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THE SIGNIFICANCE AND POTENTIAL OF THE SOLAR SALT INDUSTRY IN AFRICA

by

United Nations Economic Commission for Africa

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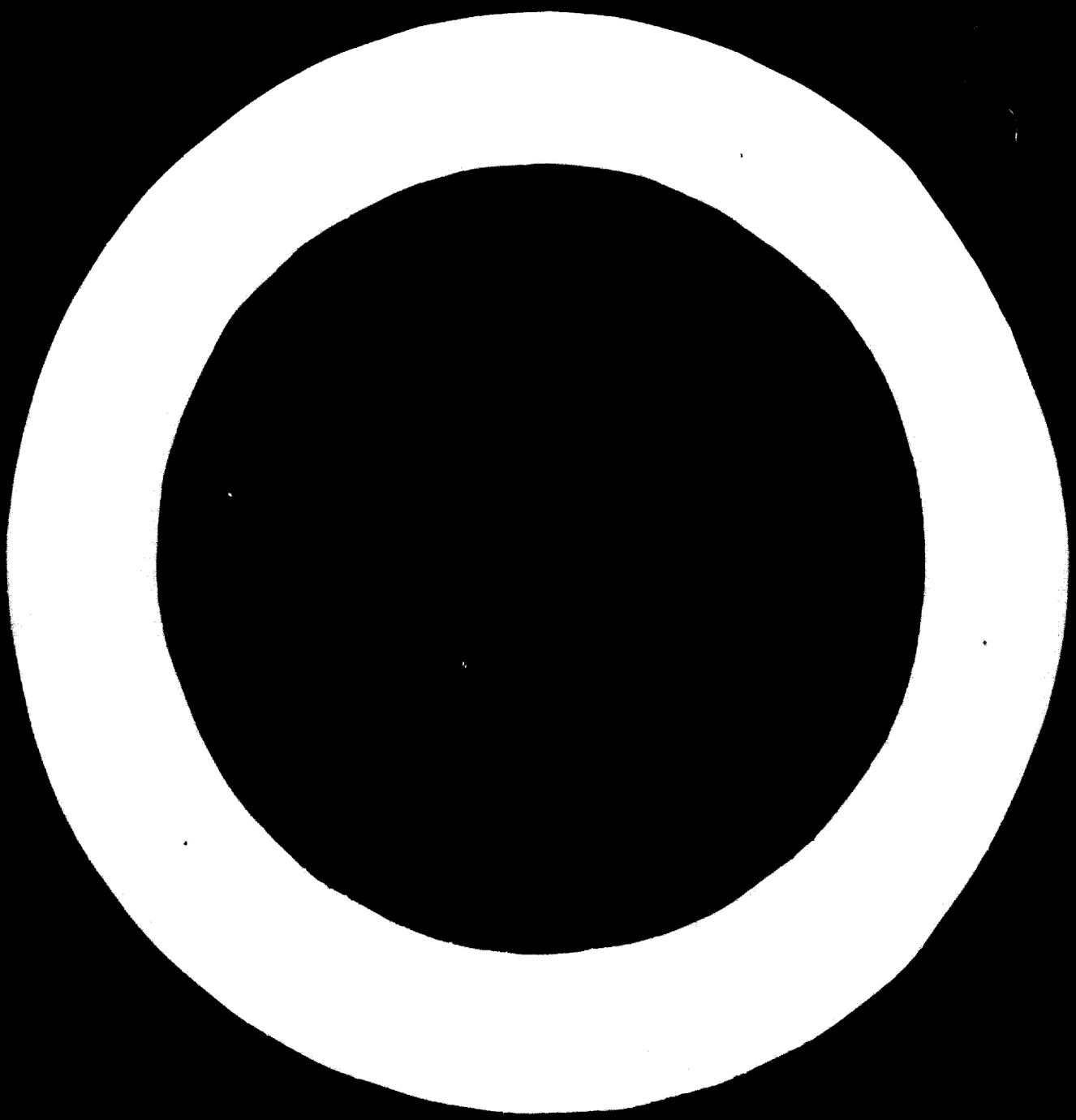

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Introduction

1. This paper was prepared on short notice. As papers on individual countries were not available for co-ordination, as was originally planned, and in view of the importance and potential of the salt industry for Africa, it was considered that the preparation of a short general paper was necessary.

