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# PROSPECTS OF THE GLASS INDUSTRY IN THE EAST AFRICAN SUB-REGION

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# PROSPECTS OF THE GLASS INDUSTRY IN THE EAST AFRICAN SUB-REGION

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# I. INTRODUCTION

1. Although glass has been known as a household article for centuries, the mechanization of its industry did not come about until the turn of this century. The last twenty years in particular have seen a rapid expansion in the use of glass for technical purposes. And today there are nearly five hundred different glass products in commercial use. The rapid progress in technology, on the one hand, and improved living conditions, on the other, have brought about an unprecented expansion in the use of glass, such as curtain-walling in modern architecture, unbreakable and heat-resistant kitchen wares, the use of fibre glass in the textile industry and in the reinforcement of plastics, etc.

2. Because glass containers are heavier and more fragile, they have obvious disadvantages as compared with those of paper and plastic materials. Nevertheless, recent technological developments have made it possible to produce glass containers of lighter weight without any loss of mechanical strength. This, together with the usual advantages of glass, (namely transparency and impermeability to gasses, both of which are very essential properties for the packaging of food), tends to assure the future market for glass containers.

3. Glass products can be conveniently classed into two broad categories: 1) Glassware and 2) Flat Glass.

4. In this study, glassware embraces articles of glass that are conventionally included under Group 665 of the SITC[1/], i.e., bottles, jars, flasks, and similar containers; stoppers and other closures of glass; commercial containers; inners for vacuum vessels; glass table-ware and other articles of glass for household, hotel and restaurant use; and other articles such as laboratory, decorative, hygienic and pharmaceutical glass. But broadly speaking, the bulk of glassware produced and imported into the sub-region consists of bottles, jars, drinking glasses and glassware for household use. For practical purposes, therefore, glassware can be taken to mean those few articles.

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1/ Standard International Trade Classification.

5. Similarly, flat glass embraces group 664 of the SITC i.e., glass in the mass; drawn, or blown glass; cast or rolled glass; bricks, tiles and other construction materials of pressed or moulded glass; safety glass, sheet glass, plate glass, etc. The two main items considered in this study are sheet glass and plate glass.

6. Sheet glass is extensively used in housing and building. It is a much cheaper glass to produce in the thicknesses normally used for house glazing, and for this reason is used almost exclusively in that field. It has visible distortion, and therefore it is not in general used where quality glazing is required - as for example shop windows or other wide windows. In these cases, plate glass is used. This essentially is a thicker glass, and it is also one which is carefully and highly finished. A distortion-free product results from a series of grinding and polishing processes. Other plate glasses are also manufactured, such as patterned glass, wired glass, obscured glass, etc. The differences in manufacturing processes are small.

7. The above are the main types of flat glasses used in building. In the East African sub-region, by far the main type used is sheet glass. The present study therefore concentrates on sheet glass production. However, within this definition, plate glass is also included. This is done for two reasons:

(i) the plate glass market is still very small in the sub-region and does not call for separate analysis and

(ii) the market study is more conveniently undertaken with the two products combined.

8. Sheet glass in this study, therefore, includes both sheet glass and plate glass combined. Broadly it refers to flat glass of 2.8 mm. thickness, each metre square weighing 7 kg.

9. It might be of interest to indicate broadly the importance of glass products in the sub-region's imports. In the early sixties, the 12 countries of the sub-region imported goods worth about $1,158 million.

Of this, less than $7 million was accounted for by glass. This is a mere 0.6 per cent, and provides a rough indication of the scope for import substitution. It would be a mistake, however, to measure the economic benefits of the area's glass industry purely in terms of import substitution. Although accurate quantitative estimates cannot be provided at this stage, the indirect benefits of the industry are undoubtedly of some significance; and these need to be borne in mind when assessing the total impact of the growth of this industry on each country's national economy.

10. The study covers 12 countries of the East African sub-region - i.e., Burundi, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Rhodesia, Rwanda, Somalia, Tanzania, Uganda, Zambia. Whenever data permitted, the following countries have also been covered - Comoro Islands, French Somaliland, Reunion and Seychelles.

## II. CURRENT SITUATION

11. Broadly speaking, the characteristics of the industry in the early sixties can be summarized as follows:

12. There are only three countries in the sub-region which have plants producing glass containers. The S.A.V.A. glassworks in Ethiopia has been in operation since 1955. It produces some 6,000 tons of bottles, drinking glass, etc., a year. No reliable estimate of its capacity is available, but unofficial estimates vary between 6,000 tons and 10,000 tons. For a long time, the level of consumption in the country did not permit this plant to operate at full capacity. The market is growing fast, however, and the establishment of a new plant near Addis Ababa with an annual capacity of 7,800 tons is being seriously considered.

13. Kenya has two bottle and tableware plants, with a combined maximum capacity of 12,000 tons a year, which just about meets the country's own requirements. In the past, however, these plants were also supplying part of the requirements of Tanzania, Uganda, Rwanda and Burundi. These plants have in recent years competed successfully with imports, as the substantial reduction of imported wares testifies.

14. In 1964, a plant in Rhodesia started producing containers of various types. Its capacity is of the order of 11,000 tons. Quite clearly, Rhodesia's own demand even in 1970 does not come up to that level. Indications are that the plant was established to supply the markets of Zambia and Malawi, in addition to that of Rhodesia.

15. Zambia, Tanzania, Uganda, Madagascar are either planning for new plants or have at one time or another considered the possibility of replacing imports with domestic manufactures. Tanzania appears to have reached an advanced stage of planning in this respect. A new plant is under construction in the Dar-es-Salaam area. Its capacity is between 4,500 tons and 6,500 tons a year. As total consumption was about 1,400 tons in 1960 and will be less than 5,000 tons in 1970, it appears unlikely that Tanzania's own market will justify full capacity utilization.

16. In Zambia, Uganda and Madagascar no concrete plans have as yet been seriously proposed and accepted. Knowing that their markets are big enough to support plants of medium or small size capacities, each has nevertheless looked into the possibility of establishing plants for glass containers. Madagascar's imports in 1960 amounted to about 950 tons, but by 1962 they had reached a level of about 1,300 tons. Indications are that by 1970 the market will have expanded to over 4000 tons. That is probably why there was a suggestion to consider establishing a plant of 2,500 tons a year that will later be expanded to 5,500 tons. But that suggestion does not appear to have been taken up yet. In Uganda, something similar has happened. Private investors have shown interest in putting up a glass container plant.

17. In the remaining five countries - i.e., Somalia, Mauritius, Burundi, Rwanda, Malawi - not only do plants not exist but the size of individual markets have so far precluded even preliminary investigations.

18. With respect to sheet glass there is no industry in the sub-region. All requirements are imported. Table I[1/] shows imports of sheet glass by country in the period 1954-1963, and Table II[1/] imports of plate glass for the same period. Plate glass imports are relatively small, and for all purposes these quantities could be added to the import of sheet glass. The comments under this section will therefore be based on Table III[1/], which combines both.

19. The trend of imports and hence of consumption of the sub-region has not shown dramatic increases over the nine years under consideration. By and large consumption has fluctuated between 11-16 million sq.ft. annually. Nevertheless, a notable increase was registered in the years up to 1957. Between 1954 - 1957, the compounded annual rate of increase was of the order of 13.5 per cent. Subsequently, however, fluctuations in consumption have dominated the picture, and in later years (1960-1963), the trend was visibly one of decline.

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1/ See Annex I.

20. The trend in imports (also consumption) was very closely related to trends in housing and building activity. Several of the countries of the sub-region had recorded intensive housing and building activities in the years prior to 1957. Subsequently, this trend was followed by a downward trend which gathered momentum especially towards the close of the fifties.[1/]

21. Reflecting this trend in housing and building activity, it would be noted that the former Fed. of Rhodesia and Nyasaland recorded its peak consumption of sheet glass in 1957, when it attained a consumption of 7.6 million sq.ft. and recorded an annual compounded rate of growth of over 10 per cent. Consumption fell to a low level of 3.38 million sq.ft. in 1961. The same trend, but to a less marked extent, was also recorded in Kenya and Uganda. The peak consumption of 2.92 million sq.ft. attained in Kenya in 1956 has not been repeated; on the contrary, yet another sharp fall occured in 1961, bringing consumption down to 1.34 million sq. ft. In Uganda, the peak consumption occured as far back as 1955, when consumption was recorded to be 1.3 million sq.ft. Subsequently the trend was either one of decline or minor fluctuation, but the 1955 record consumption was not repeated. Recent trends, however, have been encouraging. In 1963, consumption rose to 1.0 million sq. ft.

22. In the other remaining countries of the sub-region consumption has also followed very closely the ups and downs of the building industry. In Tanzania, the trend in consumption has by and large tended to be an upward one. In the period 1954-1963, it rose from 0.8 million sq.ft. to 1.1 million sq.ft and the annual compounded rate of growth was about 3.0 per cent. In Ethiopia, consumption also rose at an annual rate of growth of 3 per cent in the same period from 9 million sq.ft. to 1.2 million sq.ft. Similarly also in Madagascar, consumption rose from 0.8 million sq.ft in 1954 to 1.0 million sq.ft. in 1963 and an annual

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1/ See the Cement and Allied Industries in the East African Sub-region E/CN.14/INR/84, Addis Ababa, July 1965.

rate of growth of 2.5 per cent was recorded. In all three countries, it would be relevant to note that considerably higher rates of growth were recorded in other periods. A rate of growth of 4.0 per cent was recorded in Tanzania and Madagascar between 1958 and 1963. In Ethiopia, rates of growth of 8.0 and 9 per cent were attained in the periods 1954-1957, and 1958-1961. These considerable rates of growth could in all cases be traced back to periods of more intensive housing and building activities.

23. Tables I, II and III upon which the previous comments were made are useful in indicating the market situation for sheet glass in the sub-region and in throwing light on the broad trends in its history. It would be appreciated that in so far as the future prospects of the market are concerned, the above trends are dominated by fluctuations and inconsistancies so that no clear and reliable methodology could be elaborated on the basis of observations of past evolutions. Therefore, for assessing future demand other methods will have to be sought.

## III. THE DEMAND FOR GLASS IN THE SEVENTIES

### (a) Glassware

24. There could be several ways of estimating the future consumption of glassware for a country or group of countries. As glassware falls within the general category of consumer goods, perhaps the ideal way of forecasting its demand is to observe the changing pattern of private consumption expenditure over a number of years as well as changes in the expenditure on relevant items (i.e., food, beverages, pharmaceutical products, etc.) for a fairly representative group of developing and developed countries, and make the necessary projections on the basis of these observed relationships. However, this method is not practicable. It becomes necessary, therefore, to accept compromises in methodological finesse in order to have estimates whose reliability may not be beyond question but which nevertheless give the general outlines of future development.

