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SOUTH-SOUTH CO-OPERATION IN MINERAL RESOURCE-BASED INDUSTRIES*

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Preface

This paper, on the potential for greater South-South co-operation in selected mineral-based industries, was written as one of the background essays for the Global Report now being prepared at UNIDO. The paper generally follows the Global Report by dividing the world into the 11 regions of the UNITAD model.

With a view to self-consistency all the figures concerning mineral reserves and rates of their extraction and refining (except those referring to fuels), were taken from Mineral Facts and Problems, US Bureau of Mines Bulletin 671, the 1980 edition.*

It was one of the writer's objectives not to duplicate published work. The reader is therefore referred, in addition to the references in the text, especially to the following publications.

- UNIDO, Mineral Processing in Developing Countries, ID.253, which concentrates on the issue of how to boost the value added to minerals and metals in the developing countries producing them;

- UNIDO, 1990 Scenarios for the Iron and Steel Industry, IS.213, which, in addition to being a treasure house of detailed technical information, lists the development intentions of the Southern countries;

- UNIDO, Fertilizer Manual, No. 13 in the Development and Transfer of Technology series, ID.250; and

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* The figures stated there in non-metric units (short tons, pounds, etc.) were all converted to metric units. As a result, some of the data in this paper are stated to an unlikely degree of accuracy: this, however, has been considered preferable to a great deal of arbitrary round. The data in the source were regrouped to fit the eleven-region subdivision of the globe chosen for the Global Report. - In assigning to the eleven regions some minor items labelled "others" in the source, subjective judgment was used.

- UNIDO, Second World-Wide Study on the Petrochemical Industry: Process of Restructuring, ID.WG.336/3.

For petroleum, natural gas and petroleum refining, no better source than the periodic.l Petroleum Economist is used.

Summary

A.1. Of the mineral resource-based industries, this paper considers petroleum refining, petrochemicals, mineral fertilisers and metallurgy.

2. The South is undergoing a process of economic differentiation. The NICs are slated to play a predominant role in the industries considered here, both as producers and consumers and as makers of capital goods and diffusers of technology. OPEC may contribute significantly to the financing of expansion in these industries. For these reasons, much of South-South co-operation may get short-circuited between these two groups, leaving the poorer or less sophisticated Southern countries out in the cold. A firm political purpose is required to keep that tendency within reasonable bounds.

3. The general proposal advocated in this paper is that the South should aim at an intelligent, calculated and gradual collective import substitution in the mineral resource-based industries.

B.1. Petroleum refining is widespread in the South: 73 developing countries have refineries.

2. The distribution and current extraction of petroleum reserves is biased so that most Southern countries are as dependent on the petroleum-exporting countries as is some of the North.

3. Developing countries that possess either ample reserves of petroleum or a sizeable domestic market or both may profitably expand their refining sector. This may entail a considerable shrinkage of refining capacities in the North.

4. Refinery technology is still very much of a Northern monopoly.

5. Developing country importers obtain the quasi-totality of their crude petroleum imports and more than half their refinery product imports from developing-country exporters. The percentage of products could be increased to 80-85 per cent.

6. Current South-South co-operation in petroleum refining is confined to

trade plus some financing and marketing, exploration and training; instances of technical assistance are few and far between.

D.1. The basic petrochemicals considered are ethylene, propylene, butadiene, benzene, the xylenes and methanol.

2. The feedstocks natural gas and naphtha (plus some other refinery products) are considered. Flared natural gas is an obvious, cheap potential source of petrochemicals. Biomass and solid fossil fuels may become important as alternative feedstocks in the longer term.

3. Basic petrochemicals production is not widespread in the South: in 1979, only 13 countries manufactured ethylene and only seven each made butadiene and benezene. By 1990, these numbers are expected to increase, to 30 for ethylene and 10 to 12 for butadiene.

4. Southern capacities for making basic petrochemicals are somewhat short of consumption levels as a rule; yet Southern producers do export basic petrochemicals to the North. Short-circuiting these trade flows within the South seems a viable opportunity of enhancing South-South co-operation in the medium term.

5. Today, South-South co-operation in basic petrochemicals is virtually non-existent and does not seem to enjoy any priority anywhere. An effort at changing that attitude seems worthwhile.

E.1. Mineral fertilisers. As to the resource base, phosphate rock is very much a Southern whereas potash is a Northern mineral. The latter is perhaps the most important deficit mineral of the South. Most of nitrogen fertiliser is made out of the same feed stocks as are basic petrochemicals.

2. Fifteen Southern countries export phosphate rock; 39 produce and 19 export phosphate fertiliser; 47 produce and 28 export nitrogen fertiliser; however, for want of viable mineral deposits, only four produce and two export potash fertiliser.

3. By 1990, the market-economy South is expected to be self-sufficient in nitrogen fertiliser but still short in phosphate fertiliser, despite its

excellent reserve situation. Building factories to satisfy this uncovered Southern demand is highly recommendable. In potash, a sizeable Southern deficit will persist, but it is probably not worth the effort to go for self-sufficiency.

4. South-South co-operation in regional fertiliser capacity allocation, joint ventures, training and marketing etc. has a very good record which carries the seeds of its own flourishing. Other industries may study it to their profit.

F.1. The chapter on Metallurgy considers iron and steel, aluminium, copper, lead and zinc, and tin.

2. Ferrous metallurgy. Iron ore is abundant in almost every world region, but coking coal distribution is biased in favour of the North. Many developing countries have developed or developable hydropower resources; this permits them to go in for electrometallurgical operations (electric steelmaking, aluminium smelting).

3. The conventional iron and steel complex with its multi-million-ton yearly output is too big for most developing economies; they may accordingly prefer unconventional facilities (direct-reduction, electric or charcoal-based) combined with mini or midi rolling mills.

4. By 1985, ten developing country steel producers, all of them NICs or quasi-NICs (India) are expected to join the world's 50 biggest.

5. Southern awareness of South-South co-operation potential in iron and steel seems to be largely confined today to tentatives at improving the terms of sale of iron ore.

6. Non-ferrous metallurgy. Bauxite, copper ore and tin ore reserve distgribution is biased in favour of the South; lead and zinc ore distribution, in favour of the North.

7. In 1979, Southern production exceeded Southern consumption in copper, lead and tin, but fell short of it in aluminium and zinc. With the centrally planned economies of the South disregarded, the South had a surplus position

in aluminium, too.

8. Even in those metals in which there is a Southern surplus, trade flows tend to pass at least partly through the North. Some of these flows might be short-circuited, South to South.

9. The International Bauxite Association (IBA) and Conseil Intergouvernemental des Pays Exportateurs de Cuivre (CIPEC) and similar organizations to be set up for the other metals could contribute to the expansion of metallurgy relative to mining in the South. The experience of the International Tin Agreement is also of relevance.

10. There are numerous metallurgical plantmakers in the more developed countries of the South (mainly in the NICs).

G.1. A system of Global Trade Preferences among Developing Countries (GSTP) could be instrumental in promoting the higher processing of mineral-based commodities in the South.

2. The way in which the benefits of enhanced South-South co-operation and economic progress, including tariff reductions and a higher value added resulting from a higher degree of processing, should be split among the developing countries involved is by no means clear as yet. The issue is liable to become as controversial within the South as it is between the South and the North.

3. A case study of Brazil's African trade reveals that intra-South trade between economically unequal Southern partners is likely to duplicate many of the features of North-South trade.

4. It also highlights ways in which the poorer or less developed Southern countries may expand their trade with the richer and more developed ones (the quid pro quo issue).

5. Intra-South movements of manpower so far have been scanty, but the few existing instances seem to foreshadow an intra-south brain drain phenomenon.

6. In the shorter term, intra-South training may become the most important single facet of South-South co-operation in industry.

7. As to the future institutional framework of South-South co-operation in the mineral resource-based industries, the examples of the international ore-and-metal associations (IBA, CIPEC, ITA) and of the regional fertiliser associations of the South may serve as potential models.

8. A great deal of technology is available within the South for the industries considered here, but systems consultancy capacity is inadequate; also, basic engineering of plant and the most sophisticated parts and components of plant and equipment have to be imported from the North, a situation that will persist at least in the medium term.

9. The South would be able to make do, more or less, with the technology that it possesses, but its present capacities of capital goods production would probably be unable to satisfy all Southern needs, no matter how much those needs would be cut back by de-linking.

10. Enhanced South-South co-operation would probably do little immediate harm *per se* to the North, and would probably bring some long-term benefits. It might, however, hurt the North in the short term at times of deep recession.

11. "Harsh" de-linking would cause considerable harm. Trade patterns of minerals and mineral-based commodities would have to be restructured extensively and unfavourably.

12. Enhanced North-North-South-South co-operation would have to be financed jointly by the North and the capital-surplus South. The problem would be to create the right atmosphere for such joint financing and to distribute the benefits equitably. Such co-operation would be liable to enhance existing core-periphery relationships, thus repressing rather than promoting the intra-South co-operation aspect of the scenario.

13. UNIDO would have to study in more depth than heretofore certain aspects of these subjects; to help disseminate the Southern experience in fertiliser and ore-and-metal co-operation to the benefit of the other

industries; to sponsor and supervise the training of Southern nationals in the South; and to provide or sponsor systems consultancy in the industries discussed here.

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LIST OF ACRONYMS

ADIFAL	Asociacion para el Desarrollo de la Industria de los Fertilizantes de America Latina
AFCFP	Arab Federation of Chemical Fertilizer Producers
AIP	Asean Industrial Projects
API	American Petroleum Institute
APICORP	Arab Petroleum Investment Corporation
ASEAN	Association of South East Asian Nations
BF	blast furnace
BOF	basic oxygen furnace
CEAO	Commission Economique de l'Afrique Occidentale
CIPEC	Conseil Intergouvernemental des Pays Exportateurs de Cuivre
CMEA	Council for Mutual Economic Assistance
CPE	centrally planned economy
CVRD	Companhia Vale do Rio Doce, Brazil
DAP	diammonium phosphate
DR	direct reduction ironmaking
DTCD	Department of Technological Cooperation for Development (UN)
EF	electric furnace steelmaking
FRG	Federal Republic of Germany
GATT	General Agreement on Tariffs and Trade (UN)
GDP	gross domestic product
GSTP	Global System of Trade Preferences
HyL	Hojalata y Limina Co. of Mexico
IBA	International Bauxite Association
IBRD	International Bank for Reconstruction and Development (the World Bank) (UN)
ILO	International Phosphate Industry Association (formerly the International Superphosphate Makers' Assoication)
ITA	International Tin Agreement

ITC	International Tin Council
LD	Linz-Donawitz process of oxygen steelmaking (Austria)
LING	liquified natural gas
LPG	liquified petroleum gas
NIC	newly industrializing country
NOPEC	non-NIC, non-OPEC country
NPK	nitrogen-phosphorus-kalium (potassium) fertiliser
OBO	special ship for carrying ores, bulk goods and oil
OECD	Organization for Economic Co-operation and Development
OO	special ship for carying ores and oil
OPEC	Organization of Petroleum Exporting Countries
UNCTAD	UN Conference on Trade and Development
UNDP	UN Development Programme
UNIDO	UN Industrial Develoment Organisation
UNITAD	UNIDO-UNCTAD joint Global Project of world economic forecasting
UNRFNRE	UN Revolving Fund for Natural Resources Exploration
TCDC	Technical Co-operation among Developing Countries (UN)

DEFINITION OF UNITAD WORLD REGIONS*

1	NA	North America	6	LA	Latin America
2	WE	Western Europe	7	TA	Africa South of the Sahara
3	EE	European CPEs	8	NE	North Africa + West Asia
4	JP	Japan	9	IN	Indian Subcontinent
5	OD	Other developed	10	AS	East + Southeast Aisa
			11	OA	The Asian CPEs

The regions are geographical entities. Turkey and Yugoslavia are included in WE. OD includes Australia, New Zealand and South Africa. The Pacific islands except Hawaii are attached to AS, which also includes Thailand, Malaysia, Singapore, Indonesia and the East Asian countries.