2. Although this introductory paper attempts to present, in a general way, the past situation and the future possibilities of solar salt production in the four sub-regions[1/] of the African region, it is not intended to replace the one as originally conceived. If it proves useful as background document, it will have served the purpose for which it was intended.

Consumption

3. Table 1 presents consumption of salt by sub-regions including the present solar salt producing countries and those expected to become producers in the near future. In general, the sub-regional totals show an upward trend. Some of the discrepancies could be explained by the fact that figures referring to some countries, the United Arab Republic in particular, are approximate in that they were estimated from production plus import minus export figures. In other words, they do not take into account the corresponding stocks. Consequently, large variations in apparent consumption figures, such as those for 1964, are possible. Rates of increase calculated on the basis of 1960-1965 and 1960-1964 result in 3.6 per cent and 10.4 per cent, respectively, implying that the actual rate of increase should be within the limits of this range.

4. In most African countries, salt consumption, where industrial use is insignificant, is mainly used for dietary purposes. This contrasts to situations in developed countries where table salt accounts for only about 10 per cent

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1/ North Africa: Algeria, Libya, Morocco, Sudan, Tunisia and the United Arab Republic
West Africa: Dahomey, Gambia, Ghana, Guinea, the Ivory Coast, Liberia, Mali, Mauritania, the Niger, Nigeria, Senegal, Sierra Leone, Togo and Upper Volta
Central Africa: Cameroon, the Central African Republic, Chad, the Republic of the Congo, the Democratic Republic of the Congo, and Gabon
East Africa: Burundi, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Rwanda, Somalia, Tanzania, Uganda, Zambia and Rhodesia.

Table 1

Consumption of salt in the four sub-regions of Africa

	1000 tons					
	1960	1961	1962	1963	1964	1965
NORTH AFRICA	303	365	352	455	620	488
Algeria	95	96	95	105	111	75
Libya	11	12	15	19	13	-
Morocco	30	21	28	37	61	34
Sudan	42	52	57	36	59	60
Tunisia	17	25	29	29	33	32
United Arab Republic	108	159	128	229	343	287
WEST AFRICA	211	247	241	262	304	324
Ghana	21	26	19	23	33	35
Guinea	15	15	16	16	15	16
Nigeria	107	113	115	126	134	145
Senegal	30	33	36	17	34	35
Togo	5	8	9	11	11	11
CENTRAL AFRICA	76	60	90	30	90	59
EAST AFRICA	223	213	229	230	261	262
Ethiopia	68	71	76	72	76	81
Kenya	44	41	46	44	40	37
Madagascar	12	12	15	19	30	
Mauritius	4	4	4	4	4	4
Tanzania	35	22	26	25	26	26
SUB-REGIONS (Total)	813	885	912	1027	1339	1133

Sources: 1) Studie über die Entwicklung der chemischen Industrie für ausgewählte Produktgruppen in Nordafrika, ECA, 1968.

2) Statistical Yearbook, UN, 1967.

3) Research into the Chemical Industry and Fertilisers in West Africa (E/CN.14/INR/109), ECA, 1966.

4) National statistical and other publications.

of total consumption. The average per capita consumption of the four sub-regions in Africa (3.5 kg in 1960 and 4.0 kg in 1965, as shown in table 2) is low even by the world standard, which is about 26 kg. Noteworthy are the disparities between the sub-regions and between individual countries. In 1960, per capita consumption ranged between 2.5 kg in West Africa and 4.6 kg in North Africa. In 1965, the latter with its 6.9 kg kept its leading position, while Central Africa at 2.2 kg fell to the rear. About 50 per cent of North African consumption is industrial. The balance, equivalent to 3.5 kg, is equal to the total per capita consumption in East Africa. The picture as regards individual countries is even worse, with 1965 extreme figures of 0.6 kg in Dahomey and 10.0 kg in the United Arab Republic.