25. While the method followed here appears to be both practical and straightforward, it in no way precludes the possibility of other equally reliable estimates, nor does it pretend to be entirely free from assumptions which are 'unreal', in the sense that such assumptions rest on optimistic expectations of East Africa's economic development. But in the circumstances it appears to be a useful way of providing the preliminary estimates upon which certain general recommendations can be made.

26. In the following table, gross domestic product per capita is shown with the per capita consumption of glassware. Except for a small number of countries (Rwanda, Burundi, Somalia) and islands (Zanzibar, Seychelles, Comoro), the table gives a complete list of countries in the sub-region.

TABLE 1

Per Capita Income and Per Capita Consumption of Glassware - 1960

| Country | Per Capita GDP (US $) | Per Capita Consumption of Glassware (in pieces) a/ |
|---|---|---|
| 1. Ethiopia | 40 b/ | 0.51 |
| 2. Tanzania | 60 | 0.49 |
| 3. Uganda | 64 | 0.52 |
| 4. Kenya | 78 | 3.93 |
| 5. Madagascar | 106 | 0.58 |
| 6. Zambia | | |
| 7. Malawi | 139 | 3.49 |
| 8. Rhodesia | | |
| 9. Mauritius | 170 | 1.57 |

Sources: United Nations, Demographic Yearbook, 1963.
United Nations, Yearbook of International Trade Statistics, 1961.
United Nations, Yearbook of National Accounts Statistics, 1963.
United Nations, Statistical Yearbook, 1963.
Madagascar, Plan Quinquenal, 1964-1968.
Mauritius, Commerce & Industry, 1964
~~Annual Trade Reports of the East African Countries, 1960~~

a/ One piece is taken to be equivalent to 300 grammes.
b/ 1962.

27. Obviously, there can be no rigid mathematical relationship between these two aggregates. But equally obviously, the level of per capita income plays a significant role in determining the level of demand for such an item as glassware. If the level of per capita income goes up substantially, a similar movement in the consumption of glassware can be expected, and for a country whose per capita income is, say, 2 to 3 times higher than that of another, one would equally normally expect a significantly higher level of consumption of that commodity.

28. The number of countries for which data are available does not allow a graphical representation of this relationship. Had the number of countries in the East African sub-region been much larger and had it been possible to obtain reliable data for all, a chart would have clearly shown a positive correlation in which a movement in the independent variable (per capita income) could be quantitatively related to a similar movement in the dependent variable (per capita consumption of glassware). Projections in a case like that would have reduced themselves into a simple problem of arithmetic.

29. In the present case, the future demand of glassware has been estimated essentially on the observation of its consumption pattern for 1960. But some corrections have been made in one or two cases, where these were found to be necessary.

30. Essentially three steps have been involved in estimating glassware consumption for 1970 and 1975. The first was the projection of population; the second of Gross Domestic Product. From these two, per capita income was obtained. The income and population picture in 1970 would consequently look as follows:

TABLE 2

Income and Population in 1970

| Country | Populations (millions) | GDP (US$ millions) | Per capita GDP (US$) |
|---|---|---|---|
| 1. Ethiopia | 23.8 | 1,194.5 | 50.2 |
| 2. Somalia | 2.4 | 158.4 | 66.0 |
| 3. Kenya | 10.3 | 1,020.3 | 99.9 |
| 4. Tanzania | 11.3 | 929.3 | 82.2 |
| 5. Uganda | 8.6 | 758.5 | 88.2 |
| 6. Rwanda | 3.0 | 182.3 | 60.8 |
| 7. Burundi | 3.3 | 193.2 | 58.5 |
| 8. Zambia | 4.2 | 957.7 | 228.0 |
| 9. Malawi | 4.6 | 178.8 | 38.9 |
| 10. Rhodesia | 5.0 | 1,161.4 | 232.3 |
| 11. Madagascar | 6.2 | 911.6 | 146.8 |
| 12. Mauritius | 0.8 | 219.4 | 274.3 |

Note: For sources and methods see paper on Industrial Co-ordination.

31. The corresponding situation in 1975 is shown in table 3.

TABLE 3

Income and Population in 1975

| | Country | Population (millions) | GDP (US$ millions) | Per capita GDP (US $) |
|---|---|---|---|---|
| 1. | Ethiopia | 26.3 | 1,561.1 | 59.4 |
| 2. | Somalia | 2.7 | 202.2 | 74.9 |
| 3. | Kenya | 11.8 | 1,365.3 | 115.7 |
| 4. | Tanzania | 12.6 | 1,286.0 | 102.1 |
| 5. | Uganda | 10.0 | 1,096.6 | 109.6 |
| 6. | Rwanda | 3.3 | 232.7 | 70.5 |
| 7. | Burundi | 3.7 | 246.6 | 66.6 |
| 8. | Zambia | 4.9 | 1,307.0 | 266.7 |
| 9. | Malawi | 5.3 | 233.7 | 44.1 |
| 10. | Rhodesia | 6.0 | 1,482.3 | 247.1 |
| 11. | Madagascar | 6.8 | 1,163.5 | 171.1 |
| 12. | Mauritius | 1.0 | 280.0 | 280.0 |

Note: For sources and methods see paper on Industrial Co-ordination.

32. There is no need to go into a detailed consideration as to how these projections have been arrived at. This has been done in two separate papers, one on the demographic situation, the other on industrial co-ordination problems in the East African sub-region. Broadly, however, the demographic projections are based partly on country projections and partly on a rather optimistic growth rate which has been assumed for the purpose of the Lusaka Conference.

33. A careful examination of the relationship between per capita income consumption of glassware in Table 1 on the one hand, and the per capita income figures for 1970 and 1975 on the other, constitutes the third and

final step in arriving at demand for the product in those two target years. From Table 1, the correlation between the two variables was worked out. From this quantitative relationship, and from the projections of per capita income already made, per capita consumption of glassware was calculated for each country for the year 1970 and 1975. As is to be expected, such calculations generally produce a few odd results. After making the necessary corrections, and including the three countries which were omitted from Table 1, the following figures were arrived at.

TABLE 4

Per Capita Consumption of Glassware (in pieces)

| | Country | 1970 | 1975 |
|---|---|---|---|
| 1. | Ethiopia | 1.05 | 1.16 |
| 2. | Somalia | 1.24 | 1.35 |
| 3. | Kenya | 4.20 | 4.30 |
| 4. | Tanganyika | 1.44 | 1.69 |
| 5. | Uganda | 1.52 | 1.78 |
| 6. | Rwanda | 1.18 | 1.30 |
| 7. | Burundi | 1.15 | 1.25 |
| 8. | Zambia | | |
| 9. | Malawi | 4.10 | 4.20 |
| 10. | Rhodesia | | |
| 11. | Madagascar | 2.24 | 2.54 |
| 12. | Mauritius | 3.81 | 3.88 |

34. With the population figures already estimated for 1970 and 1975, it was simple to get corresponding figures on each country's total glassware consumption. It will be noted that Zambia, Malawi and Rhodesia have been grouped together in the preceding table. This results from the fact that in 1960 these countries were members of the Federation of Rhodesia and Nyasaland. In the following table, however, figures have been separately given. The breakdown of the total figure

was made possible by the use of their separate per capita income figures.

TABLE 5

Future Consumption of Glassware in the East African Sub-region

| Country | Consumption (in $10^6$ pieces) 1970 | Consumption (in $10^6$ pieces) 1975 |
|---|---|---|
| 1. Ethiopia | 25.0 | 30.5 |
| 2. Somalia | 3.0 | 3.6 |
| 3. Kenya | 43.3 | 50.7 |
| 4. Tanzania | 16.3 | 21.3 |
| 5. Uganda | 13.1 | 17.8 |
| 6. Rwanda | 3.5 | 4.3 |
| 7. Burundi | 3.8 | 4.6 |
| 8. Zambia | 25.9 | 33.0 |
| 9. Malawi | 4.4 | 5.0 |
| 10. Rhodesia | 26.3 | 30.0 |
| 11. Madagascar | 13.9 | 17.3 |
| 12. Mauritius | 3.0 | 3.9 |
| Total | 181.5 | 222.0 |

35. A comparison between these projections and the situation in 1960 brings out the following. As Table 6 below shows, nine of the twelve countries of the sub-region (i.e. excluding Rwanda, Burundi, and Somalia) consumed a total of about 27 thousand tons of glassware in 1960. In 1970 they are expected to consume just under 2 times that much and in 1975 about 2 1/3 times. By any standard, this is a substantial increase. But it is only when expansion is of that magnitude that industrial backwardness in the underdeveloped world can be said to be effectively tackled. And in the East African context these figures are positively within reach.

TABLE 6

Consumption of Glassware (in metric tons)[1/]

| Country | 1960 | 1970 | 1975 |
|---|---|---|---|
| 1. Ethiopia | 3,081 | 7,500 | 9,150 |
| 2. Kenya | 9,572 | 12,990 | 15,210 |
| 3. Tanzania | 1,368 | 4,890 | 6,390 |
| 4. Uganda | 1,033 | 3,930 | 5,340 |
| 5. Zambia | | | |
| 6. Malawi | 10,843 | 16,980 | 20,400 |
| 7. Rhodesia | | | |
| 8. Madagascar | 937 | 4,170 | 5,190 |
| 9. Mauritius | 309 | 900 | 1,170 |
| Total | 27,143 | 51,360 | 62,850 |

36. The countries in the sub-region show great variation in resources and in size. The market for glassware inevitably reflects this. Some show a sizeable market, others a small one. Broadly speaking, three major groups can be distinguished. To the first belong high-consumption countries, i.e., Ethiopia, Kenya, Zambia, and Rhodesia. The second includes medium-consumption countries, i.e., Tanzania, Madagascar and Uganda. The remaining five, namely Malawi, Rwanda, Burundi, Somalia and Mauritius, constitute a third group where consumption is pretty low.

37. In 1970, the first group will account for 66 per cent of glassware consumption of the other two groups, i.e., 34 per cent. Of that proportion, the second group would have 24 per cent, and the third 10 per cent.

1/ The conversion factor which has been used is 300 grammes to 1 piece.

38. That picture will remain substantially the same in 1975. Sixty-five per cent of consumption would still remain within the high consumption countries, while the medium consumption countries would account for 25 per cent and the third group for 10 per cent.

39. Insofar as this broad pattern stems from a corresponding pattern in the distribution of human and natural resources, it may not be easy to alter the picture radically. Nonetheless, if a co-ordinated market for the sub-region can be agreed upon, the low consumption areas need not necessarily be limited to their respective levels of consumption. Small deficiencies in production in the high consumption areas may quite easily be made up by production in the low consumption areas, for which such small deficiencies might very well constitute a substantial addition to their markets. It is not within the scope of this paper to provide an exhaustive analysis of this problem; but as it is one of the key questions in any multi-national co-ordination of markets, it inevitably permeates all aspects of industrial growth. The next Chapter takes up the subject and points to it as one of the alternative methods of rationalizing the distribution of productive units among individual countries.