* UNIDO, The UNITAD System, 1981 Report, UNIDO.IS.337, p.97.

A Introduction

It is becoming increasingly unjustified to consider the South or Third World as homogeneous for any purpose whatever. Work on the "UNIDO Global Report" avoids this pitfall by subdividing the South into six regional groups, one of them centrally planned. As far as South-South co-operation is concerned, however, it is useful to consider another subdivision in combination with that regional grouping, one in which the sizes and levels of sophistication of the developing countries' economies are given the prime role. In such a grouping, there are the NICs in a broad definition of the term (so as to include India, for example) at one end of the range and some poor land-locked quasi-subsistence economies at the other. Countries at opposite ends of the range may be next-door neighbours; Nigeria and Niger are the obvious example.

The NICs so defined will over the next twenty years or so play an overwhelming role in any scenario of South-South co-operation. Each of them will increasingly develop interest patterns, attitudes and forms of economic behaviour converging to that group of developed economies whose social system it will decide to adopt. Hence, the NICs' attitudes will not be uniform; on an average, however, one may predict them to end up more laisez-faire and less parternalistic than today's developed countries. Absence of guilt over a colonial past may be a strong motive in that direction. Insignificant exceptions apart, the NICs are the only serious source of capital goods and technology within the South for the industries envisaged in this paper; together with OPEC, they would in any harsh de-linking situation be called upon to finance a major part of growth in the South.

The NICs are also slated to become the most important Southern markets for many Southern products, minerals and mineral-based ones in particular. An important issue here is whether an adequate degree of complementarity exists or can be developed between the Southern economies. Complementarity within the South will probably unfold more as the South recovers its full range of varied economic identities. At one end of the range, Brazil is a mineral giant in all except fuels; at the other, the NICs of Southeast Asia have an almost Japanese dependence on mineral imports and much the same attitudes to those. The crucial issue is, what goods produced in the South, especially in the poor South, can the NICs and the capital-surplus OPEC countries be expected to absorb in payment for their supplies of capital and capital goods? The Southeast Asian NICs will be eager to absorb minerals and, if they cannot avoid it, also minerals-based commodities of higher processing. Many NICs, on the other hand, will be so self-sufficient - and also, with their hosts of cheap labour, so intent on protection practically all their domestic industries - that generating trade flows into them will be a considerable problem, a clear case of insufficient complementarity. In the process, much of South-South trade would be liable to become short-circuited just between the NICs and OPEC, leaving the NOPEC (non-NIC, non-OPEC) countries out in the cold.

The above line of thought provides a frame of reference for degrees of complementarity intra-South and for a subdivision of the relationships of co-operation that may arise. Leaving aside autarky pursued by any one country on its own as meaningless for an enquiry into South-South co-operation, we find subregional co-operation as the smallest cell, and find that, for reasons of geographic uniformity, similarity of climate etc., the prima facie likelihood of complementarity is least (in our above example, the question as to what Niger can offer Nigeria under co-operation requires some very careful thought). Subregional co-operation in the mineral resource-based industries may nevertheless make good sense if it permits to profit by the economies of scale inherent in the technologies involved. (An example in point is fertilizer co-operation within ASEAN, to be detailed below.)

At the subregional level, complementarity as to natural resources is likely to be partial: in neighbouring countries, natural resource endowments are likely to be more or less similar. For example, Mozambique has a fair grade of coal and Angola has none, whereas with fair grade iron ore it is the other way round. (Mozambique does have some iron ore, but it is of an indifferent grade.) On the other hand, both countries are rich in electric power. This being the case, what makes more sense: to set up a joint-venture ferrous metallurgy operation and incur the sea freight cost between, say, Maputo and Luanda (or the other way round), or to save the freight cost, set up two separate operations, and confine co-operation to just a minerals swap? Clearly, answering such questions requires fairly thorough feasibility studies: they cannot accordingly be tackled here except in the most general terms.

Regional co-operation raises much the same issues as subregional co-operation, except that complementarity is somewhat more likely. Also, regional co-operation makes sense for such operations the least economically viable size of which is too big for any but the biggest national or subregional markets to accommodate. Viable size, however, depends on the state of the art at any given time: 15 years ago, a steel complex in the South would typically have been viable at the regional level only (except in region-sized countries like Brazil or India), whereas the advent of the mini and midi steel plant today permits countries with small economies to integrate at the subregional level or indeed to go it alone. In contrast, an aluminium industry will, if not export-oriented, probably be viable, if at all, regionally (rather than subregionally) only.

Interregional co-operation is likely to offer the greatest complementarity. It also involves all the technical paraphernalia of South-North (or North-South) trade, specifically including marine shipping and port facilities. The globalization of trade in minerals and in the products of some mineral resource-based industries after World War II was made possible in the first place by technological progress in marine transport. The goods involved being bulky as a rule, the costs of loading, haulage and unloading loom large in any interregional transaction. This is even more true of the products of their higher processing, despite the higher value of those: iron ore e.g. is cheaper to haul, per unit of contained iron, in specially constructed ore carriers or OO (ore-oil) or OBO (ore-bulk-oil) vessels than are, say, merchant bars of steel. Sea freight being so much cheaper as a rule than any form of land freight, a site close to a deep-water harbour is a must for any facility intended for interregional exports. So, whereas political will may be a major factor in setting up arrangements of subregional or regional co-operation, economic considerations will probably gain the upper hand in decision-making about interregional ones.

B. Petroleum Refining

B.1. The Resource Base

World proven petroleum reserve distribution (Table 2) is strongly biased in favour of just two developing regions, NE and LA. The remaining developing regions are rather worse off than either NA or EE and not much better off than WE, OD or JP. The events since 1973 have demonstrated that the non-oil South is no less dependent on the petroleum-exporting countries than the North is.

Expensive petroleum and the cornering of the market by OPEC have actuated compensating mechanisms working towards more petroleum and more of it outside OPEC. OPEC's share of world production declined from 52 per cent in 1972 to 34 per cent in the first half of 1982; the share of the non-OPEC developing countries including China rose from 6 per cent to 17 per cent. Since 1970, the ranks of petroleum producers have been joined by Cameroun, Ghana, Greece, Guatemala, Norway, the Ivory Coast and the Philippines. In 1981, the petroleum discovery/product ratio exceeded 2.0 for the first time since 1969 (it averaged 1.46 between 1969 and 1976 and 0.91 between 1976 and 1980).1/ Between 1979 and July 1, 1982, petroleum consumption declined by 15 per cent world-wide. As a result, the psychosis of immediate shortage has receded and a more rational view prevails. In fact, the reserve picture suggests that no non-man-made shortages of petroleum need be feared at least up to the end of the century.

Apart from bona fide thrift and substitution, this trend has been promoted also by changes in refinery technology which permit to wring more light and middle distillates out of a barrel of crude and by changes in both production and refinery technology which permit to extract and refine crudes far towards the heavy end of the spectrum at something like acceptable profitability.

Nevertheless, the world-wide distribution of the petroleum available for export, produced as it is in rather few countries, is a problem that still looms large. Since the countries hardest hit by the high petroleum prices are

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1/ IEA, World Energy Outlook, OECD, Paris, 1982.

developing ones in the main, and so are the major petroleum exporters, this clearly is an important arena of South-South co-operation, one where much remains to be done.

B.2. Refining - the size of the problem[2/]

Yearly refinery throughput practically equals yearly petroleum consumption, both world-wide and country by country:

Million tons, world	1976	1977	1978	1979	1980
Refinery throughput	2796.7	2922.2	2994.7	3076.6	2943.3
Petroleum consumption	2836.2	2980.4	3039.1	3122.0	2989.0

World refinery capacity, on the other hand, was 3,740,000 t in 1976 and 4,126,000 t in 1980; world-wide capacity utilization factors accordingly were 0.75 and 0.71 in those two years. Utilization has further declined since, drastically so in places (by 1981, it had sunk to 0.57 in the FRG and to 0.51 in Italy).

Table 1 presents refinery capacities and throughputs compared with petroleum production for the eleven UNITAD regions. It shows for 1980 a capacity utilization between 100 and 90 per cent for OA; between 90 and 80 per cent for IN + AS and EE; between 80 and 70 per cent for NA; between 70 and 60 per cent for WE, JP, OD, LA and NE; and below 50 per cent for TA. Up to 1986, existing refineries are to be expanded by 108 million tpy, and a further 132 million tpy worth of new capacity is to be added on: 32 per cent of the total increment is to be in the Middle East. On the other hand, the scrapping of some 160 tpy of refinery capacity has been announced in WE alone.[3/]

2/ For some of the data in and the argument of this section, I am indebted to my colleague Andor Sipos and his "A tőkés világ alojfinomitó iparának válsága és egy uj munkamegosztás lehetőségei" (Crisis in the capitalist world refining industry and scope for a new division of labour), a manuscript, World Economy Institute of the Hungarian Academu of Sciences, Budapest, 1982.

3/ The Petroleum Economist, September 1982, pp. 375-377, and September 1981, pp.389-396.

This essentially means that, between petroleum prices not sufficiently sensitive as yet to a declining demand and consumers little willing to pay even current prices for products, refinery margins have actually turned negative: in 1981, refining and marketing losses averaged almost $4.60 per barrel over the six largest Western European markets. This squeeze is expected to work through to crude petroleum prices too, improving refinery margins, but cut throat competition in refining is liable to persist. This means that two types of refiner will find themselves in a comparatively favourable situation: (1) those who, producing more petroleum than they can currently refine, can convert some of their petroleum exports into product exports, keeping refinery residues as an industry fuel (given the huge profits on most crudes, a negative refinery margin is purely an accounting convention to most such refiners); and (2) those who, needing more products than they can currently refine, can build up refinery capacity in the shelter of a large enough domestic market. OPEC countries are likely to fall into the first group; developing countries with sizeable product markets into the second. The developed regions with their excess refinery capacities will find themselves squeezed in the middle, in a classical case of input starvation.

Table 1. World Petroleum Production, Refining Capacity and Throughout by Regions, 1976 and 1980. (Million Tons)

Region	Crude Production 1976	Refinery Through-put 1976	Refinery Capacity 1976	Crude Production 1980	Refinery Through-put 1980	Refinery Capacity 1980
1. NA	465.8	771.5	932.4	494.4	772.1	992.6
2. WE	44.6	677.1	1025.8	122.3	648.5	1061.4
3. EE	539.2	511.7	550.0	619.7	596.7	664.1
4. JP	0.6	209.4	296.8	0.4	204.8	297.0
5. OD	19.5	44.3	60.2	19.2	45.0	66.6
6. LA	225.3	255.1	407.1	289.0	285.5	469.5
7. TA	125.7	15.5	22.9	129.1	21.3	36.4
8. NE	1261.1	135.4	189.7	1090.1	146.9	244.6
9. IN 10. AS	103.5	120.0	184.3	116.1	169.6	206.4
11. OA	85.0	71.2	72.0	106.0	83.2	87.1
Totals	2870.3	2812.2	3741.2	2986.3	2973.4	4125.7

Remark: Totals do not agree with the figures on p. 16 owing to differences in rounding.

Source: UN Yearbook of World Energy Statistics, 1980, ST/ESA/STAT/SER.J/23, New York, 1981.