Table 2

Apparent per capita consumption of salt by sub-regions
(kilograms)

	1960	1965	1970	1975	1980
North Africa	4.6	6.9	7.8	8.5	9.5
West Africa	2.5	3.3	4.0	5.2	6.2
Central Africa	3.1	2.2	2.7	3.3	4.0
East Africa	3.2	3.5	4.3	5.3	6.3
Sub-regions (average)	3.5	4.0	5.0	6.0	6.9

5. The drastic fall of per capita consumption in Central Africa and the comparatively low rise in the other sub-regions, particularly East Africa, reflect the post-independence situation and the crisis in the Democratic Republic of the Congo.

6. The 1960 and 1965 average total sub-regional per capita consumptions are all below the 4.5 to 6.8 kg level estimated as the requirement for dietary purposes. Because of the use of salt in fishery and industry in certain countries, the actual per capita consumptions for dietary purposes should be lower than shown in table 2. This gives a good general indication regarding the potential demand for table salt. On the basis of 5 kg per capita 1960 and 1965 potential demand for dietary purposes should, for example, have amounted to 1.2 and 1.4 million tons instead of the 813,000 and 1,133,000 tons shown in table 1.

7. The future demands for salt presented in table 3 were estimated by country and then grouped by sub-regions, under which are listed present potential producers. These figures are based either on available estimates (Algeria, Libya, Morocco and the Sudan) or estimated on the basis of past trends, population growth, need for approaching the 4.5 to 6.8 kg per capita level for dietary purposes and the requirements of certain chemical industries. The last factor has not been considered in the Central African case, as there was no available information upon which estimates could be based at the time of writing.

8. According to these estimates the 1965 consumption is expected to increase by a factor of 2.6 to 2.8 million tons by 1980. This is equivalent to a yearly average increase of 6.5 per cent. While first sight of this might appear to be on the high side, it can be observed that this is not the case from table 2.

9. The total 1980 average per capita consumption of the sub-regions is 6.9 kg or the same as that of North Africa in 1965 or the maximum in the range assumed for human requirement. This, of course, would mean that the actual per capita consumption for dietary purposes is below 6.9 kg. Of the 1980 East African estimate, for instance, about 15 per cent is expected to go into the chemical industry. This will reduce the per capita consumption from 6.3 kg to 5.3 kg, and it may be reduced still further as part of the remaining salt will be used for fishery, hides and skins preservation, animal feed etc. Similarly, exclusion of salt for the chemical industry results in 4.9 kg instead of 6.2 kg in West Africa. In general, the 1980 average per capita consumption for dietary purposes is expected to be considerably below that considered adequate for the human diet. Consequently, the estimates cannot be considered high.

Import and export

10. Africa is a net exporter of salt. The average sub-regional 1960-1965 export averaged 679,000 tons yearly (see table 4). As was the case with production, North Africa takes the lead in exports. Its share in the first half of this decade was about 77 per cent compared to 20.5 per cent for East Africa.

Table 3

Future production and consumption estimates in the four sub-regions of Africa

	Production (1000 tons)				Consumption (1000 tons)				Net exports or imports (-) (1000 tons)			
	1965	1970	1975	1980	1965	1970	1975	1980	1965	1970	1975	1980
NORTH AFRICA	1048	1430	1942	2519	488	653	835	1062	560	777	1107	1457
Algeria	135	180	240	320	75	103	137	183	60	77	103	137
Libya	6	8	11	16	-	8	11	16	6	-	-	-
Morocco	38	52	71	98	34	52	71	98	4	-	-	-
Sudan	80	90	110	135	80	73	89	108	-	17	21	27
Tunisia	315	400	510	650	32	84	107	137	283	316	403	513
United Arab Republic	484	700	1000	1300	287	333	420	520	207	367	580	780
WEST AFRICA	90	415	675	900	324	448	669	916	-234	- 33	6	- 16
Ghana	31	100	150	200	35	48	66	91	- 4	52	84	109
Guinea	3	15	25	50	16	21	76	85	- 13	- 6	- 51	- 35
Nigeria	-	200	300	400	145	213	312	459	-145	- 13	- 12	- 59
Senegal	56	100	150	150	35	42	51	62	21	58	99	88
Togo	-	-	50	100	11	15	19	24	- 11	- 15	31	76
CENTRAL AFRICA	-	-	-	-	59	82	111	146	- 59	- 82	-111	-146
EAST AFRICA	296	380	486	582	282	361	502	670	34	- 1	- 6	- 88
Ethiopia	238	250	350	400	81	95	140	175	129	155	210	225
Kenya	31	40	60	80	37	52	77	103	- 6	- 12	- 17	- 23
Madagascar	15	50	60	70	15	25	31	54	-	25	29	16
Mauritius	4	5	6	7	4	5	6	7	-	-	-	-
Tanzania	10	15	20	25	26	49	64	85	- 16	- 34	- 44	- 60
SUB-REGIONS (Total)	1434	2205	3113	4001	1093	1544	2117	2794	341	661	996	1207
SUB-REGIONS (Total) (on the basis of a 5 kg need for dietary purposes)					1380	1550	1770	2020				

