obtained, on some wealth producing activity.

There are two Mechanical Rice Cultivation societies in Gbundapi and Torma Bum in the Southern Province. These societies own two catepillar D 4 tractors each, with ploughs and hurrows. This year (1965) six international BTD 6 tractors have been purchased by these societies to extend the scheme next year. The Co-operative Department provides workshop tools, fitters and mechanical superintendents. The societies buy fuel and spares and pay drivers from the Le.7 (£3.10/-) per acre collected as ploughing and harrowing fees. This money is also used to buy equipment. These societies plough for anybody on certain sites for Le.6 (£3) per acre paid in advance and Le.1 per acre (10/-) for seed harrowing. This is usually done in the Southern and North-central Districts.

Co-operative rice mills are small motor driven mills and are located in Bauma (Mandu), Kenema, Segbwema, Pendembu, Gbundapi, Gbap and Gbeyama (Windu), all in the Southern Province. Fourteen others are in the process of being installed in Port Loko, Kambia and in the North-central Bolilands Districts. The need to expand this scheme of Co-operative rice mills is greatly felt due to the general lack of adequate milling facilities in the country.

Since 1951, the Co-operative Department has been operating a loans scheme to societies, utilising commercial bank overdrafts

guaranteed by the Government. In 1963 this overdraft was Le 640,000 (£320,000) and now it has been increased to Le 1,000,000 (£500,000). This is used to issue loans to societies for the building of stores, purchasing machines for mechanical cultivation, purchasing launches and also for normal short term agricultural credit.

The Co-operative Department does not provide any transport facilities. The Southern Province Co-operative Union has a large launch. Some societies own launches and a few others are building them and installing engines. These engines have been purchased through the R.C.S. loan fund scheme. However, no society in the Northern Province own launches. This is a great disadvantage for transport costs could be substantially reduced if Co-operative societies operate launches.

Among the difficulties that have been encountered in respect of the working and spread of the Co-operative society system are primarily the illiteracy of the people and their inability to appreciate the Co-operative principle. Also, the lack of good trained men to do all the work that is needed for the successful operation of the Co-operative system is another difficulty. Conservatism and the independent outlook of most farmers, and also the lack of responsibility and interest in the activities of the society, hinder the proper functioning and sound establishment of

the Co-operative movement. The paucity of trained personnel to carry out the secretarial and accounting work of societies, and the shortage of facilities for training such people, have limited to a large degree the extension of the Co-operative society system. Defects in the composition and set up of the societies add to the difficulty.

The Co-operative movement has definitely not taken a sound foundation as yet, but in spite of the various problems and limitations under which the movement functions, farmers in the main swamp rice growing areas on the Bonthe-Pujehun Districts and the Scarcies rivers area, have acquired a notable measure of benefit from the Co-operative society system.

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WHITE, H.P. "Mechanical Cultivation of Peasant Holdings in West Africa", Geography, Vol.43, Nov. 1958, pp. 269-270

C. MAPS & ATLASES

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CLARKE, J.I. Sierra Leone in Maps (To be published in 1966 by the University of London)

Topographic Maps

1: 62,500 Sierra Leone (Gold Coast Survey Head Quarters, Accra)

1: 63,360 Vicinity of Freetown (Geographical Section, General Staff, War Office)

1:250,000 Sierra Leone - West Africa. (Gold Coast Survey Head Quarters, Accra)

1:500,000 Sierra Leone - (layer coloured) (Geographical Section, General Staff, War Office)

Other Maps

1: 2500 Freetown and District (Surveys and Lands Development, Freetown)

1: 10,000 Freetown Peninsula (D.O.S.)

1: 16,00 (Approx:)	Sketch Map, Rhombe (D.O.S.)
1: 16,000 (Approx:)	Land Use, Rhombe (D.O.S.)
1: 40,000 (Approx:)	Sketch Map, Little Scarcies (D.O.S.)
1: 40,000 (Approx:)	Land Use, Little Scarcies (D.O.S.)
1: 40,000 (Approx:)	Sketch Map, Ribi-Bumpe (D.O.S.)
1: 40,000 (Approx:)	Land Use, Ribi-Bumpe (D.O.S.)
1: 50,000	Sierra Leone (D.O.S.)
1: 500,000	Chiefdom boundaries; Agricultural Production and Trade. (Surveys and Lands Dept. Freetown)
1: 1,000,000	Administrative; Vegetation; Tribal; Geological; Soil; Population; Agricultural Products; Soil Conservation..... Forest Reserves; Land classification; Population and Fallows; Degraded Areas; Zones of Production; (Surveys and Lands Dept: Freetown) Mineral Deposits (D.O.S.) Navigable Waterways (Survey Dept., Accra)

(D.O.S. - Directorate of Overseas Surveys)

D. AIR PHOTOGRAPHS

Covering the whole of Sierra Leone - Fairey Air Surveys Limited, 1958, 1962.