(b) Sheet Glass

40. It would appear to be imperative that any methodology for projecting future demand of sheet glass which could be considered useful, should be based on trends in the housing and building industry, for it is in this sector that the utilization of sheet glass takes place. Of essence then, the starting point in elaborating a methodology would be the definition of the place of the construction industry in general and of the housing and building industry in particular in the national economy.

41. It is evident that the intensity of over-all construction activity at any given period is directly governed by the magnitude of investments channelled into the economy. Data of the share of the construction industry in gross domestic fixed capital formation (GDFCF) are available for several countries at different levels of economic development over-

a number of years, and are reproduced in Table 6. A close examination of the data appears to indicate that the share of the construction industry in GDFCF falls within the broad range of 50-70 per cent. By and large, developing countries tend to show a higher percentage share than the developed countries. Admittedly, there are important exceptions to this general observation, but on the whole they do not alter sensibly the validity of the statement.

42. With reference to the housing and building component of construction, the data contained in the table would again be useful in throwing light on the pattern of relationship between the building component and changes in capital formation with respect to GDP. Broadly, it could be observed that the share of housing and building in capital formation falls in the range of 30-50 per cent. In addition, although not appreciable, there would appear to be a general tendency for this share to decrease as the capital formation content to GDP increases. This is especially true of individual countries; the observation of the world-wide pattern can, however, be visualized only within a fairly broad spectrum. The relative emphasis on housing and building in investments could vary from one country to another at the same level of the ratio of capital formation to GDP.

43. Two broad groupings could be observed from the data. It would appear that (a) those countries whose ratio of capital formation to GDP falls in the range of 15-10 per cent and less, show a ratio of housing and building to capital formation within the broad range of 40-50 per cent and over, and (b) those countries whose ratio of capital formation to GDP falls in the range of 15-20 per cent and over, show a ratio of housing and building to capital formation of 40-30 per cent and less.

44. In the East African sub-region, the capital formation content of GDP was of the order of 12-15 per cent in the early sixties which clearly puts the sub-region in the first group of countries. From the economic development plans that are either being elaborated or being

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1/ See Annex I.

implemented in the sub-region it could be noted that capital formation would be accounting for a growing share of GDP. The targets set for this share would vary from country to country. But the assumption that the share of capital formation in GDP would be of the order of 20 per cent for the sub-region by the middle of the seventies seems to be reasonable.

45. This higher ratio implies that the share of housing and building in capital formation should decrease to within the broad range of 30-40 per cent as noted earlier. However, in the case of the East African sub-region, such a trend cannot possibly be justified within the near future, for the following reasons:

(a) The present housing and building stock in the sub-region is far from adequate, moreover the little that exists is largely of sub-standard quality which requires replacement. The situation in the case of an industrialized country at a similar ratio of capital formation to GDP level would not be the same.

(b) The rate of demographic growth being higher in Africa than in the industrialized countries, the demand for new housing and building stock in the sub-region would be considerably higher than in the industrialized countries even if their respective ratios of capital formation to GDP might be identical.

(c) Housebuilding costs are generally higher in developing countries, and therefore for the same level of investment, the volume of building would be lower than in the developed countries.

46. These arguments tend to justify the broad assumption that in developing countries the share of housing and building in capital formation would continue to remain at its present high level for yet a considerable number of years. For purposes of projecting investment in housing and building in the East African sub-region, the present median ratio of 45 per cent representing the share of housing and

building in capital formation would, therefore, be assumed to remain constant over the period of projection, i.e., 1961/63-1975.

47. While the assumption of the trend of capital formation with respect to GDP on the one hand and of housing and building with respect to capital formation on the other within the period 1961/63-1975 would thus make possible the projection of investments in housing and building, there now remains the problem of converting values into quantities.

48. In 1964, the secretariat carried out a survey on housebuilding costs[1/] as well as on costs of services related to housing and building programmes[2/] in Africa. The results of these studies have been used to project the volume of housing and building in 1975 for the sub-region. It should be appreciated that housebuilding costs would not remain at their present high level through to 1975. Expansion of the domestic building materials industry, and improvements in labour productivity and other cost-sensitive factors are expected to bring about reductions in housebuilding costs. The estimate of the secretariat is that, taking all factors into consideration, a reduction of construction costs by 25 per cent should be possible in 20 years.[3/]

49. Consideration of the above points, and the study of the two secretariat papers on the costs of building and related facilities would lead to the following conclusions:

(a) The share of total housebuilding costs that go into services and other related facilities could be taken to be of the order of 30 per cent in the sub-region;

(b) The average housebuilding cost in the sub-region fell from \$50 per $m^2$ in the early sixties and might reach Eth.\$45 per $m^2$ in the mid-seventies.

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1/ Pilot Enquiry into Housebuilding costs in Africa, HOU/WP/5-Addis Ababa.

2/ Economics of Grouped Housing in Africa, HOU/WP/7-Addis Ababa.

3/ The Building Materials Industry in Africa, HOU/WP/4-Addis Ababa.

50. Finally, the data analysed for the secretariat paper on housebuilding costs reveal the relationship between areas of openings in residential units and their gross floor areas.[1/] It would appear that the area of openings per $m^2$ of gross floor area tends to remain constant at 0.4 for gross floor areas exceeding 100 $m^2$. For units below 100 $m^2$, the ratio declines sharply to about 0.15 at about 45 $m^2$ gross floor area.

51. In this context, the following points should be taken into consideration in estimating future demand for sheet glass:-

(a) the need for low cost housing in the sub-region is defined by dwelling units of the order of 50 $m^2$ gross floor area,

(b) this need would represent the major share of the total housing need and would in all probability represent half of the total share of housing and building in capital formation in 1975 (i.e., 22.5 per cent).

(c) the present low utilization of sheet glass in rural housing would not change appreciably within the coming decade, and that also in many countries unglazed doors and windows would continue to be used in low cost housing even in urban areas.

52. All the various assumptions made are summarized in Table 7, where they have been used to estimate the demand for sheet glass not only in 1975, but also in the early sixties. The latter estimate would help in verifying the soundness of the methodology used. The estimates embrace the whole of the countries of the sub-region listed in the first pages of this report. In addition, the quantities also include other flat glass used in building, in particular plate glass.

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1/ Pilot Enquiry into Housebuilding Costs in Africa (HOU/WP/5).

TABLE 7

Demand for Sheet Glass in 1970 and 1975

| | Year | | 1961-63 | 1970 | 1975 |
|---|---|---|---|---|---|
| 1. | Gross Domestic Product (GDP) | $10^9$ US$ | 5.45 | 7.90 | 10.46 |
| 2. | Gross Domestic Fixed Capital Formation, (GDFCF) increasing from 12-15 per cent to 20 per cent of GDP | $10^8$ US$ | 8.18 | 13.43 | 20.92 |
| 3. | Investments on housing and building, constant at 45 per cent of GDFCF | $10^8$ US$ | 3.68 | 6.04 | 9.41 |
| 4. | Deduct 30 per cent for expenditure on services, and related facilities | $10^8$ US$ | 1.10 | 1.81 | 2.82 |
| 5. | Investment on Housing and Building proper | $10^8$ US$ | 2.58 | 4.23 | 6.59 |
| 6. | Conversion of investments into quantity magnitudes expressed in total gross floor area of housing and building on the basis of housebuilding costs decreasing from $50 to $45 per $m^2$ during the period 1961/63-1975. | $10^6$ $m^2$ | 5.16 | 9.02 | 14.64 |
| 7. | Sheet Glass requirements on basis of the above volume in housing and building activities, using the following co-efficients and divisions. | | | | |
| | (i) 50 % of volume of H&B at 0.16 sheet glass conversion co-efficients | $10^6$ $m^2$ | 0.41 | 0.72 | 1.17 |
| | (ii) 40 % " " " " " 0.24 " | $10^6$ $m^2$ | 0.50 | 0.87 | 1.41 |
| | (iii) 10 % " " " " " 0.40 " | $10^6$ $m^2$ | 0.21 | 0.36 | 0.59 |
| 8. | Total sheet glass requirements | $10^6$ $m^2$ | 1.12 | 1.95 | 3.36 |
| 9. | Equivalent in sq.ft. | $10^6$ sq.ft. | 12.06 | 21.00 | 36.17 |
| 10. | Equivalent in metric tons on the assumption that the average thickness of glass is 2.8 mm 1/ | $10^3$ tons | 7.84 | 13.65 | 23.52 |
| 11. | Implied compounded annual rate of growth 2/ | percentage | | 7.2 | 11.5 |

1/ Each metre sq. of glass of thickness 2.8 mm. is assumed to weigh 7 kg.

2/ Computed on basis of figures in $m^2$ units.

53. The estimate of annual consumption of sheet glass in the 1961/63 period arrived at in the above computation is some 400,000 sq.ft. over the actual average consumption level of 11.6 million sq.ft. recorded for the major consumer countries of the sub-region. The discrepancy of 400,000 sq.ft. could be explained by the consumption of those countries for which data were not available, namely: Somalia, Burundi, Rwanda, Reunion and French Somaliland. It would, therefore, appear that the methodology of projection used would give fairly reliable orders of magnitude of future demand for sheet glass.

54. In addition, the compounded annual rates of growth implied by the computation cannot be considered as non-attainable. The projected growth rates of 7.2 per cent and 11.5 per cent for the periods 1961/63-1970 and 1970-1975 respectively have in the past been attained by one country or another during a period of intensified building activity. Notable examples of this are: the growth rates of over 10 per cent recorded in Mauritius and the former federation of Rhodesia and Nyasaland in the period 1954-1958; a growth rate of over 8.5 per cent in Ethiopia over the period 1953-1963, and a growth rate of nearly 6 per cent for the sub-region as a whole in the period 1954-1960.

55. Further, the growth rate of the period 1970-1975, being higher than that for the period 1961/63-1970 comes about with the expectation of increased rate of housing and building that would follow the assumed reduction in the trend of construction costs. For the same investment, it would be possible to satisfy a greater share of housing and building demand.

56. Taking into account the observed tendency of the estimate for the starting year to be on the lower side,[1/] it could be appreciated that the 1975 over-all estimate could be increased from 36.2 million sq.ft. to about 40.0 million sq.ft. This might on the other hand appear to be an over-estimate, but for purposes of a broad discussion of the future development of the sheet glass industry in the sub-region such a projected demand would not be unacceptable.

57. The breakdown of this over-all demand by country is not necessary for the purposes of the present study, but a breakdown by some broad grouping of countries which could be considered as forming economic units for supporting a sheet glass industry is highly relevant. The same methodology is again used, and the summary of the computation for four groups of countries during the years 1970 and 1975 is reproduced in Table 8 below.