11. Only four countries, namely, the United Arab Republic, Tunisia, Ethiopia and Algeria, accounted for 97 per cent of the exports. Their contributions were: the United Arab Republic, 41.5; Tunisia, 30.3; Ethiopia, 20.5 and Algeria, 4.9 per cent.

12. Intra-African trade accounted for but a small part of the exports. In the latter part of the period, for example, export from the four major producers to other African countries, mainly West African countries, was 2.5 to 3.0 per cent of the total. On the basis of 1965 data (1963 for Algeria), Japan, the United States of America, France, Yugoslavia, Brazil and Italy were, in descending order of importance, the major customers for African salt. Their shares ranged between 5 per cent (Italy) and 50 per cent (Japan).

13. As shown in table 3 North Africa is the only sub-region showing net export in the estimates made for the 1965-1980 period. Its exports will increase from 560,000 tons in 1965 to about 1.5 million tons in 1980.

14. Although their combined contribution is expected to decline to 83 per cent, the four major exporting countries of the past will remain so in the future. By 1980 the United Arab Republic, with 39 per cent, will lead the others. Next will follow Tunisia with 26 per cent, Ethiopia with 11 per cent and Algeria with 7 per cent. Ghana, Senegal and Togo, with 5.5, 4.5 and 3.8 per cent respectively, are expected to account for the major part of the balance.

15. As the production figures in this paper refer to solar salt only, the magnitudes of the net imports should be lower than those shown in the table. If the suggested extensions and new capacities will materialize, West Africa, the most import-oriented sub-region, may, within the near future, be able to depend upon local sources. This is likely to happen to the Central African sub-region. With the coming into operation of the Congo (Brazzaville) potash installation, it is possible that the sub-region will be more than self-sufficient, provided that all Member States of the sub-region avail themselves of the opportunity to satisfy their needs from this source.

16. As regards East Africa, the estimated output shown in table 3 should be increased further if exports outside the sub-region, to Japan in particular, are to be maintained. Ethiopian exports to Japan increased at 5.4 per cent per year during the 1961-1967 period. On the basis of 1960-1967, this rate

Table 4

Exports of salt from the four sub-regions of Africa

	1000 tons					
	1960	1961	1962	1963	1964	1965
NORTH AFRICA	524	542	367	456	548	646
Algeria	30	34	25	25	20	60
Libya	1		1	-	-	-
Tunisia	89	149	131	267	195	378
Sudan	12	1	1	1	1	1
United Arab Republic	392	358	209	163	332	207
WEST AFRICA	20	11	12	43	5	
Senegal	20	11	12	43	5	
CENTRAL AFRICA	-	-	-	-	-	-
EAST AFRICA	52	142	214	212	135	145
Ethiopia	50	125	200	195	121	129
Kenya	-	1	1	-	-	-
Madagascar	2	2	1	2	2	
Mauritius	-	-	-	-	-	-
Tanzania	-	13	11	14	11	16
Uganda	-	1	1	1	1	-
SUB-REGIONS (Total)	596	695	593	711	688	791

Source: National statistical and other publications

works out to 19 per cent. Using these rates, the export possibilities to Japan in 1980 could be anything between 330,000 and 1.6 million tons. If the conservative figure were to apply, Ethiopia should be able to double its 1980 estimated output to 800,000 tons.