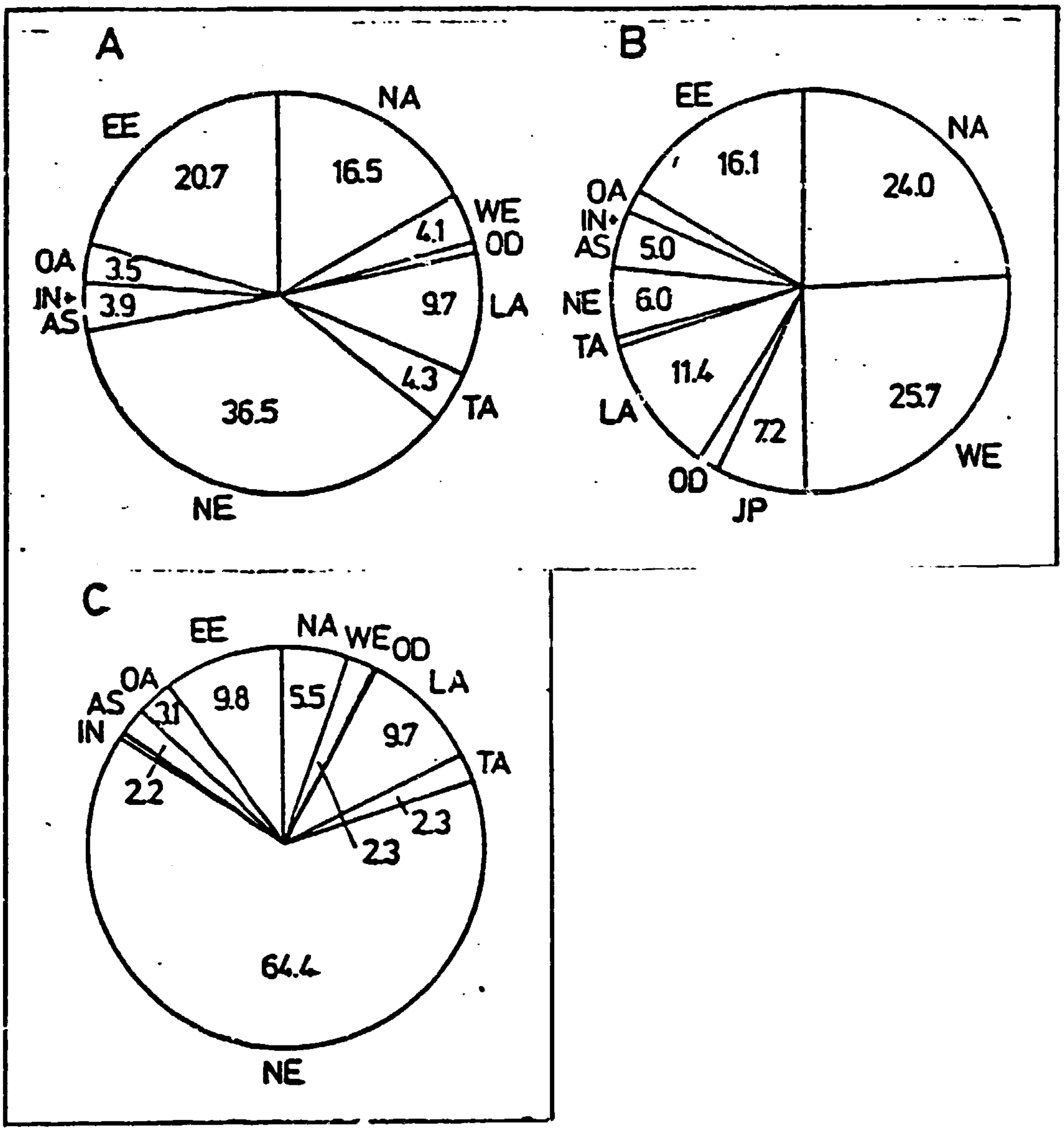


Figure 1. Percentage distribution of A - crude petroleum production, B - refinergy capacity and C - world proven petroleum reserves, 1981 over the eleven UNITAD regions.

The percentages not shown are A - 0.05% for the OD region, and C - 0.34% for the OD region and 0.45% for the ID region.

The world totals (100%) equal 2986.3 million tons of petroleum in the case A, 4125.7 million tons per year of capacity in the case B and 85.5 thousand million tons of proven reserves in the case c.

Source: UN Yearbook of World Energy Statistics, 1980, ST/ESA/STAT/SER.J/23. New York. 1981.

This is a process that may be brought about by the spontaneous operation of the market forces, without any political will or action on the part of those concerned.

It should be added to round out the picture that more than half the crude petroleum produced in the world is distributed through foreign trade channels, but only 13 per cent on average of energy petroleum products is (Tables 3 and 4). Only three world regions are net exporters of refinery products: the two UNITAD regions with the greatest share of crude petroleum production, NE and EE, plus, remarkably enough, Latin America, the greatest refined-products exporter of them all - thanks to a number of major transit refiners operating in the Caribbean. All in all, the South has an excess refinery output. (Fig.3.)

Table 2. World Proven Oil Reserves, 1979

Region	Proven reserves Million tons	%	Region	Proven reserves Million tons	%
1 NA	4630	5.47	7 TA	1983	2.32
2 WE	1953	2.28	8 NE	55117	64.43
3 EE	8366	9.78	9 IN	385	0.45
4 JP	3	0.00	10 AS	1908	2.23
5 OD	287	0.34	11 OA	2632	3.03
6 LA	8284	9.68	World	85548	100.00

Source: UN Yearbook of World Energy Statistics, op.cit.

Table 3 Share Entering into World Trade of Crude Petroleum and Energy Petroleum Products, 1980.

Product	World Consumption Million tons	World Consumption % of all Products	World Trade Million tons	World Trade % of all Products	World Trade % of World Consumption
Crude Petroleum	2,898.0	n.a.+	1,543.8	n.a.+	51.7
LPG	113.7	4.56	24.1	7.22	21.2
Aviation gas	3.0	0.12	0.9	0.28	31.2
Motor spirit	628.0	25.18	34.8	10.41	5.5
Kerosene	119.5	4.79	7.3	2.20	6.1
Jet fuel	74.3	2.98	16.2	4.84	21.8
Diesel fuel	662.2	26.55	97.5	29.16	14.7
Resdual fuels	811.0	32.52	153.5	45.90	18.9
Statistical discrepancy	82.4	3.30	-	-	n.a.+
Total energy products	2,494.1	100.00	334.4	100.00	13.4

Source: as in Table 2.

+ not applicable

Table 4. Consumption and Net Imports of Energy Petroleum Products+

Region	Consumption Thousand tons	%	Net imports Thousand tons	Share of crude oil production
1 NA	747,472	30.27	62,094	16.56
2 WE	577,606	23.39	41,220	4.10
3 EE	437,415	17.71	- 47,933	20.75
4 JP	187,462	7.59	22,965	0.01
5 OD	39,660	1.61	2,900	0.64
6 LA	172,660	6.99	- 80,573	9.67
7 TA	19,293	0.78	3,726	4.32
8 NE	79,221	3.21	- 39,794	36.50
9 IN	131,171	5.31	6,890	3.89
10 AS				
11 OA	77,716	3.15	90	3.55
Stat. diff.	-	-	28,415	-
Totals	2,469,676	100.00	0	100.00

Remark: Naphtha, a petrochemicals feedstock, the only non-energy product that may be of interest here, makes up slightly less than 3 per cent of the total world consumption of energy petroleum products.

Source: UN Yearbook of World Energy Statistics, op.cit.

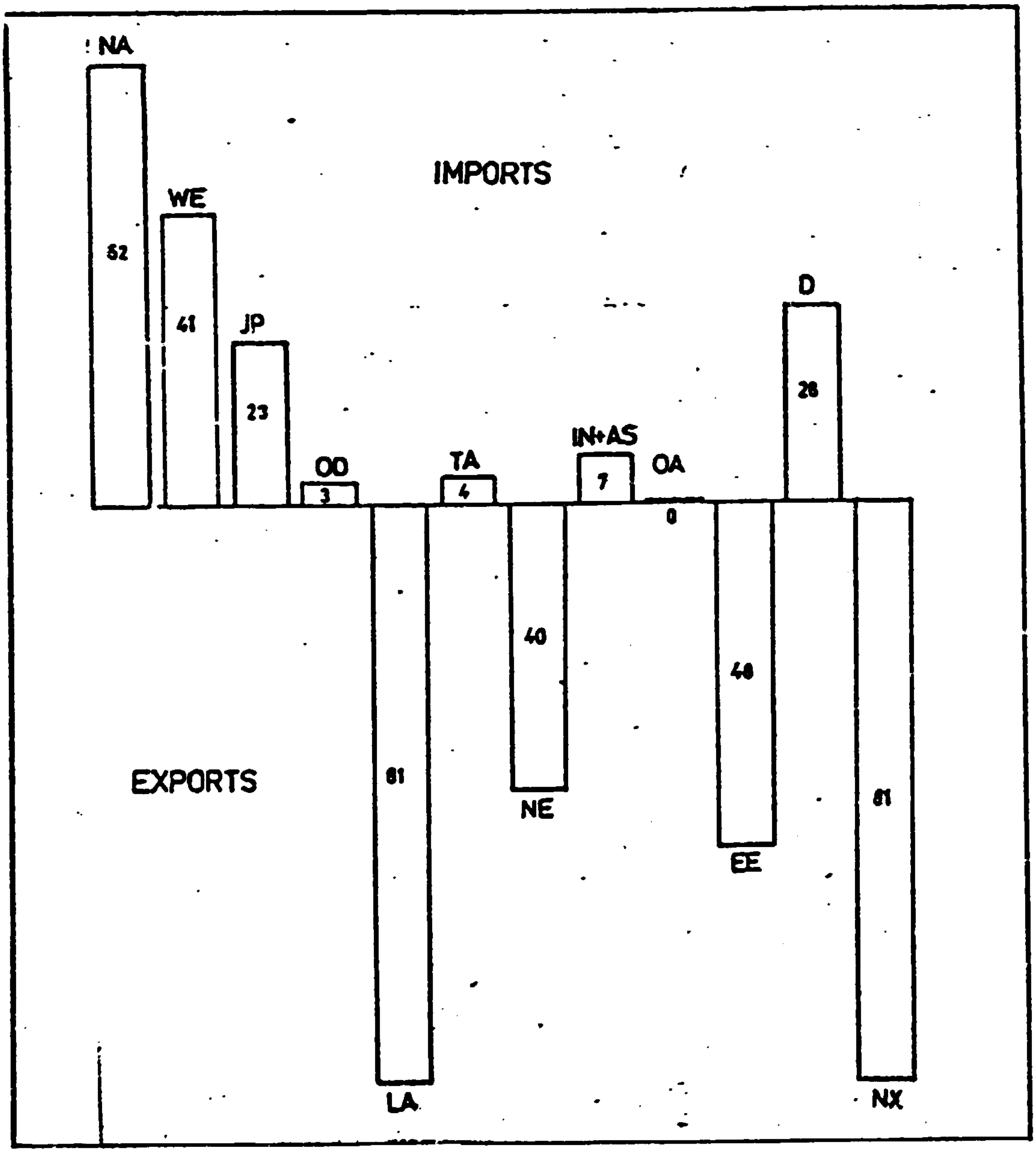


Figure 2. Net imports of energy petroleum products in 1980 into the 11 UNITAD regions, million tons. D is the statistical difference; NX is the South's net export position.

Source: UN Yearbook of World Energy Statistics, op. cit.