1/ A secretariat estimate of sheet glass consumption for these countries in the early sixties puts it at

| | |
|---|---|
| Somalia | 200,000 sq.ft. |
| Burundi, Rwanda | 150,000 sq.ft. |
| Reunion, Fr. Somaliland | 200,000 sq.ft. |
| Total | 550,000 sq.ft. |

This will bring the total sub-regional annual consumption to some 12.2 million sq.ft. which is very close to the estimated value of 12.1 million sq.ft. based on the present methodology.

TABLE 8

Demand by Groups of countries

| Grouping of Countries | Zone A/ Ethiopia Somalia Fr. Somaliland | Zone B/ Burundi Kenya Rwanda Tanzania Uganda | Zone C/ Malawi Rhodesia Zambia | Zone D/ Madagascar Mauritius Comoro Reunion |
|---|---|---|---|---|
| GDP ... $10^9$ US$ | 1.81 | 4.23 | 3.02 | 1.40 |
| Percentage share of computed 1975 market by groups of countries | 18 | 39 | 32 | 11 |
| Breakdown of assumed 1975 over-all market of 40 million sq.ft.. $10^6$ sq.ft. | 7.2 | 15.6 | 12.8 | 4.4 |
| Equivalent in metric units 103 tons | 4.7 | 9.4 | 7.7 | 2.7 |
| Breakdown of the corrected 1970 over-all market of 23 million sq.ft.. $10^6$ sq.ft. | 4.1 | 9.0 | 7.4 | 2.5 |
| Equivalent in metric units 103 tons | 2.5 | 5.4 | 4.8 | 1.6 |

## IV. BASIC FACTORS TO BE CONSIDERED

58. In the preceding section attention was focussed on estimating the future requirements of glass products for the East African sub-region. This section examines the main questions that will have to be seriously considered if the countries of the sub-region decide to build up glass industries to meet those requirements.

### (a) Raw materials

59. The technology of glass manufacture is mainly defined by two basic processes. Firstly, a carefully weighed batch of raw materials consisting of silica, alumina, lime, magnesia, soda, iron oxide, sulphate, and cullet (broken glass chips) of the correct chemical compositions are thoroughly mixed and heated to a high temperature until the chemical reactions which form molten glass are completed. In the second step, primary fabrication of glass articles are realized through one form or another of the following operations: pressing, blowing, rolling, drawing, floating, etc. The final operation is finishing and is involved in cutting, grinding, polishing, packing, etc.

60. In mechanized production units, the furnace is designed for a specific type of forming operation, so that parts of the forming equipment may become an integral part of the melting unit. Consequently, the manufacture of two glass products from the same furnace is not practicable - especially such two products as glass containers and sheet glass. The finishing operation can, however, be separated from the primary operations with respect both to time and space.

61. The principal ingredients for glass production are sand, soda ash, limestone, felspar and dolomite. Sand is by far the most important raw material in glass making, since silica comprises over 70 per cent of the finished glass product. The chief sources of calcium compounds for glass making are limestone and dolomite, the latter supplying magnesium. In addition, in sheet glass manufacture felspar is the most common source for alumina; but its use in sheet glass making is limited

to very small quantities. Oxides of sodium, which make up some 15 per cent of the finished sheet glass product, are mostly obtained from soda ash. In addition, there are other minor additives, which are incorporated in the manufacturing process to obtain certain specified qualities and standards of products. In general, orders of magnitude of the quantities of the basic raw materials required to manufacture one ton of glass are 600-750 kg. of silica; 200-250 kg. of soda ash; 200-250 of limestone and dolomite; 50-80 tons felspar and/or other materials. These quantities refer to beneficiated raw materials. Beneficiation is an essential operation in order to minimize impurities, to which glass making is especially sensitive. Raw material quantities transported to the factory site could be considerably higher than the orders of magnitude given above. The quantities of beneficiated raw materials used depend mainly on the choice of glass composition.

62. To determine the feasibility of using raw material sources for glass manufacture, satisfactory physical and chemical investigations are essential. In the East African sub-region, such investigations have been undertaken in several countries. These are now briefly reviewed.

63. In Ethiopia, several sources of silica bearing raw materials, i.e., sand, sandstone and quartz have been investigated. Many of them have been judged unsuitable for sheet glass or clear container glass manufacture for various reasons: insufficient reserves, too high beneficiation costs, uneconomic transport distances, totally undesirable impurities, etc. However, other alternative sources have been proved to be satisfactory for sheet glass and clear glass container manufacture: notably (a) in the Blue Nile Canyon area, (b) near Adola, (c) at Kulubi, (d) at some 50 km. from Asmara, etc. It is significant to note that these places have also limestone deposits in their vicinities.[1/] Dolomite reserves have been recognized in the Agordat, Blue Nile Canyon

1/ See: The Cement and Allied Industries in the EA Sub-region (E/CN.14/INR/84) AA.

and Chercher areas, and felspar in Neghelli, Massawa and Harar. However, there is no soda ash production in Ethiopia at the present time.

64. Sands suitable for the manufacture of glass are found along the coast in Kenya notably in the Sokoke forest. The sand deposits in the interior would be too contaminated with impurities for cheap utilization especially in sheet glass and glass container manufacture. There are important limestone reserves along the coast, notably near Mombasa as well as in the interior, e.g., at Sultan Hamud. Felspar is already mined at Kinejiki, and dolomite was recently found near Voi. Soda ash has been produced in Kenya since 1924, and still is an important export commodity. Much of this was formerly exported to South Africa, but economic sanctions have forced South Africa to look for other supplies. Though this has adversely affected Kenya's balance of trade, the widespread establishment of glass industries in the sub-region would more than offset Kenya's loss of trade and would of course provide close source of supply for the industries. In the event that Kenya's supplies turn out to be inadequate, the raw material can easily be imported from outside the sub-region.

65. Sands from various localities in Tanzania have been investigated for their potentials as glass making materials. Dar-es-Salaam beach sands appear to be unsuitable, but the most promising areas are (a) the shores of Lake Victoria near Bakoba, where a substantial reserve of good quality sand has been recognized and (b) the Pugu Hills where, however, a certain amount of beneficiation would appear to be required. Limestone of the appropriate quality and adequate reserves is found in Tanga, Dar-es-Salaam, and also in the Southern province. There are no reports of the presence of dolomites, but felspar has been found in several places. Soda ash is not produced in Tanzania at the present time, although the industry could be set up on the basis of the high salt crust and brine deposits of Lake Natron.

66. In Uganda, glass sands are found in many places along the shores of Lake Victoria. The best quality sands are found near Entebbe.

There are also other deposits, notably at Bukakata. So far as limestone is concerned the Sukulu deposits are not appropriate for glass making because of their high iron oxide content. In the Western Province, however, limestone deposits of better quality have been recognized. Soda ash is not produced in Uganda at present. In Rwanda, and Burundi, quartz veins could supply silica, but sands and sandstone are not common.

67. Deposits of glass sands are reported in the vicinity of Tamatave in Madagascar. Another glass sand deposit is recognized further inland at Moramanga near Tananarive. Limestone deposits are found in several places, notably at Antsirabe, Majunga, etc.[1/] Felspar is found in abundance in association with other minerals. There is no local production of soda.

68. In Zambia, the Kapiri Mposhi pure quartz sand deposits appear to be promising for glass manufacture, but further investigations are required to indicate whether they are of the appropriate chemical composition for sheet glass manufacture. Potential sand deposits for glass manufacture are known to be present in the Awels district and Umtali areas in Rhodesia. In both countries, the supply of the appropriate quality of limestone would pose no problem to the development of the industry. Felspar is also found in both countries. Soda ash is not produced in either country. Moreover, brine deposits have not yet been found, although investigations are proceeding in the Lake Makarikari area of Bechuanaland.

69. The above summarises the situation as regards basic raw materials for glass manufacture. By and large, the countries covered by the summary present positive conclusions in so far as establishing a glass factory is concerned. There are a few other countries where the extent of mineralogical surveys would not warrant the immediate establishment of glass works. However, sand and limestone could be considered to be fairly common. These tentative conclusions would now have to be cross-checked with other vital input factors.

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1/ Op.cit.

(b) Fuel and Power

70. Fuel resources and their cheap availability play a decisive role in the feasibility of a glass industry project. About half a ton of coal or its equivalent is used for every ton of glass melted. The price of fuel is the most important factor influencing the cost of production. Three methods are used for heating glass furnaces: gas produced from coal; natural gas; and heavy oil. Prices being equal, the preference of fuel is either oil or natural gas to coal because of ease of handling and consistency of composition of the former.

71. In the East African sub-region, both types of fuel are available. New oil refineries are under construction in Ethiopia, Madagascar, Tanzania, and Rhodesia.[1/] In addition, one refinery has already been completed at Mombasa in Kenya. The prospects for cheaper fuel supply in these countries appear to be materializing. Alternative fuel supplies also exist.

72. There are various well known lignite deposits in the central highlands of Ethiopia, notably at Chilga and Debre Berhan. Lignites also occur in Somalia and Kenya. In Tanzania, there are large reserves of coal in the Ruhuhu river area, which have important economic potentials. Coal has also been recognized in several places in Malawi and Zambia, but in the former Federation, Rhodesia dominates the East African coal situation with the substantial production of Wankie. Coal and lignite deposits have also been investigated in Madagascar, but remoteness of location constitutes a major handicap.

73. With regard to natural gas, sizeable deposits are known to exist in Lake Kivu (Rwanda). The exploitable portion of these deposits has been estimated at 44 thousand million cubic metres. Potentially, this represents a valuable asset not only for glass manufacture but for a complex of chemical industries. At present, however, exploitation still poses certain difficulties. The gas is found mixed with water

1/ See Petroleum Industry in the East African Sub-region (E/CN.14/INR/79), Addis Ababa, June 1965.

at a certain level below the surface of the Lake; and a method has yet to be found which allows the extraction of the gas without causing disturbances in the body of the lake which might cause the gas to escape.

74. Electric energy is still considered to be too costly a form of energy for glass melting. In the advanced countries, however, a tendency in that direction has been observed in recent years. Ease of application and control are among the major considerations which, in spite of higher costs per unit of heat, have led to more and more usage of electric energy. But even so, it is used primarily to supplement conventional heating means rather than to supplant them.[1/]

(c) Employment

75. The production of glass has become a highly mechanized process. This means two things. First, that the conventional method of estimating future employment via productivity rates is wholly inappropriate. Second that the glass industry will only provide little direct employment to mitigate the present and future unemployment problems of the sub-region. As in so many other cases, it is possible to manipulate the ratio of labour to capital within certain given limits, and consequently arrive at capital or labour intensive techniques. In the case of glass, however, the choice of labour intensive techniques in effect means the choice of obsolete techniques (blowing by mouth rather than mechanical blowing, for instance). Such techniques are as much a technological retrogression as the substitution of combines in agriculture for human labour, and are, consequently, not desirable. It should not be surprising, therefore, that the following estimates of employment for the sub-region are on the whole very low.