Production and its future outlook

17. As is well known, solar salt can be produced economically only under certain conditions. These include suitable land surface, quality of sea-water, climatic conditions and access to transport facilities.

Suitable land surface

18. The surface of the solar ponds should be impervious, at sea level and adjacent to the sea. The first is to minimize loss of brine by seepage, and the other two to minimize the cost of pumping sea-water.

Quality of sea-water

19. In general, the solid content of the oceans is about 3.5 per cent, of which about 2.7 is sodium chloride. This percentage may, however, be appreciably reduced in or near areas where rivers empty their waters into the oceans. The opposite can be the case in more or less land-locked areas, such as lagoons, where there is no dilution from rivers. The former case is disadvantageous for production, whereas in the latter it is advantageous.

Climatic conditions

20. Climatic conditions play an important role in the economic exploitation of sea salt. The essential factors here are high rate of evaporation and very low rainfall or a long period of dry weather. Strong winds, sunlight and low humidity favour evaporation.

Access to transport facilities

21. Salt is a cheap and bulky commodity. Its delivered price, and therefore transport cost, is an essential element in determination of the extent of the market area of any source. This means that a salt-works should be situated in a place where adequate dock facilities and suitable and reasonably inexpensive transport systems are available.

22. Africa, with its extensive coastline and tropical, semi-arid and arid zones may be expected to manifest a range of possibilities resulting from combinations of these factors. As terrain and nature of soil or ground vary considerably even within a very limited area, it is not possible to make generalizations concerning the suitability of the coastal surface for solar ponds. As regards the other factors, some generalizations are in order.

23. Owing to unfavourable climatic conditions such as high humidity and long rains, and to dilution by rivers, certain parts of Africa are not suitable for salterns. The Gulf of Benin, with its tropical climate and salt content ranging between 3.0 and 3.3 per cent, is a good example as regards a great part of the Atlantic coast. Parts of Senegal, Guinea, Ghana and Togo are exceptions in the areas characterized by tropical climate. Conditions along the East African coast are not very different from those of West Africa.

24. Judged from the point of view of output (see table 5), North Africa seems to be well suited for solar salt production. As regards salinity, climate and absence of rivers diluting the sea, however, the Red Sea coast appears to be nearly ideal. In some parts, its salt content is said to be about 50 per cent higher than that of the ocean. Its abundant sunlight, very low rainfall and the dry land mass surrounding it in almost all directions would seem to favour the economic production of sea salt. In short, the most suitable coastal areas for solar salt production, as far as quality of sea-water and climatic conditions are concerned, are those on the Red Sea and the Mediterranean Sea.

25. As regards transport facilities, it should be noted that the major salt-works export most of their outputs and should therefore have access to reasonably good dock facilities. In view of the stiff competition in the international salt market, some of these facilities, such as those in Assab, Ethiopia and Kaolack, Senegal should be enlarged to accommodate larger vessels and thereby reduce transport cost, which is a crucial cost element for salt. In general, however, the salt-works enterprises lack the financial strength to undertake investments of this nature. It is felt that assistance in this direction would encourage salt producers to exploit further the possibilities in the most promising countries.

Table 5

Production of salt in Africa

	1000 tons							
	1953	1960	1961	1962	1963	1964	1965	1966
NORTH AFRICA	699	892	980	848	907	1264	1048	1163
Algeria	61	130	130	120	130	130	135	140
Libya	15	12	12	15	19	13	6	8
Morocco	41	30	21	28	37	61	38	39
Sudan	55	54	53	58	37	60	60	43
Tunisia	139	166	247	290	292	325	315	306
United Arab Republic	338	500	517	337	392	675	494	627
WEST AFRICA		65	65	71	84	90	90	99
Ghana		12	18	19	20	31	31	34
Guinea		3	3	4	4	3	3	4
Senegal	55	50	44	48	60	56	56	61
CENTRAL AFRICA	-	-	-	-	-	-	-	-
EAST AFRICA		188	240	261	268	298	296	333
Ethiopia	157	122	185	210	213	224	236	237
Kenya	21	22	23	19	17	27	31	32
Madagascar		14	14	14	20	29	15	46
Mauritius	2	4	4	4	4	4	4	4
Tanzania		10	10	10	10	10	10	10
SUB-REGIONS (Total)	934	1141	1281	1176	1255	1648	1434	1591
AFRICA (Total)	1241	1544	1603	1767	1740	2129	2082	2154

Sources: 1) Studie über die Entwicklung der chemischen Industrie für ausgewählte Produktgruppen in Nordafrika, ECA, 1968.