Table 5. Major oil-importing Developing Countries: Crude and Products Imports. (million tons)

	1979	1985		1990		1995	
	Fact	Low	High	Low	High	Low	High
				Projected			
Brazil	47.5	44.0	53.5	52.0	78.0	63.0	99.5
Hong Kong	5.0	7.8	8.5	6.3	8.1	7.2	10.5
India	15.3	-0.1	13.6	-0.6	14.6	0.0	31.0
South Korea	26.3	31.0	38.0	57.0	73.5	93.5	112.0
Philippines	8.7	4.7	7.6	2.4	5.5	0.0	5.8
Province of Taiwan	19.0	26.2	32.3	35.5	52.5	61.5	81.0
Thailand	10.6	10.0	11.7	7.2	11.0	9.6	14.3
Turkey	13.7	11.3	13.3	10.4	14.0	8.6	15.3
Argentina	2.8	-7.5	-4.2	-13.4	-6.3	-16.7	-4.6
Chile	3.9	3.2	4.4	3.2	4.8	1.1	5.1
Cuba	9.3	10.7	11.4	12.5	13.1	13.8	14.5
Morocco	3.1	3.8	4.2	2.2	3.0	1.3	3.0
Pakistan	3.8	1.4	2.7	0.7	2.8	-0.2	3.2
Total	169.0	146.5	197.0	175.4	274.6	242.7	390.6
Probable Total+	n.a.	164.0	179.5	204.0	246.0	289.0	344.5

+ Since it is unlikely for all these countries to have oil imports at the high (or low) end of the range in one year, a statistical method has been used to produce a likely low and high total.

Source: Petroleum Economist, September 1982, p.366

B.3. Scope for South-South Co-operation

B.3.1. Trade

With all the developed regions except EE net importers of petroleum, the petroleum-importing developing countries have traditionally been supplied by the petroleum-exporting ones: in 1976, 94.5 per cent (on a dollar price basis) of crude petroleum imported by the developing countries came from other developing countries. In petroleum products, on the other hand, the corresponding figure was only 69.7 per cent (of which 39.5 per cent moved in interregional, 30.8 per cent in regional and 29.8 per cent in subregional trade).[4/] The import bill of the developing countries was $3.9 bn for

4/ UNCTAD Secretariat, Statistics of Trade Among Developing Countries by Country and Product, TD/B/C.7/36/Add.1,2,3. These tables count Rumania, Turkey and Yugoslavia as developing countries.

products. The data are somewhat obsolete, but they reflect the right proportions. By 1990, developing refiners may well supply 80 to 85 per cent of the product markets in the developing world. Southern markets in crude petroleum and products taken together may be expected to grow by 3 to 4 per cent a year between now and 1990, implying a total trade flow, at a very rough estimate, of some $70 billion in 1976 dollars in the year 1990.

B.3.2. Siting and Expansion

Of the 254 countries and territories characterized as such in the UN Statistical Yearbook, 114 have refineries; 73 of those are developing. Of the 140 that have none, 127 have populations of less than one million. Of the remaining 23, 14 are landlocked. The remaining nine are Benin, Guinea, Cameroun, Mauritania, Haiti, Hong Kong, Papual New Guinea, Vietnam and Yemen. In Cameroun and Mauritania, refining is to start soon. Of the nine, only Yemen, Papua New Guinea and Hong Kong had, in 1980, a per caput GNP exceeding $300.

The following findings emerge. (1) A refinery site on tidewater is a considerable advantage, especially for transit refiners. (2) A refinery on tidewater, close to a sizeable market, may be profitable even if supplied with petroleum produced outside the country (provided of course that refining margins are more or less adequate). (3) Land-locked countries with small-size economies prefer to import products. (4) Even using the most modern technology, refinery output can be adapted to a country's particular product demand mix within limits only. If there is no ready external market for the unwanted products, domestic refining may be more expensive than the importation of products. This is why, e.g., Papua New Guinea, a medium-size economy as developing countries go (population, 3 million; per caput GNP in 1980, $780) chose not to build a refinery.[5/]

Let us add that it is much cheaper as a rule to expand an existing refinery than to build a new one on a greenfield site.

5/ The Petroleum Economist, 1981, p. 234.

All in all, one may expect that, between now and 1990, few developing countries will enter the refining scene as newcomers (mostly those in which new petroleum deposits will have been discovered). Most of refinery expansion in the developing world should accordingly be expected to take place in the countries which already have some refining. Between 1975 and 1990, refining throughputs are expected to increase by the following factors: 2.2 for Latin America, 2.1 for North Africa and the Near East, 2.5 for Asia and India and 1.6 for tropical Africa.

B.3.3. Technology

In today's atmosphere of cut-throat competition, everyone wants the most modern processes and equipment (the most sophisticated catalysis; plant enhancing light and middle distillate recovery such as visbreakers, flexicokers, flexicrackers, hydrocrackers etc.). As a result, reliance on the developed market economies' engineering and consultancy specialists is quasi-total. Those have the further advantages of a global market awareness and of possessing the techniques needed to adapt to changes. Hence, even though the building of a modern refinery in, say, Brazil would have an import content of less than 20 per cent in money terms (project identification; licences and know-how; basic engineering; some construction supervision; the most advanced equipment including computer control and automation; catalysis), developing countries are not expected to co-operate in the actual construction of refineries to any significant extent before 1990.

B.3.4. Other South-South Co-operation

1. The surplus of the Cameroun refinery now coming onstream is earmarked for Chad and the Central African Republic. (316)[6/]

2. The Brazilian Braspetro is prospecting for, and has struck petroleum, in Lybya. (31)

6/ The numbers in parentheses refer to the page numbering of the 1981 volume of the Petroleum Economist.

3. The Nouadhibou refinery of Mauritania is to be reactivated with Algerian assistance. (124)

4. The Asian Development Bank is financing $5m out of a total cost of $7.8m of a refinery expansion and improvement project in Burma. (81)

5. India and the United Arab Emirates are to construct a 12 million tpy joint-venture refinery at Mangalore, India. (82)

6. Indonesia has concluded an agreement with Kodeco Energy Co. of the Republic of Korea, by which the two are to share the production of an Indonesian oilfield. (273)

7. Assisted by a loan from the Al-Saudi Bank of Paris, the Republic of Korea has bought out Gulf Oil's share in the Ulsan refinery. (38)

8. Mexico is to help Cuba evaluate its offshore potential, and to participate in exploration in Costa Rica, possibly also in China, Panama, Peru, Colombia and Uruguay. (39)

9. Mexico and Venezuela have agreed to supply Central American and Caribbean petroleum-importing countries on concessionary credit terms. (410)

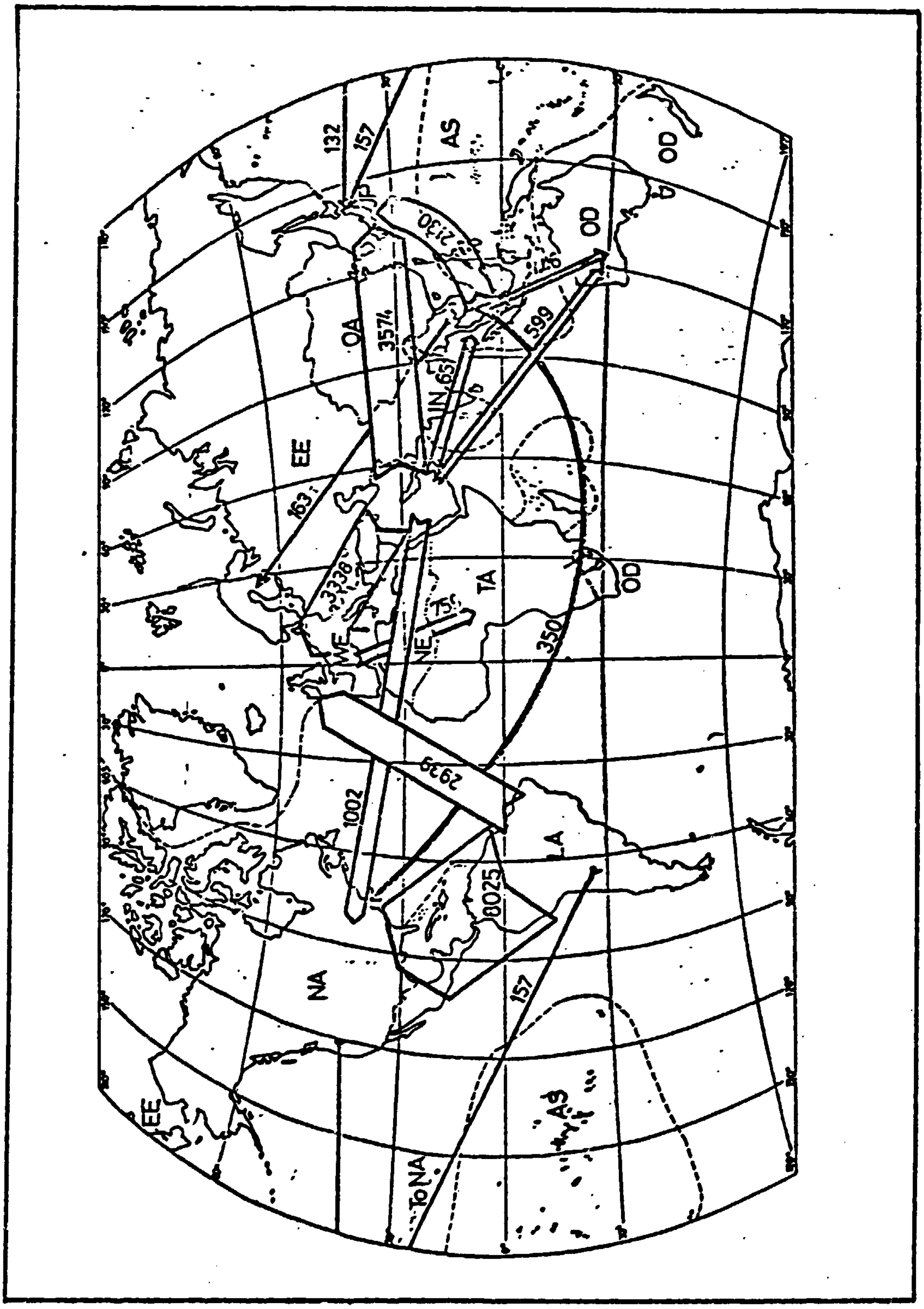
10. Kuwait, Saudi Arabia and Bahrain are to build a joint venture hydrocracker in Bahrein; they have ordered a feasibility study from a firm in the developed market-economy countries. (408)

11. Kuwait intends to domestically refine half of its petroleum output by 1984, with the East African and South-west Asian product markets in mind. (258) It also intends to set up a company to further overseas exploration.

12. Apicorp, the Arab Petroleum Investment Corporation intends to finance development and refining in arab and non-Arab countries. (189)

Significantly, petroleum refining does not figure in AIP, the ASEAN Industrial Projects package, nor in "A Programme for the Industrial Projects

Figure 3.



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package, nor in "A Programme for the Industrian Development Decade for Africa", nor in any other document on South-South cooperation available to this writer.[7/] [8/] This is in stark contrast to existing and projected co-operation in fertilisers. It seems as though the developing countries felt either that refineries can take care of themselve, or that they might still be dominated by the developed market economies' corporations too much to be interfered with. Neither attitude is justified. UNIDO may, and should, take a hand in dispersing these attitudes.

Figure 3.

Petroleum products, refined (SITC Code 344 - revised): interregional trade flows between market-economy regions, $million, 1980. Flows worth less than $100 million and intraregional flows not shown. Source: UN 1980 Yearbook of International Trade Statistics, Vol. II, ST/ESA/STAT/SER.G/26/Add.1, pp. 962-963.