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1/ Shand, E.B., Glass Engineering Handbook, Mc Graw-Hill, p. 158.

76. In Madagascar, preliminary estimates showed that a plant producing 2,500 tons of glassware a year would employ about 100 workers[1/]. In Ethiopia, a plant whose capacity was three times as much was expected to employ 102 people. Madagascar's estimates would suggest a high employment figure of 2,200 for the sub-region in 1970; whereas that of Ethiopia would only give 700 for the same year. For 1975, the figure varies from a low of about 800 to a high of about 3,000. The truth lies somewhere between the two. A figure of 1,500 for 1970 and 2,000 for 1975 would perhaps be nearer the truth.

77. Data on labour requirements for sheet glass production for different scales of operations of plant indicate that total requirements increase very slightly with increase in size of plant. Hence, labour inputs per unit of output fall as scale increases. The following data refer to labour requirements of plants operating in industrialized countries:-

| | | | |
|---|---|---|---|
| Scale of operation (tons) | 5,500 | 7,500 | 10,500 |
| Labour requirements (No.) | 24 | 28 | 37 |
| No. of labours required per 1,000 tons | 6.4 | 5.6 | 4.8 |

78. Data for developing countries also indicate a similar fall in labour requirements with increases in scale of operations:-

| | | | |
|---|---|---|---|
| Scale of operations (tons) | 5,500 | 6,500 | 9,000 |
| Labour requirements (No.) | 155 | 170 | 195 |
| No. of labours required per 1000 tons | 28.2 | 26.2 | 21.7 |

79. The labour requirement of plants in developing countries are indicated to be of the order of five times the requirements of plants in the industrialized countries. The degree of mechanization is the main cause for this notable disparity. Materials handling, in-plant

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1/ The Malagasy Market, Marchés tropicaux et méditerranéens, July 1963, p. 97.

transportation, and various other auxilliary operations in the developing countries are thought to be more economically labour operated - because of the generally prevailing low wages. Although there is considerable lattitude in applying labour - capital substitutions in developing countries, however, it should be appreciated that there are limitations to the extent to which this could be carried with advantage.

80. With respect to the administrative and technical personnel required (included in the foregoing data) both in developed and developing countries, many of the differences that exist reflect the organizational and institutional characteristics of the various countries. Broadly, however, the tendency is for the employment of a considerably larger number of supervisory and administrative staff in the countries of the developing regions.

(d) Investment and related problems

(i) Glassware

81. How much investment would the new glassware plants that will supply East Africa's requirements for 1970 and 1975 call for? To answer the question in detail would call for a series of feasibility studies carried out on the spot. This study cannot obviously provide such an answer. What it will attempt to do is to provide an order of magnitude. It ought to be borne in mind that even as an order of magnitude, the figures are to be taken only as rough indicators.

82. An extensive study of glass making in one of the countries of the sub-region estimates that in order to build a factory producing some 8,000 tons of glassware a year, a total investment of some US $ 1 million is required. That covers the cost of the machinery, buildings and installation. In 1970, glassware consumption in the 12 countries of the sub-region is estimated to be around 55 thousand tons. The corresponding figure for 1975 is about 67 thousand tons. If the foregoing estimate on investment is applied to these figures, one

obtains a figure of about US$ 7.0 million for investment in 1970 and US $8.5 million for 1975.

83. These figures cannot be taken literally, however. In the first place, they assume that the countries of the sub-region will each choose a plant whose capacity is 8,000 tons to meet demand in 1970 and 1975. This, of course, cannot be assumed. There are markets where needs will be adequately and most economically met by factories of lower capacity. It is quite reasonable, therefore, to expect plants of lower capacity in many parts of the sub-region. Investment is bound to be higher in such a case. The figure for a factory of 8,000 tons also includes the cost of buildings. Here, one comes up against the problems of different wage rates and costs of building materials in the various countries. In this respect, however, the country whose investment figures have been quoted does not appear to be among the high cost countries. Its figure may, therefore, be taken as average or slightly below average. The same can be said of the cost of transporting the machinery. Finally, there are preliminary indications that other countries have seriously considered putting up plants which in relation to the one considered here appear to be too costly.

84. All these tend to indicate that the foregoing estimates are on the whole conservative. Thus, taking them as a lower limit, it might be roughly indicated that in 1970 investment will be in the range of $7 to 9 million, and $8 to $11 million in 1975. Needless to add that these are only very rough indications.

(ii) Sheet Glass

85. Unit cost of fixed investment is markedly sensitive to scale of operations in the sheet glass industry. The table below is compiled on the basis of data from various sources[1/], and defines the trend quantitatively and more strikingly.

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1/ e.g., "The Expansion of the Sheet Glass Industry in Ethiopia" - a report submitted to the Technical Agency of the Imperial Ethiopian Government in 1963.

TABLE 9

The variation of unit cost of fixed investment with scale of operations

| Scale of operations - annual capacity - (tons) | Unit costs of fixed investment in the sheet glass industry US$ per ton | |
|---|---|---|
| | Industrialized countries | East African Sub-region |
| 2,500 | ... | 400-450 |
| 3,000 | ... | 300-350 |
| 5,500 | 75-80 | 230-250 |
| 6,500 | ... | 190-220 |
| 7,500 | 60-75 | |
| 9,000 | ... | 150-170 |
| 10,500 | 55-60 | ... |

86. Two series of costs are indicated: one for the industrialized countries and another for the East African sub-region. Unit costs of fixed investment in the East African sub-region are noted to be as high as three times as they are in the industrialized countries. One of the main reasons for this lies in the initial high cost of capital equipment and machinery. There are also other contributory factors, such as distant maritime, road and rail transport, handling and insurance charges, increased costs of erection of plant and machinery, higher costs of feasibility and engineering studies, training costs, initial breakage costs and so on. A substantial share of the cost of fixed investment is accounted for by the non-variable factors. This is reflected in the sharp increases of unit costs at low productive capacities. It is evident from the figures of the table that unit costs begin to be reasonable at annual capacities exceeding 5,000 tons.

87. Plants which are defined as economic minimum sized plants operate in the range of 5-6,000 tons. There are several of these units already installed in some of the developing countries. On the basis of 300-330 days of operation per year, this is a daily production rate of 15-20 tons. The area equivalent range is 8-9 million sq.ft. annually of sheet glass of average thickness of 2.8 mm.

88. Should the internal market of any country reach this level, then in all likelihood, a domestic sheet glass industry should be feasible. A factory could still be established with tariff protections to pull it through the initial difficult stages even if the cost of production is judged to be too high. Cost of production, however, becomes a critical and decisive factor when it comes to more than one country sharing an integrated sheet glass industry. Prices of the locally produced product would have to compete with c.i.f. prices of the imported product in all the participating countries. The above concept of the minimum economic plant size might have to be increased significantly to take account of this factor effectively.

89. Once more the economies of scale play an important role in the cost of production factor as well. Unofficial estimates in both the industrialized countries and the countries of the East African sub-region give the following range of costs at different scales of operations.

TABLE 10

The variation of cost of production with scale of operations

| Scale of operations capacity in tons | Unit cost of production in the sheet glass industry US$ per ton | |
|---|---|---|
| | Industrialized countries | East African Sub-region |
| 2,500 | .... | 200 |
| 3,000 | .... | 170 |
| 5,500 | .... | 120 |
| 6,500-7,500 | 65-70 | 110-120 |
| 9,000 | .... | 110 |
| 10,500 | 60 | .. |

90. The orders of magnitude of production costs are much higher in the East African sub-region than in the industrialized countries at the same level of scale of operations. Based on the incomplete data of the table, the ratio appears to be 1 to 2. This disparity in costs is envisaged to come about with higher costs of inputs under the East African supply situation. It should in particular be noted that the above series of production costs tend to be conservative estimates, and by and large reflect hinterland operation conditions. The sitting of the industries in the coastal areas in closer proximity to the oil refineries under construction or in operation and also near the major parts of the sub-region, where alternative supply of imported fuel is cheaper, would in all probability bring about a 10-20 per cent reduction in production costs.

91. However, major reductions in production costs could in the first stage best be brought about through increasing scale of operations. From the table it would be noted that within the given range, the quadrupling of capacity yields a halving of production costs. Similar to the discussion on unit costs of fixed investment, the rate of decrease of unit cost of production becomes progressively smaller with increases in annual capacity beyond 5,000 tons.

92. The main components in the cost are labour, fuel and raw materials. Broadly, they account for 20, 40 and 30 per cent, respectively. The only element of cost which varies directly with scale of operations is the cost of raw matorials. The others decrease only slightly with reduced production. Therefore, major attempts at production costs should aim at the most favourable prices of fuel and energy on the one hand, and efficient utilization of labour on the other.

93. The comparison of costs of production indicated in the table with current c.i.f. prices would now be attempted to see whether there is scope for profitable integrated sheet glass industries in the sub-region. The following table compiles the average c.i.f. price of

sheet glass at the ports of entry in the countries of the East African sub-region.

TABLE 11

C.i.f. prices for sheet glass

| Country | Place | Date | C.i.f./landed price US.$ per ton |
|---|---|---|---|
| Ethiopia | Assab | 1963 | 142 |
| Kenya | Mombasa | 1963 | 133 |
| Madagascar | Tamatave | 1963 | 232 |
| Mauritius | | 1962 | 133 |
| Tanzania | Dar-es-Salaam | 1963 | 149 |
| Malawi, Rhodesia, Zambia | Umtali | 1963 | 122 |

By and large the thickness of the glass is thought to be of the order of 2.5 mm. Price quotations of sheet glass vary considerably with variations in thickness and size. There are also cheaper sources of supply. Therefore, the data of the above table can only give broad orders of magnitude of c.i.f. prices.

94. The salient conclusion to be drawn from the comparison of the two tables is that within the framework of integrated development of the industry, a glass industry begins to be profitable at scales of operations exceeding 5,000 tons per annum. This again highlights the conclusion arrived at from the consideration of unit costs of fixed investment in an earlier paragraph.

95. Finally, in this connexion, the importance of the marketing costs and their influence on the feasibility of a glass industry cannot be over-emphasized. Inter-territorial transport facilities have not yet been adequately developed. Freight and handling charges are high.

Therefore, the glass industry like all others will have to balance carefully those factors which influence decisions of location. In addition, in this case, the need of export markets on the one hand, and the general East African sub-regional pattern of the lucrative markets being situated in the hinterland on the other, will need careful consideration, study and judgement for best solutions. By and large, however, the balance appears to be in favour of coastal plants.

## V. ORGANIZING FOR SUB-REGIONAL PRODUCTION

### (a) The Alternatives

#### (i) Glassware

96. The preceding analysis strongly suggests that there is a good case for establishing glass making plants to meet demand in 1970 and 1975. Where and when are such plants to be established?