2) Statistical Yearbook, UN, 1967.

3) Research into the Chemical Industry and Fertilizers in West Africa (E/CN.14/INR/109), ECA, 1966

4) National statistical and other publications.

26. Compared to a number of other salt-producing countries, namely Canada, China (mainland), France, Federal Republic of Germany, India, Italy, Mexico, Poland, the Union of Soviet Socialist Republics, the United Kingdom and the United States of America, total African production of salt is small; 1966 output was less than that of any one of these countries. Unlike them, however, by far the greatest part of African salt is derived from the seas and oceans by solar evaporation.

27. During the 1953-1966 period, regional production increased at an annual average rate of growth of 4.0 per cent to 2.2 million tons in 1966 (see table 5). In contrast, the average rate of increase for the four sub-regions was 4.2 per cent (from 934,000 to 1.6 million tons). As the sub-regional figures refer to sea-salt outputs only, the rate of increase including rock salt should be slightly higher.

28. For the reasons mentioned above, much of the African coast is considered unsuitable for economic exploitation of sea salt by solar evaporation. A brief look at the 1960-1966 sub-regional production trends will make this clear.

29. North Africa. This sub-region is the leading African producer of solar salt. It contributed 74 per cent of the sub-regional output during the period 1960-1966. The United Arab Republic, with 50 per cent of the North African production, ranked first among the North African as well as other African countries. It was followed by Tunisia with 27 per cent and Algeria 13 per cent. The former also occupied second place in the whole of Africa.

30. West Africa accounted for a mere 6 per cent of the output of the four sub-regions. Its producers are Senegal (68 per cent), Ghana (29 per cent), and Guinea (3 per cent). Rock salt production in West Africa is significant and accounts for about 14 per cent of the total output. Mali, with a share of 88 per cent, leads the other two countries, Niger and Mauritania.

31. Central Africa has no significant solar salt production. Chad produces an average of 13,000 tons per year. There is, however, no information indicating the origin of this salt. It is possible that part of it is obtained by solar evaporation of the waters of Lake Chad.

32. East Africa accounts for a 20 per cent share of the output of salt and thus occupies the second place among the sub-regions. Ethiopia, the third largest producer in the sub-region, is the leading producer in this area and accounted for 75 per cent of the output. Following far behind are Kenya (9 per cent) and Madagascar (8 per cent). It should be noted here that the Kenyan salt is won from Lake Magadi, and that the Tanzanian solar salt production is only about 30 per cent of the country's total salt output.

33. The main obstacle to larger outputs by certain salt-works has been and remains the limitation imposed upon them by inadequate port and transport facilities. The extent to which the potential solar salt production will be exploited in such and other areas will therefore depend upon the improvement and expansion of berthing and loading capacities. The future prospect for the development of the solar salt industry, as presented in table 3, has been drawn up on the assumption that ways will be found to overcome the limitations mentioned above. It is discussed in the remaining part of this section.

34. The question of dock facilities is perhaps of less significance in North Africa where expansion, in general, is not expected to face major difficulties. In most countries it is assumed that the export/consumption ratio will be the same as for 1965 and will remain constant throughout the period in question.

35. According to the resulting estimates, production is expected to increase from about 1 million tons in 1965 to 2.5 million tons in 1980. The United Arab Republic will account for half of this and Tunisia and Algeria for 25 and 12 per cent respectively.

36. The prospects for development in West Africa are mainly based on capacity utilization and country projects including indications and interests shown by certain countries. A tenfold increase, that is, from about 90,000 tons in 1965 to 900,000 tons in 1980, is envisaged. Together with a rock salt output of some 45,000 tons, total West African production may reach 945,000 tons yearly.