Regional boundaries are shown in dot-dash line on land and in dashed line on the seas. The arrows refer to entire UNITAD regions and are not intended to pinpoint actual points of loading or destination. All flows to or from the OD region are shown as ending/beginning in Australia.

7/ UNIDO, The Development of the ASEAN Industrial Projects (AIPs), prepared by Consultant Mohamed Ariff, UNIDO/IS.281, 25 January 1982.

8/ UNIDO, A programme for the Industrial Development Decade for Africa, ID/287, 1982.

C. Basic Petrochemicals

The basic petrochemicals to be considered here are ethylene, propylene, butadiene, benzene, the xylenes and methanol. (Ammonia is to be discussed in the chapter on fertilizers.)

The feedstocks used to make basic petrochemicals include natural gas, LPG (liquified petroleum gas) or a refinery product such as naphta, a distillate in the diesel fuel range, refinery tail gas etc. Of these, only natural gas is a mineral in the strict sense. The availability of the others depends on refinery capacities and product patterns.

C.1. Resource Base - Natural Gas

For world natural gas production and proven reserves, cf. Table 6. The fact that proven reserves more than doubled between 1970 and 1982 implies that the reserve picture reflects exploration effort rather than ultimate potential and that gas discovery can be expected to outstrip consumption at least until the year 2000. In fact, until recently, a fair amount of the gas extracted was just a nuisance by-product of the petroleum, to be got rid of by flaring (cf. Table 7). Most non-associated gas (gas unconnected with any petroleum deposit) has been discovered over the last 10 to 15 years, as gas rose to the rank of a premium fuel in its own right in the industrialized world. As one of the results, the market in LNG (liquified natural gas) shipped by refrigerated tanker is fast expanding today.

The salient fact in Table 6 is that the South, which owns 42 per cent of proven natural gas reserves, gives only 13 per cent of commercial production. Small wonder that the industrialization concepts of most gas-owning countries rely heavily on natural gas as a fuel and feedstock. Making petrochemicals, predominantly for export, figures among the targets of many such countries.

As shown in the chapter on petroleum refining, much of refinery capacity is standing idle these days. The product mixes of refineries being comparatively inflexible, a low refinery utilization constrains feedstock production too to some extent. This is one of the major advantages of natural gas as a petrochemical feedstock.

Table 6 World Natural Gas Production and Proven Reserves, 1981

Region	Production* bn cu. m. 1981	% 1981	Proven Reserves Billion cubic m. 1.I.1970	1.I.1982	As % of world
NA	628.60	40.3	9264	8184	9.6
WE	190.22	12.2	4160	4903	5.7
EE	519.43	33.3	9482	34457	40.5
JP	2.41	0.2	20	27	negl.
OD	12.37	0.8	541	1038	1.2
LA	69.68	4.5	1651	5077	6.0
TA	1.42	0.1	184	1738	2.0
NE	65.60	4.2	11752	24587	29.1
IN	16.85	1.1	719	1190	1.4
AS	32.57	2.1	224	3028	3.5
OA	19.05	1.2	102	730	0.9
Total	1558.20	100.0	39099	84959	99.9**

* Commercial, excluding flared or reinjected; mainly excluding field usage.
** One tenth of a per cent acounts for reserves neglibible on a world scale.

Remark. billion - one thousand million.

Source: The Petroleum Economist, August 1982, p.319.

Table 7. Gas Flaring by the Five Greatest Flaring Countries

Country	Flaring, 1978	Billion cu. m. 1979	Change %
Saudi Arabia	30.3	37.8	+ 14.9
Nigeria	20.0	24.3	+ 21.2
Algeria	12.2	12.8	+ 4.8
Indonesia	8.7	10.8	+ 23.8
USSR	12.0	11.0	- 8.3
Totals	83.2	96.7	+ 16.2

NB: In 1979, total flaring world-wide amounted to 190 billion cu. m, 12.7 per cent of all the gas extracted.

Source: The Petroleum Economist, August 1980, p. 337

C.2. Basic Petrochemicals - the Size of the Problem

There is a considerable similarity between the problems of petroleum refining and of basic petrochemicals production:

- Capacity utilization is very low, about 60 per cent in Western Europe. In 1980 and 1981, the industry lost $5 bn in the developed market-economy world. Demand growth at present is a mere 2 per cent per year.[9/]

- The major chemical producers are pulling out of basic petrochemicals and going into specialized products whose profit margins are more rewarding for the time being. This development foreshadows a shift of cut-throat competition towards specialized chemicals in the medium term.

- Here too, two types of producer will find themselves in a comparatively favourable situation: (1) those who own petroleum or natural gas and can therefore offset book losses on basic petrochemicals against the huge profits on hydrocarbon production, and (2) those who, needing more petrochemicals than they can currently produce, can build up petrochemicals capacity in the shelter of a domestic market. Here too, the OPEC countries are likely to fall in the first group and big-economy developing countries into the second. The developed regions with their excess petrochemicals capacities will be squeezed in the middle in another case of input starvation under the impact of the market forces.

9/ The Economist, London, Nov, 1982, p.20.

C.3. World Distribution of Production and Consumption [10/]

The place, present and future, of the developi g world in world basic petrochemicals production and consumption is presented in Table 8. It should be pointed out that the figures there show developing-world production and demand to be evenly balanced: actual trading between the developed and developing regions involves larger volumes.

Table 8. Basic Petrochemicals Capacities, Production and Demand in the Developing World, Referred to World-wide Figures, 1979, 1984 and 1990.

Product	Capacity		Production		Demand		
	1979	1984	1979	1984	1979	1984	1990
Ethylene							
1000 tons	3360	7900	2680	6150	2680	6150	13950
% of world	7.2	12.9	7.2	12.4	7.2	12.4	19.8
Propylene							
1000 tons	1520	3050	1190	2410	1190	2410	4470
% of world	5.8	9.1	6.0	9.5	6.0	9.5	12.1
Benzene							
1000 tons	1600	3170	1180	2620	1300	2700	5000
% of world	7.4	11.2	6.9	11.4	7.4	11.7	16.2
Butadiene							
1000 tons	540	1040	420	900	420	900	1600
% of world	8.3	13.3	7.9	14.4	8.5	14.2	19.3
Xylenes							
1000 tons	830	2150	660	1690	800	1800	3000
% of world	12.6	21.7	10.8	19.7	13.1	20.9	25.3
Methanol							
1000 tons	1560	3310	1320	2900	940	1800	3550
% of world	11.3	13.9	11.3	15.3	8.0	9.8	12.9

Source: UNIDO, ID/WG.336/3/Add.1, op. cit., pp. 6-11.

10/ Much of the information used in this section has been taken from UNIDO, Second World-Wide Study on the Petrochemicals Industry, ID/WG.336/3 and Add.1, 19 and 20 May 1981.

In 1990, the developing world is expected to consume about 20 per cent of world output in the case of ethylene and butadiene, about 25 per cent in the case of the xylenes, about 16 per cent in the case of benzene and about 11-12 per cent in the case of methanol and propylene. Between 1975 and 1990, 35 per cent of the world-wide demand increment is to be in the developing world for the xylenes, 29 per cent for butadiene, 28 per cent for ethylene, 22 per cent for benzene, 16 per cent for propylene and 13 per cent for methanol. Between 1979 and 1990, demand for basic petrochemicals is expected to rise in the developing world by a factor of 4.2 for ethylene, 2.8 for propylene and butadiene, 2.85 for benzene, 2.75 for the xylenes and 3.0 for methanol.

C.4. Scope for South-South Co-operation

International trade in the six basic petrochemicals considered here is reflected well enough by their imports into the OECD in 1979, exclusive of intra-EEC trade.

The trade in ethylene is seen to be less by an order of magnitude. A gas of low boiling point (-104^{o}C), ethylene has to be transported by sea in refrigerated tankers. Its transfer to shore is an operation that requires comparatively expensive equipment.

Propylene also is a gas at room temperature, but its boiling point is higher at -48^{o}C: it can be liquified under fairly low pressure. The other three products are liquid at room termperature.

Table 9. Imports of Basic Petrochemicals into the OECD, Exclusive of Intra EEC trade, 1979

Chemical	Imports, thousand tons	Of which, originating in the developing world %	the CPEs %
Ethylene	87.7	22.0	-
Propylene	402.3	-	-
Butadiene	461.8	1.0	0.4
Benzene	611.9	7.2	17.9
Xylenes	757.2	7.1	5.6
Methanol	1119.8	50.1	7.6

Source: UNIDO, ID/WG.336/3/Add.1, op. cit., pp. 123-124

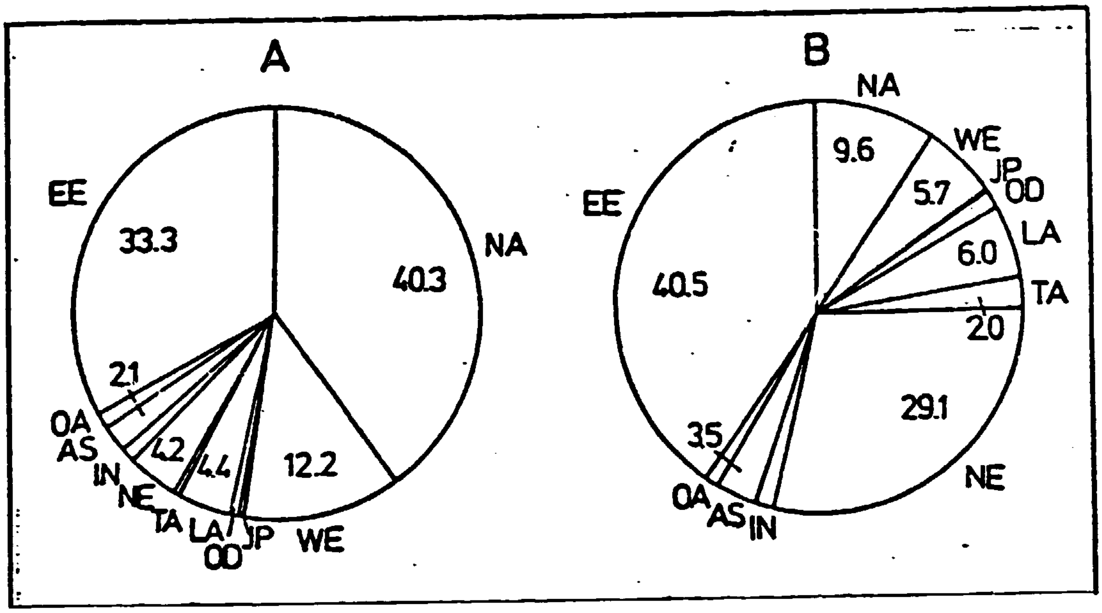


Figure 4. Percentage distribution of A - world natural gas production in 1981 and B - world proven gas reserves as of 1.1.1982 over the 11 UNITAD regions. The percentages not shown are, A - 0.2 per cent for JP, 0.8 per cent for OD, 0.1 per cent for TA, 0.1 per cent for IN and 1.2 per cent for OA; B - 0.0 per cent for JP, 1.4 per cent for IN and 0.9 per cent for OA. The world totals (100 per cent) are, 1558.2 thousand million cu. metres for production and 84.959 thousand million cu. metres for the reserves.