97. With regard to the high-consumption countries, there is obviously no problem as their markets fully justify the establishment of plants of fairly sizeable capacities. By and large the same can be said of the medium -- consumption countries. The problem arises for the five countries where consumption appears to be too low to warrant the immediate establishment of economically justifiable plants. The table below sets out the total consumption of glassware for these five countries.

TABLE 12

Consumption of glassware (tons) for low consumption areas

| Country | 1970 | 1975 |
|---|---|---|
| 1. Malawi | 1,320 | 1,500 |
| 2. Burundi | 1,140 | 1,320 |
| 3. Rwanda | 1,050 | 1,290 |
| 4. Mauritius | 900 | 1,170 |
| 5. Somalia | 900 | 1,080 |

98. From a purely technical viewpoint it may be possible to design plants to fit the markets of these countries. But it is doubtful that such technical solutions will satisfy economic requirements. What then is the solution?

99. There is perhaps no single solution that will meet the special conditions of each of the five countries. Three possible solutions will therefore be considered.

100. The first would be for these countries to take advantage of surplus capacity in the plants of their bigger neighbours. Present indications are that this will be a feasible solution. Studies indicate that the present plant in Ethiopia has a capacity approaching 10,000 tons (although it is producing from 6-7,000 tons at present). In that case, Ethiopia's proposed new plant producing 7,800 tons and the present one will have a combined capacity of some 14-18 tons a year. This will be adequate to meet Somalia's requirements in both 1970 and 1975.

101. Madagascar's market would justify the establishment of a plant whose capacity is between 4-6,000 tons. If such a plant is established, it will adequately meet the requirements of both Madagascar and Mauritius in both 1970 and 1975.

102. Tanzania has undertaken the construction of a plant with a capacity of between 4,500 - 6,000 tons. This will more than meet its requirements in 1970 (4,890 tons) and will be adequate for 1975 (6,390 tons).

103. In Uganda there is a possibility of establishing a 4-6,000 ton plant. Again this will more than meet its requirements in 1970 (3,930 tons) and 1975 (5,340)

104. Both Rwanda and Burundi can be supplied from these plants in 1970. In 1975, however, they cannot; as their demand as well as that of Tanzania and Uganda will have outstripped productive capacity. It might be justifiable to consider, therefore, that in 1975 a plant producing some 3-4,000 tons be established for Burundi and Rwanda, whose demand in that year will have reached 2,600 tons.

105. With regard to Malawi, a plant whose capacity is 10,000 tons established in Zambia can meet adequately the demand of these two countries in 1970 (9,020 tons) and in 1975 (10,500 tons).

106. The second solution is more or less a reversal of the first. Instead of the big countries supplying the smaller ones, the latter

will supply the former. This solution rests essentially on the principle of supplying the deficit in production in the large markets. For instance, Kenya's present capacity of 12,000 tons will fall short of adequately meeting its demand in 1970 by about 1,000 tons and by 3,210 tons in 1975. For Kenya, these are relatively small deficits (especially that of 1970). But for a country like Somalia, Kenya's deficit of 1,000 tons in 1970 and 3,000 tons in 1975 represents a market of 100-300 per cent its own. Sometime before 1975, Somalia can establish a plant of some 4,000 tons to supply its own market and Kenya's deficit. This solution can be generalized for most of the smaller countries of the sub-region. If Zambia decides to establish a plant of 8,000 tons (instead of 10,000 tons), by 1975 Malawi can have a plant supplying its own requirements (1,500 tons) and the deficit in Zambia's output (1,000 tons). That plant may have a capacity of 3-4,000 tons. As was suggested before, a plant of 3-4,000 tons a year for Rwanda and Burundi will, in this scheme, meet a deficit of some 400 tons in Tanzania's market.

107. As Madagascar will have excess capacity even by 1975, this scheme might have prove to be applicable to Mauritius.

108. The third alternative provides a system of inter-dependence arising from specialization. This will allow the low consumption countries to concentrate on specialized glass products which can be produced on a small scale. The following limited examples show small scale production of specialized glass products.

TABLE 13

Possibility of specialized glass production

| Type of product | Capacity (per annum) |
|---|---|
| Laboratory glass | 2,000 tons |
| Glass for electric lighting | 3,000 tons |
| Household glass | 2,000 tons |

109. If the low consumption areas specialized in the production of these types, they would be ablo to operate them on full capacity. They would consequently avoid the danger of operating small ordinary glass plants at low capacity (as they inevitably will if they decide to have a plant each), and allow the high consumption areas to supply them with ordinary glass (bottles, glasses, etc.) in exchange for their own specialized products. The high consumption areas would at the same time be free to establish large-scale plants without feeling obliged to maintain deficits in production.

110. Solutions would vary from one area of the sub-region to another. But there is a lot to be said for the last alternative where a truly interdependent system of production seems to hold much promise.

(ii) Sheet glass

111. The major factors determining the feasibility of establishing sheet glass factories in the East African sub-region were discussed at some length in the body of the report. It now remains to examine what avenues there are for launching the development of the industry in the sub-region.

112. Consideration of the present market and its future prospects has shown that no single country is likely to attain in the near future the level of scale of operations that is considered compatible with profitable operations. Both investment costs and production costs per unit of output rise steeply at production levels of less than 5,000 tons per annum. But the over-all sub-regional market is large enough even at the present time to sustain a modern and efficient sheet glass industry. The demand estimates of the sub-regional markets for 1970 and 1975, which would be of the order of 14,300 and 24,500 tons respectively, point to the need for an immediate start on the development of the industry.

113. A phased programme of action is suggested by the breakdown of the sub-regional market by broad geographic and also economic entities

within the present limitations of transport and communications. These zones and their respective markets are defined as follows:-

TABLE 14

Zonal distribution of demand

| Zone | Project sheet glass demand (tons) 1970 | | 1975 | |
|---|---|---|---|---|
| Zone A Ethiopia, Fr. Somaliland, Somalia | 2,500 | 9,500 | 4,700 | 12,100 |
| Zone B Burundi, Kenya, Tanzania, Rwanda, Uganda | 5,400 | | 9,400 | |
| Zone C Comoro, Madagascar, Mauritius, Reunion | 1,600 | | 2,700 | |
| Zone D Malawi, Rhodesia, Zambia | 4,800 | | 7,700 | |

114. Two plants appear to be feasible in the immediate future - and to be ready for operation by 1969.

Unit 1.

115. One would be a plant installed in Zone B, and taking advantage of the markets of Zones A and C. Its capacity would be primarily determined by the demand within its own zone in 1975 (9,400 tons). In addition, however, it would appear that it would in all probability have access to the market of Zone C, which would still not be of a size to justify a separate economic plant. Unit 1 would appear therefore to be assured of a market of 10,000 tons per annum up to 1975 and more (12,100 t.) after 1975. The unit can therefore be launched with an initial capacity of 10,000 tons which would be expanded to some 12,000 tons capacity after 1975.

Unit 2.

116. The other unit - Unit 2, could also be launched immediately in Zone D, but it would need additional export markets to justify a more profitable operation. These are not lacking in the neighbouring countries, namely Mozambique and Katanga. In all probability, Unit 2 would be assured of a total market of not less than 8,000 tons per annum. This order of productive unit would cover the need of Zone B well after 1975.

Unit 3.

117. Unit 3, which is based on the demand of Zone A, can only be justified after 1970. In addition, export markets would also be required. It would appear that there are tangible prospects for exporting to Aden, Saudi-Arabia and the Sudan. It is envisaged that Unit 3 can count on a market of 6,500 tons per annum as 1975 approaches, and therefore its capacity is planned as such.

118. In all the three projects, the prerequisite raw materials and relatively cheaper fuel supply have been proved to be available. In the case of unit 1, its choice of location revolves around the areas centering on Mombasa and Dar-es-Salaam. These locations have the advantages of the proximity of the oil refineries on the one hand and facilities for handling exports on the other. The choice between the two locations can only be justified through detailed cost and income calculations. The problem of choice is also present in the location of the other two units: that of unit 2 revolves around whether the location is to be in the Copperbelt or at some other centre nearer to the Umtali oil refinery, and that of unit 3 whether it is to be a coastal plant (Asmara-Massawa) or a hinterland plant (Addis Ababa).

119. The sub-division of the sheet glass market into these units of operation does not mean that inter-zonal transfer of the product is restricted. On the contrary, the free flow of the product within the sub-region would lead to a more organic structure and should be

encouraged. It is quite possible that Somalia could be supplied with her requirements of sheet glass at a cheaper price from a coastal plant in Kenya or Tanzania than from a hinterland plant in Ethiopia. Similarly, frontier areas in one zone could benefit more from a plant in another zonal grouping.

120. Estimation of the investment required for setting up the three plants could be based on the following assumptions which are made to facilitate computations:-

(a) that Unit 1 is a coastal plant.

(2) that Units 2 and 3 are hinterland plants.

(c) the calculation of the investments cover those that are required to develop the industry up to 1975 only.

121. Table 15 below summarizes the steps in the computations:

TABLE 15

Total investment requirements for sheet glass

| Unit | Annual capacity (tons) | Assumed Unit Cost of Fixed Investment US.$/ton | Total Investment US.$ |
|---|---|---|---|
| Unit 1 | 10,000 | 130 | 1,300,000 |
| Unit 2 | 8,000 | 180 | 1,440,000 |
| Unit 3 | 6,50 | 190 | 1,235,000 |
| 1975 target | 24,500 | | 3,975,000 |

(b) Economic benefits

(i) Glassware

122. The last point to consider in this analysis is the foreign exchange that will eventually be saved when local manufactures begin to replace imports. There are a number of factors to consider in this respect, the most important of which are the following:

(a) The cost of machinery and equipment

(b) The cost of imported raw materials and fuel

(c) The cost of expatriate salaries

(d) Maintenance and other related costs

(e) The cost of materials other than those in (a) (in the case of glass, refractory materials, and related tools)

(f) The price at which one unit of the product in question can be produced as compared with the unit price of the same materials imported from abroad.

123. For the purpose of this analysis, a sample plant will be considered where all these calculations will be worked out. The calculations draw upon an exhaustive study made on the possibilities of glass production in Ethiopia[1/]. This study considered the feasibility of establishing a plant with a yearly capacity of 7,800 tons producing different types of bottles, flasks, and pressed glass. It made a number of estimates on the price per unit of each type of glass. On the basis of these price figures and on the basis of the capacity of the plant, the country would produce 1 kilo of glass at US.$ 0.127. The import price per kilo of the type of glass the plant would produce comes to US.$ 0.216. Taking out customs duty (30 per cent), the latter figure drops to US.$ 0.166. The unit price of the domestically produced commodity would consequently represent a saving of 23 per cent. That is the first and important consideration.