37. With the possible exception of Senegal, the production methods in use in the salt works of West Africa do not lend themselves to large-scale production. Even in Senegal, the leading producer country in the area, because

of poor soil quality precluding mechanical working, harvesting is done by manual methods. In other words, it is difficult to assess the future possibility of the sub-region on the basis of existing artisanal salt-works.

38. From table 3 it can be seen that the biggest output envisaged is that for Nigeria. As the Nigerian coast is not considered suitable for solar evaporation, in the final analysis, vacuum evaporation may be the process to be used. Under Nigerian conditions (high demand for salt and the availability of local fuels) production of salt by this process may prove economical. If this does not work, the further extension of those that lend themselves to this in other countries (Ghana, Senegal, Togo and Guinea) should be considered, as the alternative is to supplement needs by import from outside the sub-region.

39. From what has been said above, it is clear that the West African sub-region deserves special assistance in the setting-up of pilot plants on the basis of both solar and vacuum evaporation to determine the feasibility and the minimum production costs for large-scale outputs.

40. There is no known solar salt-works in Central Africa. Except for the small output in Chad, it appears that the sub-region is entirely dependent on imports. Its coastline lies within the tropics, where humidity and long rains disqualify it even more than West Africa.

41. Unlike West Africa, however, Central Africa seems to be more fortunate in that the Holle potash deposit in the Republic of the Congo, where a refinery is being installed should be able to produce as much as 600,000 tons of salt per year. Holle is on the Chemin de Fer Congo-Océan and therefore well placed as regards the transport net-work serving most of the area.

42. As shown in table 5, the future outlook of East Africa may be characterized as conservative. The production figures, together with those of rock salt to be produced in Tanzania, Uganda and Ethiopia, will be just enough to make the sub-region self-sufficient. If Ethiopia continues to export most of its salt in excess of its needs to its traditional market, Japan, for which it has a strategic location, the supply gap in the sub-region will grow by as much as the amount exported. In other words, there is a good possibility for further increase in production wherever conditions permit in the sub-region.

The need for outside assistance

43. Solar salt output of the four African sub-regions represents about 75 per cent of the total output of salt in the whole region. As there were no available data, at the time of writing, on solar salt production for countries other than those in the sub-regions it was not possible to estimate the exact share of solar salt in the region. One thing is certain, however, and that is it should be higher than 75 per cent. The general conclusion to be drawn from this is that the salt industry in Africa is highly dependent upon the seas and oceans as sources of salt.

44. As sea-salt is inexhaustible, the potential for the further development of solar salt-works is great indeed. In some of the major producing countries, lack of adequate port and transport facilities, especially the former, seem to be the main bottle-necks to the expansion of existing facilities and the creation of new ones.