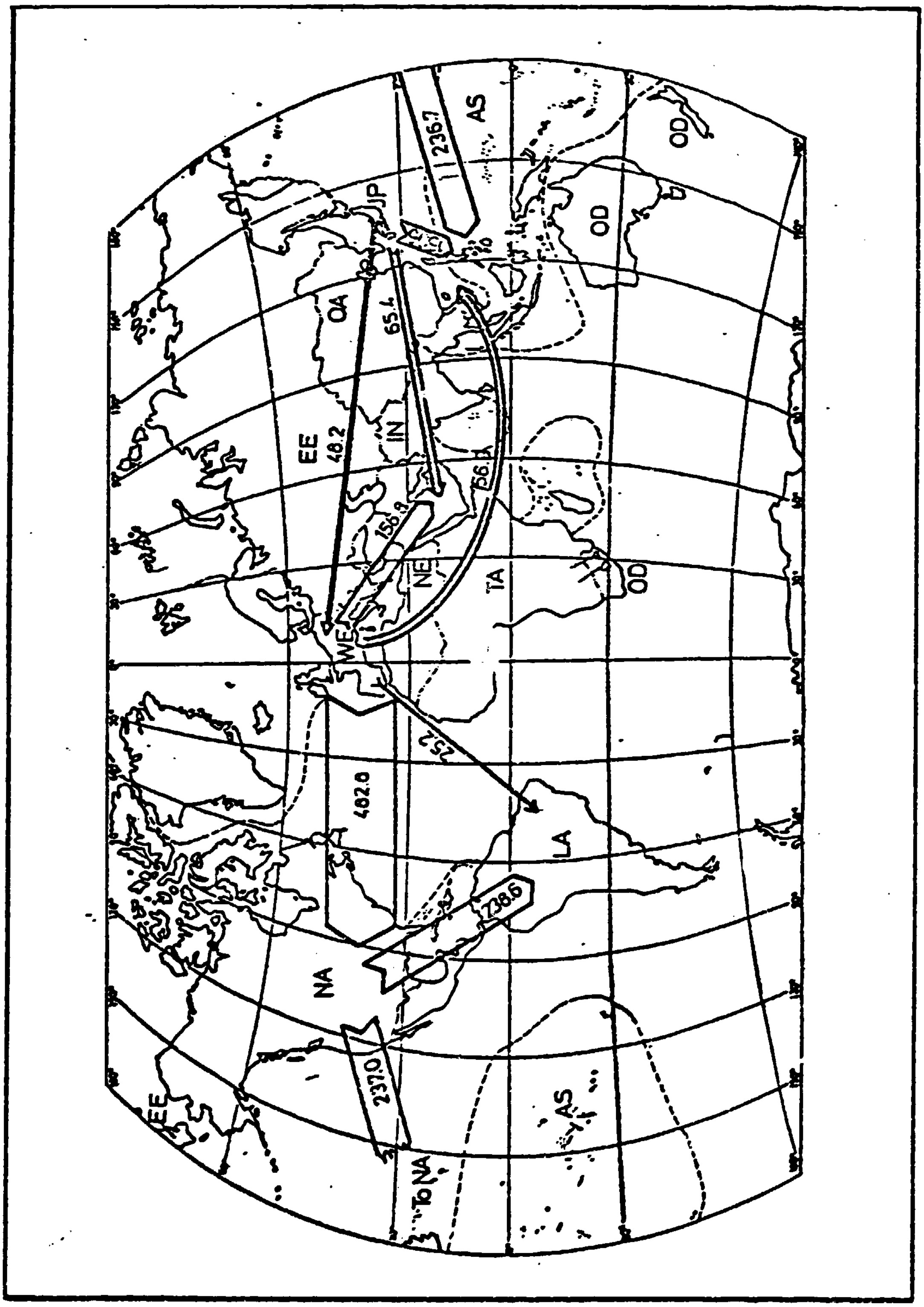
Source: The Petroleum Economist, August 1982, p.319.

Figure 5. Products of polymerization etc. (SITC Code 583 - revised): Net interregional trade flows between market-economy regions, $ million, 1980. Flows worth less than $10 million and intra-regional flows not shown.

Source: UN 1980 Yearbook of International Trade Statistics, op. cit., pp. 1014-1015

Regional boundaries are shown in dot-dash line on land and in dashed line on the seas. The arrows refer to entire UNITAD regions and are not intended to pinpoint actual points of loading or destination. See also caption to Fig.4.

Figure 5.


AS
236.7
JP
OD
QA
65.4
EE
48.2
IN
156.8
NE
TA
WE
25.2
482.0
LA
238.6
NA
237.0
To NA

In 1975, the developing world's demand and output were in a rough balance in ethylene and propylene; there was a 10,000 ton deficit in butadiene and slightly bigger ones (120,000 tons and 40,000 tons, respectively) in benzene and the xylenes. The deficit in methanol was 110,000 tons. By 1979, the butadiene deficit had disappeared; there was a benzene deficit of 120,000 tons, a xylenes deficit of 140,000 tons and a methanol surplus of 380,000 tons. Yet in 1979 the developing countries exported to the OECD group of countries;

- 19,300 tons of ethylene,
- 4,800 tons of butadiene,
- 44,300 tons of benzene
- 53,400 tons of xylenes, and
- 561,200 tons of methanol.

(It seems that no propylene was exported that year from the developing countries into the OECD group.) The actual deficits of the developing world were bigger by these amounts.

Short-circuiting these trade flows by South-South transactions is a fairly clear-cut short-term option of South-South co-operation in basic petrochemicals.

C.5. Siting and Expansion

Whereas, as shown in the chapter on petrochemicals, countries above a population of one million without a refinery are the exception rather than the rule even in the developing world, the number of developing countries with basic petrochemicals facilities is fairly small. In 1980, only India, the Republic of Korea, China, Argentina, Brazil and Mexico could make all the six products considered here. They might be joined by one other country (Iran) by 1987.

By 1987, twenty-seven developing countries are expected to have ethylene facilities. Butadiene (10 countries by 1987) is at the other extreme, probably because its downstream product, synthetic rubber, is felt to be insufficiently attractive by many developing country producers. Fifteen countries are to have propylene facilities, and sixteen each are to have facilities for the making of benzene, methanol and the xylenes.

To satisfy a non-hydrocarbon-producing country's demand for thermoplastics, synthetic fibres and/or synthetic rubbers, it is probably simplest, provided the country possesses or can reasonably be expected to build a refinery, to import crude petroleum and to refine a feedstock domestically. The importation of feedstock and convertion into basic petrochemicals in the country is probably second-best. Both options, however, come up against the intentions of the hydrocarbon-producing countries to increase the value added to their hydrocarbons before exportation. The international movements of basic petrochemicals might thus increase at the expense of feedstock and petroleum movements. Most of this increase could be in trade with the North, but some of it might be in intra-South trade. The developing countries with the most ambitious plans to export include Qatar, Libya, Saudi Arabia and Bahrain for methanol and those plus Singapore and Kuwait for ethylene. Further export-oriented capacities may be expected to come onstream by 1990 in Iraq, Iran, Indonesia, the Republic of Korea, Brazil, Mexico and Venequela. By 1990, the South may well become self-sufficient in most or all basic petrochemicals.

C.6. Technology

Much of what has been said about petroleum refining holds true here. There may, on the other hand, be a considerable scope for simple ethylene, propylene and methanol plants of smallish output working into the domestic markets of even the more moderate-sized developing economies. Some such plants would seem to be in existence already. Some of these units might use biogas as a feedstock. Monitoring and possibly promoting such developments would be a task for UNIDO.

C.7. Other South-South Co-operation

A Programme for the Industrial Development Decade for Africa[11/] states that "attempts would be made, particularly by those countries with petroleum

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11/ UNIDO, ID/287, op. cit.

and natural gas resources, to refine and process those resources into petrochemicals, especially plastics, synthetic fibres, rubbers and detergents." It too recommends the biomass route of petrochemicals manufacturing for countries not endowed with fossil hydrocarbons.

The AIP (ASEAN Industrial Projects) package does not include non-fertilizer petrochemicals.[12/]

Industrial allocation schemes in the Andean Group do on the other hand include petrochemicals as a third priority after iron and steel and fertilizers.

Just as in the case of petroleum refining, it is important to boost a hitherto greatly inadequate awareness of intra-South co-operation potential in petrochemicals.

The Gulf Organization for Industrial Consulting [13/] a joint institution of the Arab Gulf countries, has produced a study emphasizing the need for co-ordinated marketing of the petrochemicals produced by the Arab countries, preferably within the framework of an Arab Common Market to emerge from an Arab Gulf States common market. In May, 1979, GOIC convened a seminar which emphasized the possibility of creating a market to absorb the region's petrochemical products over the ten years to follow. It further emphasized the advantages of integrating oil refineries with petrochemical industries, and of the collective production of aromatics at the regional level. It also called for a strategic marketing plan, for co-operation and consultation with the Arab petrochemicals-producing states of North Africa, with a view to sharing the costs and use of infrastructure in these countries which are closer to the big markets, and for the establishment of a Gulf Petrochemicals Marketing Organization.

12/ UNIDO/IS.281, op. cit.

13/ Gulf Organization for Industrial Consulting, a brochure, undated, Doha, Qatar, p.28.

D. Mineral Fertilizers

This group of commodities includes, in the strict sense:

- potash fertilizers, produced by a process of mineral beneficiation (the differential dissolution or flotation of potash salts out of the undesirable accompanying salts);

- phosphate fertilizers, made out of phosphate rock (sedimentary phosphorite or igneous apatite) by a chemical industry process of medium sophistication, comparable with alumina refining.

Most phosphate fertilizer is prepared by a process using sulphuric acid. Hence, sulphur as the raw material of sulphuric acid shall also be discussed briefly below.

Nitrogen fertilizers are typically made nowadays out of natural gas or some petroleum refinery product such as naphtha; they are thus essentially petrochemicals. Yet, for completeness, we shall include them into the discussion here.

D.1. The Resource Base

D.1.1. Potash fertilisers

World potash reserves are abundant but very unevenly distributed: three regions (India, Japan and the Other Developed group) have none and four more (LA, TA, AS and OA) have less than two per cent of world reserves each. North America and the two European regions in 1978 gave more than 95 per cent of world potash production. Even so, Southern reserves could cover current Southern consumption for some 170 years, a fact that reveals the gross inadequacy of potash fertilizer use in the South. Also, there are Southern reserves which, probably being just slightly more expensive to work than the Northern ones, could be brought into production at a pinch. Let us add that the Near East is a substantial net exporter of potash fertilizer.

Table 10. World Potash Reserves and Resources. (Expressed as K_2O)
Resources inclusive of Reserves.

Region	Reserves Million tons	%	Resources Million tons	%
1 NA	3000	33.0	73000	50.5
2 WE	680	7.5	5740	4.0
3 EE	4800	52.9	53000	36.7
4 JP	-	-	-	-
5 OD	-	-	20	0.0
6 LA	60	0.7	380	0.3
7 TA	20	0.2	200	0.1
8 NE	300	3.3	1100	0.8
9 IN	-	-	-	-
10 AS	120	1.3	10050	7.0
11 OA	100	1.1	1000	0.7
Total	9080	100.0	144490	100.0

Remark: Percentages may not add up owing to rounding.