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1/ Study on the Feasibility of a Technological and Economically successful glasswork in the Senkelle - Ambo area

1) Volume A- Marketing Report

2) Volume B- Geological and Mineralogical report

3) Volume C- Report on Extraction and Refining methods of Quarry Materials

4) Volume D- Glass work study

5) Volume E- Technical Economic Report: Conclusions and suggestions.

Reports submitted to the Technical Agency (Imperial Ethiopian Government) - March 1965.

124. The plant in question would produce US.$ 993,200 of glass per year. As the previous paragraph shows foreign exchange calculations cannot be made on this basis. If that amount of glass were to be imported, the country would actually pay 23 per cent more, or US.$ 1,221,636. It is from that figure that the foreign exchange costs would have to be deducted.

| Hence:- | | US. $ |
|---|---|---|
| 1. | Value of total production | 1,221,636 |
| 2. | Cost of raw materials | 312,000 |
| 3. | Cost of fuel oil | 16,056 |
| 4. | Expatriate salaries | 38,400 |
| 5. | Cost of various materials | 11,520 |
| 6. | Miscellaneous (including repairs) | 4,800 |
| 7. | Savings in Foreign Exchange (1 less 2 + 3 + 4 + 5 + 6) | 838,860 |

125. That figure excludes the cost of machinery and equipment which was estimated at US.$ 680,000. But as the figures show, however, that cost is well within the yearly saving in foreign exchange - i.e., US.$ 838,860. A year's production thus appears to give a foreign exchange saving which can entirely finance the cost of machinery and equipment.

126. This conclusion, which is for a specific country and a specific plant obviously cannot be generalized. But if a plant of a fairly large capacity brings about substantial savings in foreign exchange, smaller plants would bring about perhaps <u>less</u> substantial savings, but hardly no savings at all.

(ii) <u>Sheet glass</u>

127. An investment of the order of US.$ 4 million made within the next five years at the most would make the sub-region self-sufficient for its needs of sheet glass. This is an annual rate of investment of less than US.$ 1 million, which is clearly within the grasp of the individual countries let alone the sub-region as a whole.

128. This order of investment will do away with the present expenditure on imports of sheet glass. In the early sixties, this expenditure was of the order of US.$ 1.5 million annually for the sub-region as a whole. At its peak in 1957, it approached US.$ 2.0 million annually. This order of expenditure is a net saving in foreign exchange. The foreign exchange component of the cost of production is expected to be very low in the sub-region. The prospects are therefore that the development of the industry would be arresting effectively an otherwise ever increasing expenditure on imports. Such imports are estimated to necessitate the expenditure of US.$ 2-3 million annually by 1970 and US.$ 3-5 million dollars by 1975. The cumulated value of the expenditure on imports between now and 1975, if steps are not taken to develop domestic production, is estimated to be of the order of US.$ 20-30 million. Such simple calculations already emphasize the arguments for immediate and urgent actions towards the development of the sheet glass industry in the sub-region.

(c) Concluding remarks

129. The discussion on employment and foreign exchange savings showed that the benefits to be derived from an integrated glass industry for the sub-region would not on the whole be substantial. Nevertheless, this is not an argument either for postponing the substitution of imports by domestic manufactures or for under-estimating the considerable indirect benefits that would accrue from the development of the industry.

130. The contribution of the domestic industry to technological know-how in the sub-region can hardly be exaggerated. The local industries would be valuable training grounds for glass technologists, foremen and skilled operators. The technological groundwork would thus be laid for the long-term development of the industry, for future technical initiative, and for more relevant research and study under the specific conditions and requirements of the countries of Africa.

131. Finally, it would be appreciated that the development of the industry would be one more addition to the essential need for diversification of domestic production, which is vital to economic development in general. Supply situations could be improved, rising prices due to seasonal shortages would be avoided, and unnecessary delays in supplies would not occur. For example, although production costs of the immediate plants proposed for the sub-region might not be low enough to bring down prices of sheet glass in the near future, yet the very stability brought about with regard to supplies is very likely to influence housing and building costs favourably.

(d) Summary of recommendations

1. Glassware

132. With regard to medium and high consumption areas, markets are large enough to warrant the establishment of glassware plants of varying capacities. These capacities have been roughly indicated in this study.

133. In so far as low consumption areas are concerned, (i.e. Malawi, Burundi, Rwanda, Mauritius, and Somalia), national markets are not large enough to support economically feasible plants. There are three ways in which this problem can be overcome.

134. The first is for the low consumption countries to take advantage of surplus capacity in the plants of their larger neighbours. Present indications are that this will be a feasible solution.

135. The second is for these countries to establish plants which will supply their own markets and the deficits in production in the high and medium consumption countries. There are cases where this solution is worth considering seriously.

136. The third, and perhaps the best, is a system of interdependence based on specialization. The low consumption countries would concentrate on the production of special glass products (e.g., laboratory glass), and the high consumption countries on ordinary glassware. In this way, the low consumption areas would avoid the danger of operating small ordinary glass plants at low capacity, while the high and medium consumption areas would be free to establish large and profitable plants without feeling obliged to maintain deficits in production.

2. Sheet Glass

137. The foregoing discussion on the basic economic and technical factors governing the growth of the industry would suggest the following development pattern for the industry within the East African sub-region.

TABLE 16

Sheet Glass Industry, Summary of Development Possibilities and Costs

| Unit | Annual capacity (tons per year) | Choices of location | When required | Markets to be served | Investment costs US $ million |
|---|---|---|---|---|---|
| Unit 1 | 10,000 | Coastal plant Mombassa/ Dar-es-Salaam | before 1970 | Zone A Ethiopia French Somaliland, Somalia<br>Zone B Burundi, Kenya, Tanzania, Rwanda and Uganda<br>Zone C Comoro, Madagascar, Mauritius, Reunion | 1.3 |
| Unit 2 | 8,000 | Hinterland plant Ndola/ Umtali | before 1970 | Zone D Malawi, Rhodesia, Zambia with possibilities of export to Katanga, and Mozambique to make up for under-capacity utilization before 1975 | 1.44 |
| Unit 3 | 6,500 | Possibly a hinterland plant Addis Ababa/Asmara | after 1970 before 1975 | Zone A Ethiopia, French Somaliland, Somalia with possibilities of export to the Red Sea area | 1.235 |
| 1975 Target | 24,500 | Total import substitution of sheet glass in the East African sub-region | | | 4.0[a] |

a/ Rounded figure.

# ANNEX I

## TABLE - 1

### Imports of sheet glass

(Quantities in 1000 sq.ft.)

| Country | 1954 | 1955 | 1956 | 1957 | 1958 | 1959 | 1960 | 1961 | 1962 | 1963 |
|---|---|---|---|---|---|---|---|---|---|---|
| Ethiopia a/ | 931 | 1,076 | 1,216 | 1,206 | 1,119 | 1,119 | 1,507 | 1,432 | 732 | 1,200 |
| Kenya | 2,297 | 2,277 | 2,626 | 2,613 | 1,746 | 2,314 | 2,592 | 1,291 | 1,357 | 1,409 |
| Madagascar b/ | 807 | 972 | 869 | 817 | 794 | 887 | 934 | 814 | 1,242 | 1,010 |
| Mauritius | 926 | 1,119 | 1,055 | 1,550 | 1,421 | 786 | 2,476 | 2,056 | 1,292 | 1,292 c/ |
| Tanzania | 781 | 761 | 908 | 962 | 818 | 915 | 797 | 943 | 872 | 1,023 |
| Uganda | 793 | 1,063 | 1,167 | 755 | 909 | 791 | 884 | 528 | 484 | 996 |
| Malawi, Rhodesia, Zambia | 3,917 | 5,837 | 5,627 | 7,137 | 5,804 | 4,439 | 5,191 | 3,662 | 4,416 | 4,466 |
| Total | 10,452 | 13,105 | 13,468 | 15,040 | 12,611 | 11,251 | 14,381 | 10,726 | 10,395 | 11,396 |

Source: National Trade Reports.

a/ Based on import values of sheet and plate glass. Quantity conversions. assessed by consultants.

b/ National trade report given in million ton units, sq.ft. assessments by secretariat.

c/ 1962 figure.

TABLE 2

Imports of plate glass in the East African sub-region

Quantities in 1000 sq.ft.

| Country | 1954 | 1955 | 1956 | 1957 | 1958 | 1959 | 1960 | 1961 | 1962 | 1963 |
|---|---|---|---|---|---|---|---|---|---|---|
| Ethiopia a/ | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| Kenya | 87 | 126 | 286 | 215 | 182 | 123 | 102 | 52 | 56 | 34 |
| Madagascar b/ | .. | .. | .. | .. | 110 | 126 | 145 | 111 | 147 | 270 |
| Mauritius | - | 65 | 54 | 65 | 22 | 43 | 47 | 45 | 208 | 208 c/ |
| Tanzania | 15 | 39 | 70 | 46 | 34 | 26 | 25 | 41 | 21 | 34 |
| Uganda | 32 | 63 | 56 | 37 | 50 | 46 | 26 | 42 | 22 | 20 |
| Malawi, Rhodesia, Zambia | 263 | 304 | 339 | 463 | 459 | 269 | 384 | 218 | 506 | 91 |
| Total | 397 | 597 | 805 | 826 | 857 | 635 | 729 | 509 | 960 | 657 |

Source: National Statistics.

a/ Included with sheet glass in Table 1.

b/ National trade report given in Metric units. Sq.ft. assessments by secretariat.

c/ 1962 figure.

TABLE 3

Imports of sheet and plate glass in the East African sub-region

(Quantities in 1000 sq.ft.)

| Country | 1954 | 1955 | 1956 | 1957 | 1958 | 1959 | 1960 | 1961 | 1962 | 1963 |
|---|---|---|---|---|---|---|---|---|---|---|
| Ethiopia | 931 | 1,076 | 1,216 | 1,206 | 1,119 | 1,119 | 1,507 | 1,432 | 732 | 1,200 |
| Kenya | 2,384 | 2,403 | 2,912 | 2,828 | 1,928 | 2,437 | 2,694 | 1,343 | 1,413 | 1,443 |
| Madagascar | 807 | 972 | 869 | 817 | 904 | 1,013 | 1,079 | 925 | 1,389 | 1,280 |
| Mauritius | 926 | 1,284 | 1,109 | 1,615 | 1,443 | 829 | 2,523 | 2,101 | 1,500 | 1,500 |
| Tanzania | 796 | 800 | 978 | 1,008 | 852 | 941 | 822 | 984 | 893 | 1,057 |
| Uganda | 825 | 1,126 | 1,223 | 792 | 959 | 837 | 910 | 570 | 506 | 1,016 |
| Malawi, Rhodesia, Zambia | 4,180 | 6,141 | 5,966 | 7,600 | 6,263 | 4,708 | 5,575 | 3,880 | 4,922 | 4,557 |
| Total | 10,849 | 13,702 | 14,273 | 15,866 | 13,468 | 11,886 | 15,110 | 11,235 | 11,355 | 12,053 |

Source: Tables I and II.