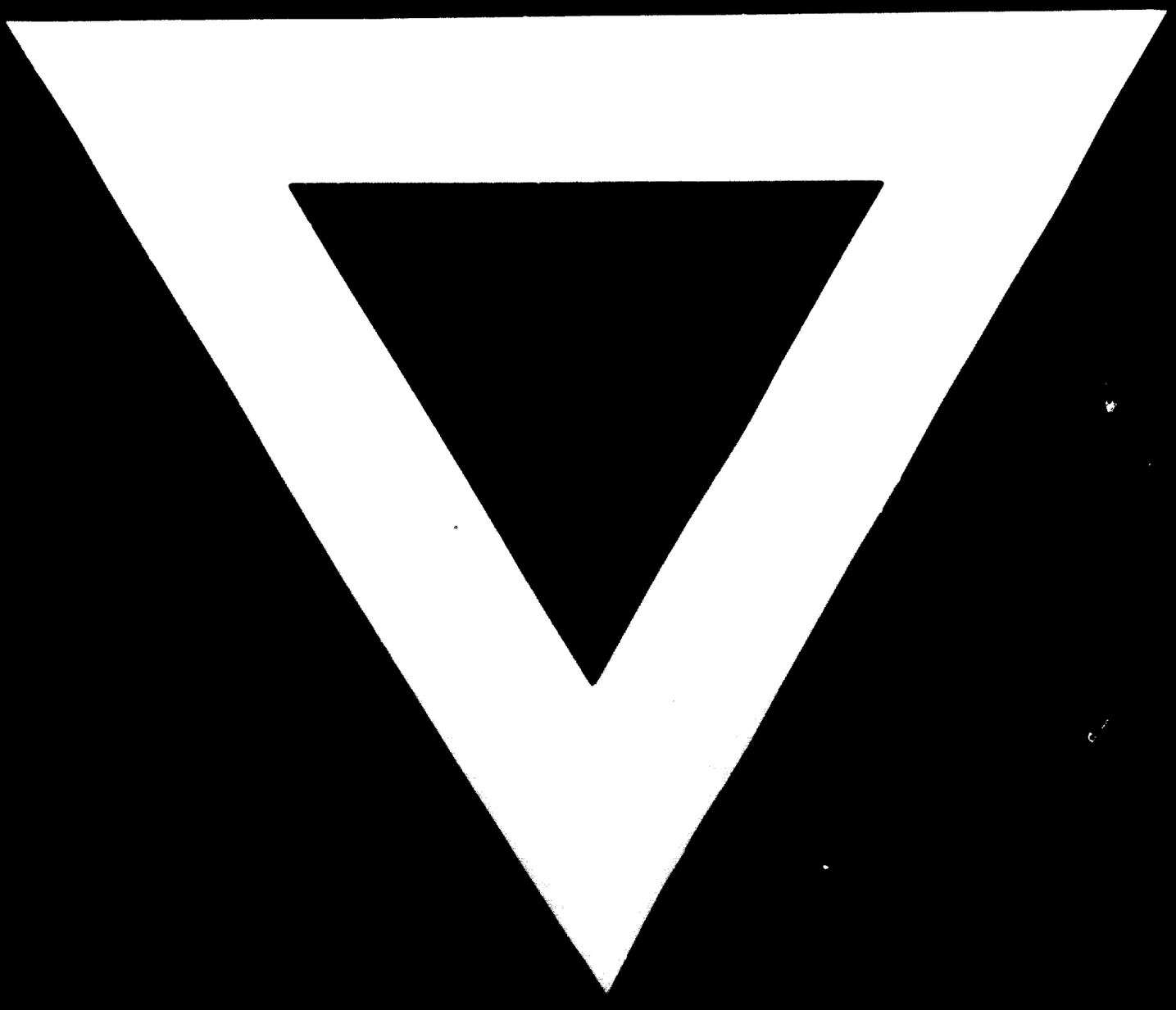
45. In general, salt producers have limited financial resources and are consequently not capable of investing in port and transport facilities. A number of them, in addition, believe that the construction infrastructure facilities is the domain of the state. This is quite logical. The states, however, also have limited funds for development.

46. Under the circumstances, assistance from the outside remains the only possible solution. The United Nations and the industrialized countries could contribute positively to the solution of this problem.

47. For climatic and other reasons, the remaining coastal areas of the African region (Western, Southern and Eastern) are not suitable for solar salt development. There are, nevertheless, some pockets with potentials for development, and starts have already been made in some countries. Guinea and Ghana have begun on an artisanal level and plans are under way for other salt-works. Togo and Ghana are beginning on a relatively larger scale. The interest shown by these countries is commendable. There is, however, lack of adequate experience and technological know-how regarding the most suitable and economical processes applicable to conditions as they exist in these areas. It would therefore be wise to begin with pilot plants or semi-industrial units which, when and if proved economical, can be expanded to produce salt for the needs of the areas in which they are located.

48. It is understood that private firms are not sufficiently interest to start undertakings of this kind. Under such circumstances the countries should be expected to assist in providing the required facilities. Nevertheless, as the governments do not have either the necessary know-how and skill or adequate finance, they will have to look for outside assistance. It is hoped that such assistance will be forthcoming from the United Nations as well as from the industrialized countries.

49. For obvious reasons, that is, lack of adequate information, this paper has not concerned itself with techniques of production processes in use in Africa. From bits of information gathered here and there, there are indications that some salt works use processing techniques that cannot be described as adequate by modern standards. There are also indications that some of the large concerns have not yet availed themselves of cost reducing up-to-date processing techniques and organizational set-ups that could render them more competitive in Technical assistance from the world market. The United Nations and industrialized countries in the introduction of modern ideas and techniques to existing salt-works will be appreciated by the concerns and the countries alike.



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