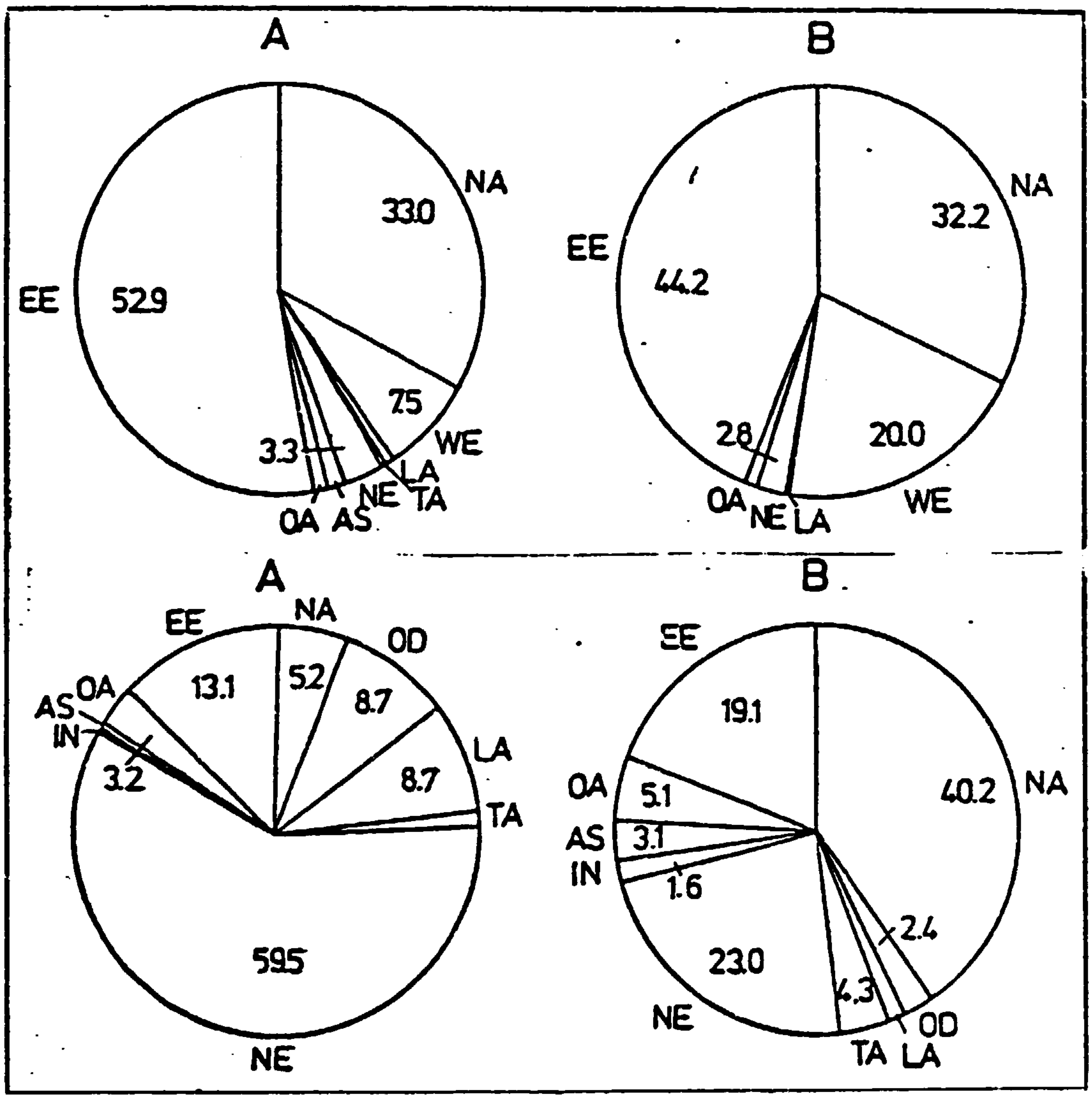
Source: US Bureau of Mines, Mineral Facts and Problems, Bulletin 671, 1980.

Table 11. World Potash Production, 1978, and Capacity, 1978 and 1985. Actual Weight

Region	Production in 1978 000 t	%	Capacity 1978 000 t	%	Capacity 1985 000 t	%
1 NA	8377	32.2	9995	32.8	11250	30.8
2 WE	5208	20.0	6755	22.2	6770	18.5
3 EE	11516	44.2	12670	41.5	15900	43.5
4 JP	-	-	-	-	-	-
5 OD	-	-	-	-	-	-
6 LA	17	0.1	20	0.1	320	0.9
7 TA	-	-	-	-	-	-
8 NE	732	2.8	730	2.4	1970	5.4
9 IN	-	-	-	-	-	-
10 AS	-	-	-	-	-	-
11 OA	150	0.6	310	1.0	310	0.8
Totals	26000	100.0	30480	100.0	36520	100.0

Remark: Percentages may not add up owing to rounding,

Source: Mineral Facts and Problems op.cit.



Top - Figure 6. Percentage distribution of A - world potash reserves and B - world potash production, 1978, over the 11 UNITAD regions. The percentages not shown are, A - 0.7 per cent for LA, 0.2 per cent for RA, 1.3 per cent for AS and 1.1 per cent for OA; B - 0.1 per cent for LA and 0.6 per cent for OA. World totals (100 per cent) are 9080 million tons for the reserves and 26 million tons for the production.

Bottom - Figure 7. Idem, A - world phosphate reserves and B - world phosphate production, 1978. The percentages not shown are, A - 1.0 per cent for TA, 0.3 per cent for IN and 0.3 per cent for AS; B - 1.3 per cent for LA. World totals (100 per cent) are 34,445 million tons for the reserves and 124.6 million tons for the production.

Source for both: Mineral Facts and Problems, op.cit.

D.1.2. Phosphate Fertilizers

D.1.2.1. Phosphorite/apatite

Almost 60 per cent of the world reserve is concentrated in the Near East. Japan is destitute, and Western Europe is very poorly provided. Despite a modest reserve position, North America is the greatest producer and the second greatest exporter of phosphate rock in the world; it is also the greatest net of phosphoric acid and, by a very wide margin, of phosphate fertilizer; this reveals that, when reserves are abundant, production and export figures may not reflect the reserve situation at all. The fact that Eastern Europe, the second strongest region as far as reserves are concerned, is the second greatest phosphate rock importer after Western Europe confirms the same thesis.

D.1.2.2. Sulphur

The reserve pattern is biased somewhat in favour of the North; the production pattern is biased much more so, in keeping with the fact that the developed industries are avid consumers of large quantities of sulphur. Reserves are fairly abundant and growing: the preoccupation with acid rain

Table 12 World Phosphate Reserves and Resources, Actual Weight
Resources Inclusive of Reserves

Region		Reserves Million tons	%	Resources Million tons	%
1	NA	1800	5.2	9250	7.1
2	WE	15	0.0	60	0.0
3	EE	4500	13.1	12000	9.3
4	JP	-	-	-	-
5	OD	3000	8.7	12000	9.3
6	LA	3000	8.7	7000	5.4
7	TA	330	1.0	930	0.7
8	NE	20500	59.5	65500	50.5
9	IN	100	0.3	300	0.2
10	AS	100	0.3	230	0.2
11	OA	1100	3.2	22400	17.3
Totals		34445	100.0	129670	100.0

Source: Mineral Facts and Problems, op. cit.

and other forms of sulphuric acid pollution makes it increasingly worthwhile for the users of fossil fuels to recover the sulphur values contained in them.

Table 13. World Phosphate Rock Production, 1978 and Capacity, 1978 and 1985. (Actual Weight.)

Region	Production in 1978		Capacity 1978		Capacity 1985	
	10^6 t	%	10^6 t	%	10^6 t	%
1 NA	50.0	40.2	52.6	35.1	71.7	39.6
2 WE	0.1	0.0	0.1	0.0	0.1	0.0
3 EE	23.8	19.1	24.8	16.6	30.0	16.6
4 JP	-	-	-	-	-	
5 OD	3.0	2.4	4.0	2.7	3.0	1.7
6 LA	1.5	1.2	1.7	1.1	3.8	2.1
7 TA	5.4	4.3	7.6	5.1	8.4	4.6
8 NE	28.6	23.0	45.4	30.3	50.7	28.0
9 IN	2.0	1.6	2.3	1.5	1.3	0.7
10 AS	3.9	3.1	4.5	3.0	3.0	1.7
11 OA	6.3	5.1	6.7	4.5	9.0	5.0
Totals	124.6	100.0	149.7	100.0	181.0	100.0

Remark: Percentages may not add up owing to rounding.

Source: Mineral Facts and Problems, op. cit.

D.1.3. Nitrogen fertilizers

The NE, NA, WE, EE and JP regions are net exporters of nitrogen fertilizers. The first four of these regions are big producers of natural gas, and only Japan relies heavily on imported feedstock. The gas reserves of the Near East alone would permit nitrogen fertilizer production far exceeding any reasonably forecast of Southern needs. Making nitrogen fertilizer for intra-South distribution could be one of the sensible ways of using gas that is being flared today.

Table 14. Identified World Sulphur Reserves and Resources
Resources inclusive of reserves

Region	Reserves Million tons	%	Resources Million tons	%
1 NA	425	24.1	2580	40.4
2 WE	290	16.4	1065	16.6
3 EE	400	22.7	1300	20.4
4 JP	10	0.6	50	0.8
5 OD	20	1.1	30	0.5
6 LA	125	7.1	215	3.3
7 TA	20	1.1	20	0.3
8 NE	400	22.7	800	12.5
9 IN	-	-	-	-
10 AS	50	2.8	250	4.0
11 OA	25	1.4	75	1.2
Totals	1765	100.0	6385	100.0

Source: Mineral Facts and Problems, op. cit.

Table 15. World Sulphur Production, 1978 and Capacity, 1978 and 1985
(Million tons)

Region	Production in 1978		Capacity 1978		Capacity 1985	
	10^6 t	%	10^6 t	%	10^6 t	%
1 NA	18.4	34.5	21.0	33.3	27.0	34.6
2 WE	9.1	17.0	11.8	18.7	12.0	15.4
3 EE	16.0	30.0	16.5	26.2	18.0	23.1
4 JP	2.7	5.1	4.0	6.3	6.0	7.7
5 OD	0.5	0.9	0.8	1.3	0.9	1.1
6 LA	2.6	4.9	3.6	5.7	4.5	5.8
7 TA	0.4	0.7	0.6	1.0	0.6	0.8
8 NE	1.4	2.6	2.0	3.2	6.0	7.7
9 IN	0.6	1.1	1.0	1.6	1.0	1.3
10 AS						
11 OA	1.7	3.2	1.7	2.7	2.0	2.6
Totals	53.4	100.0	63.0	100.0	78.0	100.0

Source: Mineral Facts and Problems, op. cit.

D.2. Trade potential

Referring to Table 16, Totals (2), the market-economy developing groups expect to become practically self-sufficient in nitrogen fertiliser by 1986/87. These and the EE group will compete for the unsaturated markets of the developed market economies and of OA. The size of the excess capacity which the developing market economies may confidently be expected to develop will depend on the outcome of that competition.

As to phosphate fertiliser, a medium-sized surplus in Africa (including Mediterranean Africa in this particular case) is more than offset by a slight shortage in NE and sizeable ones in LA, IN and AS. This and the CPEs' shortfall is covered by the North American surplus. Equipping the phosphate reserves of Africa with adequate fertiliser-making facilities to satisfy Latin American and Asian demand (and also to compete for the CEPs' demand: the Meskala phosphate-mine-and-fertilizer-plant complex now being built in Morocco with finance from, and sales contracted to, the USSR is a case in point) may open up a considerable intra-South trade potential. The problem is that Latin American and Asian demand is backed up by fairly weak buying power, comparatively speaking; it is accordingly liable to constitute the downmarket end and to shrink more than the rest of the market in any downturn.

Table 16. Regional and World Consumption of and Surplus/Deficit in Fertilizers (million tons of) $N/P_2O_5/K_2O$.