TABLE 4

Values of imports of sheet and plate glass in the East African sub-region

Value in 1000 US$

| Country | 1954 | 1955 | 1956 | 1957 | 1958 | 1959 | 1960 | 1961 | 1962 | 1963 |
|---|---|---|---|---|---|---|---|---|---|---|
| Ethiopia | .. | 89 | 104 | 101 | 88 | 98 | 136 | 136 | 62 | 129 |
| Kenya | 253 | 269 | 413 | 368 | 263 | 320 | 364 | 164 | 181 | 165 |
| Madagascar | .. | .. | .. | .. | 125 | 124 | 136 | 125 | 179 | 187 |
| Mauritius | 74 | 101 | 121 | 102 | 106 | 123 | 140 | 136 | 145 | 145 |
| Tanzania | 91 | 105 | 114 | 111 | 103 | 98 | 104 | 128 | 106 | 111 |
| Uganda | 237 | 231 | 354 | 319 | 224 | 276 | 310 | 155 | 162 | 157 |
| Malawi, Rhodesia, Zambia | 404 | 599 | 633 | 837 | 797 | 514 | 596 | 424 | 591 | 393 |
| Total | 932 | 1,303 | 1,560 | 1,643 | 1,610 | 1,391 | 1,588 | 1,202 | 1,315 | 1,211 |

Source: National Trade Reports.

TABLE 5

The share of the construction industry in gross domestic fixed capital formation

| Country | Year | Percentage GDFC/GNP | Dwellings | % | Non-Resid. Buildings | Sub-total 4 + 5 | Other Construction | Total 6 + 7 |
|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | | 5 | 6 | 7 | 8 |
| 1. Ceylon | 1950 | 9 | ---------- | 48 | ---------- | 48 | 25 | 73 |
| | 1953 | 10 | ---------- | 38 | ---------- | 38 | 30 | 68 |
| | 1958 | 12 | ---------- | 45 | ---------- | 45 | 29 | 74 |
| | 1960 | 13 | ---------- | 36 | ---------- | 36 | 36 | 72 |
| 2. China (Taiwan) | 1958 | 15 | 11 | | 21 | 33 | 18 | 51 |
| | 1960 | 18 | 13 | | 20 | 33 | 21 | 54 |
| 3. Cyprus | 1953 | 14 | 30 | | 12 | 42 | 14 | 56 |
| | 1958 | 17 | 23 | | 12 | 35 | 16 | 51 |
| | 1960 | 16 | 24 | | 11 | 35 | 14 | 49 |
| 4. Denmark | 1948 | 13 | 22 | | 10 | 32 | 15 | 47 |
| | 1953 | 16 | 19 | | 13 | 32 | 15 | 47 |
| | 1958 | 17 | 15 | | 15 | 30 | 14 | 44 |
| | 1960 | 19 | 15 | | 16 | 31 | 13 | 44 |
| 5. Ecuador | 1950 | 9 | 17 | | 6 | 23 | 29 | 52 |
| | 1953 | 11 | 12 | | 6 | 18 | 28 | 46 |
| | 1958 | 13 | 17 | | 11 | 28 | 25 | 53 |
| | 1960 | 14 | 13 | | 9 | 22 | 30 | 52 |
| 6. Ghana | 1958 | 30 | ---------- | 61 | ---------- | 61 | 18 | 79 |
| | 1960 | 20 | ---------- | 55 | ---------- | 55 | 13 | 68 |

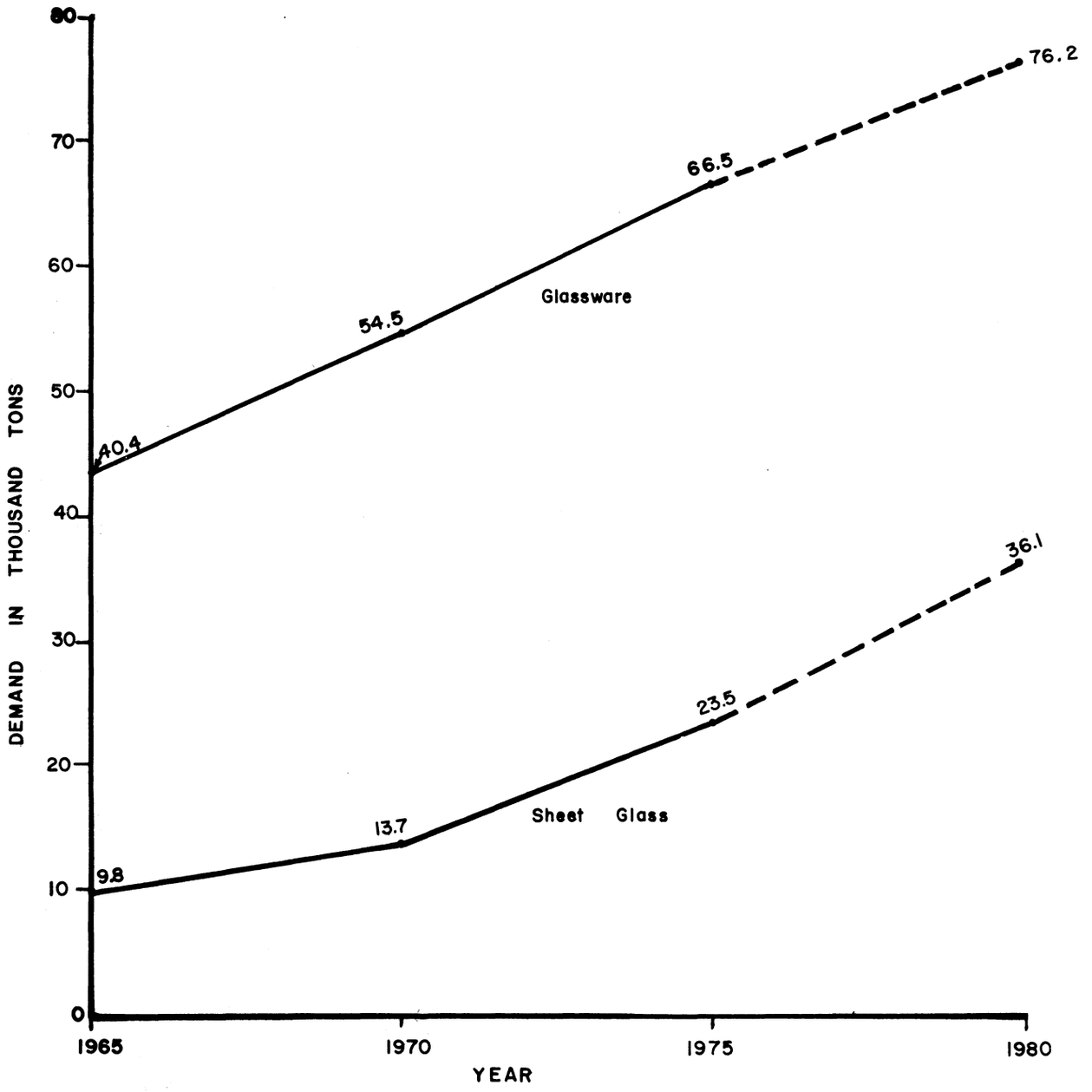
(Table 5 Continued)

| Country | Year | Percentage GDFC/GNP | Dwellings | % | Non-Resid. Buildings | Sub-total 4 + 5 | Other Construction | Total 6 + 7 |
|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | | 5 | 6 | 7 | 8 |
| 7. Greece | 1948 | 11 | 33 | | 8 | 41 | 23 | 67 |
| | 1953 | 12 | 39 | | 13 | 52 | 22 | 74 |
| | 1958 | 18 | 30 | | 10 | 40 | 21 | 61 |
| | 1960 | 25 | 21 | | 11 | 32 | 20 | 52 |
| 8. Honduras | 1950 | 12 | 29 | | 19 | 48 | 24 | 72 |
| | 1953 | 17 | 20 | | 23 | 43 | 30 | 73 |
| | 1958 | 13 | 25 | | 11 | 36 | 23 | 59 |
| 9. Ireland | 1953 | 15 | 21 | | 16 | 37 | 25 | 62 |
| | 1958 | 13 | 13 | | 17 | 30 | 23 | 53 |
| 10. Italy | 1953 | 19 | 21 | | 5 | 26 | 26 | 52 |
| | 1958 | 20 | 29 | | 7 | 36 | 25 | 61 |
| | 1960 | 22 | 25 | | 8 | 33 | 24 | 57 |
| 11. Kenya | 1950 | .. | 22 | | 22 | 44 | 19 | 63 |
| | 1958 | 19 | 18 | | 18 | 36 | 25 | 61 |
| | 1960 | 18 | 17 | | 15 | 32 | 23 | 55 |
| 12. Luxembourg | 1958 | 24 | 17 | | 18 | 35 | 22 | 57 |
| | 1959 | 23 | 16 | | 20 | 36 | 24 | 60 |
| 13. Malta | 1958 | 23 | 15 | | 16 | 31 | 28 | 59 |
| | 1960 | 20 | 22 | | 16 | 38 | 30 | 68 |

(Table 5 Continued)

| Country | Year | Percentage GDFC/GNP | Dwellings | % | Non-Resid. Buildings | Sub-total 4 + 5 | Other Construction | Total 6 + 7 |
|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | | 5 | 6 | 7 | 8 |
| 14. Mauritius | 1953 | 15 | 25 | | 11 | 36 | 20 | 56 |
| | 1958 | 16 | 21 | | 10 | 31 | 16 | 47 |
| | 1960 | 21 | 25 | | 10 | 35 | 17 | 52 |
| 15. Morocco | 1951 | 22 | 19 | | 11 | 30 | 20 | 50 |
| | 1953 | 20 | 18 | | 13 | 31 | 15 | 46 |
| | 1958 | 11 | 22 | | 7 | 29 | 21 | 50 |
| 16. Sweden | 1953 | 21 | 24 | | 39 | 62 | 15 | 77 |
| | 1960 | 22 | 23 | | 41 | 64 | 14 | 78 |
| 17. Tanganyika | 1954 | 18 | 31 | | 13 | 44 | 19 | 63 |
| | 1958 | 16 | 32 | | 18 | 50 | 13 | 63 |
| | 1960 | 15 | 28 | | 15 | 43 | 14 | 57 |
| 18. Uganda | 1953 | .. | ---------- | 37 | ---------- | 37 | 25 | 62 |
| | 1958 | 13 | ---------- | 40 | ---------- | 40 | 19 | 59 |
| | 1960 | 11 | ---------- | 35 | ---------- | 35 | 23 | 58 |

Source: United Nations Yearbook, 1962.

**The Demand for Glassware and Sheet Glass**

**1965—1980**