Region*	C 81/82	S 81/82	C 86/87	S 86/87	C 81/82	S 81/82	C 86/87	S 86/87	C 81/82	S 81/82	D 86/87	S 86/87
	Nitrogen fertilizer				Phosphate fertilizer				Potash fertilizer			
1 NA	11.70	1.27	14.30	-0.58	4.90	5.15	5.94	4.98	5.98	1.71	6.77	4.06
2 WE	9.95	-0.13	11.50	-0.49	5.37	0.61	6.01	-0.15	5.28	-0.47	5.98	-0.66
3 EE	13.33	4.06	17.00	5.19	9.02	-1.00	11.14	-1.00	8.53	2.08	10.67	3.86
4 JP 5 OD	1.43	0.21	1.69	-0.09	2.37	0.70	1.98	0.19	1.05	-0.22	1.16	0.03
6 LA	2.85	-0.11	3.64	0.71	2.52	-1.08	3.75	-1.79	1.26	-1.24	2.19	-1.95
7 AF	0.69	-0.63	1.01	-0.32	0.51	1.12	0.72	1.99	0.26	-0.26	0.36	-0.36
8 NE	1.81	0.12	2.60	0.70	1.06	-0.38	1.60	-0.17	0.06	0.06	0.08	0.38
9 IN 10 AS	7.26	-1.96	10.12	-1.11	2.55	-1.15	3.73	-2.00	1.28	-1.28	1.68	-1.68
11 OA	12.48	-1.72	14.09	-2.20	3.26	-0.51	3.80	-0.52	0.70	-0.68	0.89	-0.87
Totals												
(1)	23.08	1.35	27.49	-1.16	12.64	6.46	14.93	4.93	12.26	1.02	13.91	3.43
(2)	12.61	-2.58	17.37	-0.02	6.64	-1.48	9.80	-1.98	2.86	-2.84	4.31	-3.61
(3)	25.81	2.34	31.09	2.99	12.28	-1.51	14.94	-1.52	9.23	1.40	11.56	2.99
(4)	61.50	1.11	75.95	1.81	31.56	3.47	39.68	1.42	24.35	-0.42	28.80	2.81

Remarks: C denotes consumption; S denotes a surplus if positive and a deficit if negative. The totals listed are, (1) developed, (2) developing market economies, (3) all the centrally planned economies, EE + OA, and (f) is the world total.

*The regionalization differs somewhat from that of the UNITAD model: (1) WE does not include Turkey; (2) JP + OD includes Israel; (3) Africa North of the Sahara is included in AF rather than in NE; (5) for statistical convenience, IN + AS includes, in addition to developing Oceania, also Bermuda, Greenland and St-Pierre-et-Miquelon (whose weight is very small in any case).

Source: A World Bank draft dated Sep. 2, 1982, intended for incorporation into FAO's Current World Fertilizer Situation and Outlook, 1981/82 - 1986/87.

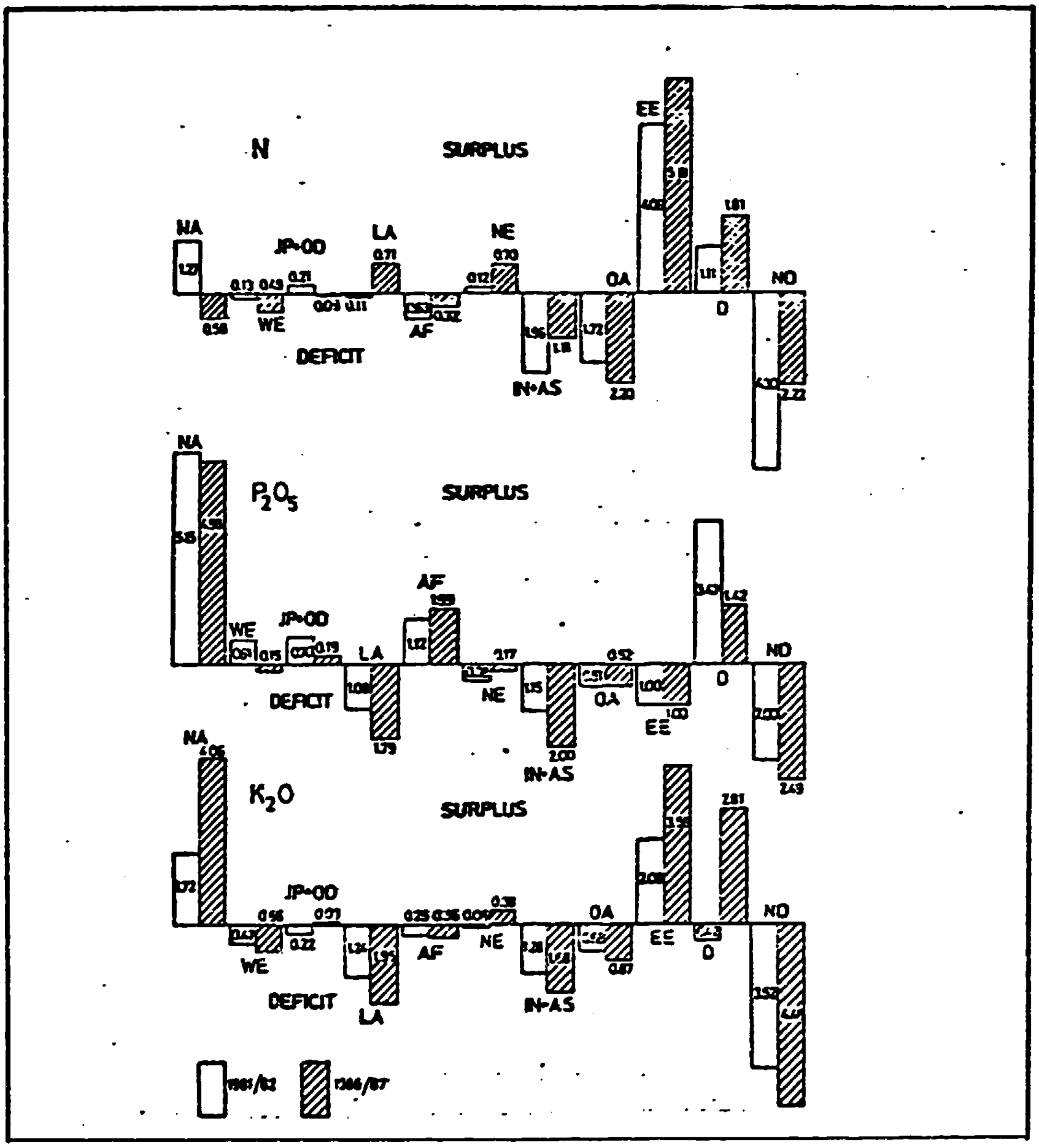


Figure 8. Regional imbalances, production minus consumption, million tons, of the three main fertilizer types, in terms of the active ingredient (N, P O or K O), in the crop years 1981/82 (fact) and 1986/87 (forecast). D - statistical difference; ND - net deficit of the South. Source: A World Bank draft dated Sep. 2 1982, intended for incorporation into FAO's Current World Fertilizer Situation and Outlook, 1981/82 - 1986/87.

Table 17. Movements of Some Fertilizer Minerals and Intermediates

Region	Rock phosphate, 10 t** imports	exports	net imports	Phosphoric acid, net imports, P 0 10^3 tons+	Ammonia, net imports, N 10^3 tons+
	1979	1979	1979	1979	1979
1 NA	4152	14787	-10635	-728.2	-317.8
2 WE	23983	44	23849	194.7	1327.6
3 EE	10457	4130	6327	436.2	-1402.2
4 JP	2828	-	2828	67.4	-47.2
5 OD	3729	122	3607	-476.7	-
6 LA	2239	48	2129	535.4	-793.9
7 TA	61	4592	-4531	-	26.1
8 NE	552	25074	-24522	-552.8	-217.6
9 IN	1758	-	1758	265.2	121.2
10 AS	2354	3634	- 1280	26.9	51.4
11 OA	1110	-	1110	-	-
Totals	53133	52431	702*	-231.9*	-1252.4*

+ These figures are probably incomplete.
* Errors, omissions and stock movements.
** Actual weight.

Source: Author's calculations based on FAO Fertilizer Yearbook, Vol. 30, 1980, FAO Statistics Series No. 36, Rome 1981.

Table 18. Phosphate Fertilizer Movements Related to Consumption, Crop Year 1979/1980, P_2O_5

Region	Exports 10^3 t	%	Imports 10^3 t	%	Net imports 10^3 t	% of consumption	Consumption 10^3 t	%
1 NA	3773	56.01	392	6.83	-3381	-61.3	5517	17.75
2 WE	1560	23.16	2425	42.27	865	12.7	6789	21.84
3 EE	466	6.92	428	7.45	-39	-0.4	8646	27.82
4 JP	30	0.45	97	1.69	67	8.0	831	2.67
5 OD	35	0.53	38	0.66	2	0.1	1763	5.67
6 LA	71	1.06	935	16.30	863	34.6	2491	8.02
7 TA	10	0.15	155	2.70	145	63.7	228	0.73
8 NE	465	6.91	295	5.13	-171	-28.1	610	1.96
9 IN	-	-	539	9.39	538	38.0	1419	4.57
10 AS	322	4.78	354	6.17	32	4.7	672	2.16
11 OA	2	0.03	81	1.41	79	3.7	2115	6.80
Totals	6736	100.00	5736	100.00	-1000+	n.a.*	31080	100.00

+ Errors, omissions and stock movements.
* Not applicable.

Source: Author's calcul[illegible] based on FAO Fertilizer Yearbook, op. cit.

Table 19. Nitrogen Fertilizer Movements Related to Consumption, Crop Year 1979/1980, N

Region	Exports 10^3 t	Exports %	Imports 10^3 t	Imports %	Net imports 10^3 t	Net imports % of consumption	Consumption 10^3 t	Consumption %
1 NA	3316	27.47	2484	19.97	-832	-7.5	11149	19.49
2 WE	4058	33.62	3176	25.54	-881	-8.2	10789	18.86
3 EE	2316	19.19	269	2.16	-2047	-17.0	12009	21.00
4 JP	773	6.40	44	0.35	-729	-93.8	777	1.36
5 OD	33	0.27	80	0.64	47	7.1	657	1.15
6 LA	205	1.70	1367	10.99	1162	43.5	2670	4.67
7 TA	5	0.04	303	2.44	298	74.0	404	0.71
8 NE	885	7.33	671	5.39	-215	-17.8	1208	2.11
9 IN	28	0.23	1922	15.45	1895	41.5	4565	7.98
10 AS	417	3.45	568	4.55	149	8.5	1760	3.08
11 OA	36	0.30	1558	12.53	1523	13.6	11212	19.60
Totals	12070	100.00	12439	100.00	369*	n.a.**	57200	100.00

* Errors, omissions and stock movements
** Not applicable

Source: Author's calculations based n FAO Fertilizer Yearbook, op.cit.

Table 20. Potash Fertilizer Movements Related to Consumption, Crop Year 197 1980, K_2O.

Region	Exports 10^3 t	Exports %	Imports 10^3 t	Imports %	Net imports 10^3 t	Net imports % of Consumption	Consumption 10^3 t	Consumption %
1 NA	7383	47.15	4928	32.05	-2455	-41.1	5973	25.74
2 WE	2752	17.58	3619	23.54	867	15.2	5716	24.37
3 EE	4731	30.21	2281	14.83	-2450	-34.7	7190	.66
4 JP	-	-	767	4.99	767	104.2	736	3.14
5 OD	-	-	370	2.40	370	102.9	359	1.53
6 LA	17	0.11	1580	10.28	1563	98.3	1590	6.78
7 TA	-	-	124	0.80	124	84.3	147	0.63
8 NE	777	4.96	109	0.71	-667	-537.5	124	0.53
9 IN	-	-	559	3.64	559	90.2	620	2.64
10 AS	-	-	644	4.19	644	110.4	583	2.49
11 OA	-	-	395	2.57	395	95.3	414	1.77
Totals	15660	100.00	15376	100.00	-284*	n.a.**	23453	100.00

* Errors, omissions and stock movements
** Not applicable

Source: Author's calculations based on FAO Fertilizer Yearbook, op. cit.

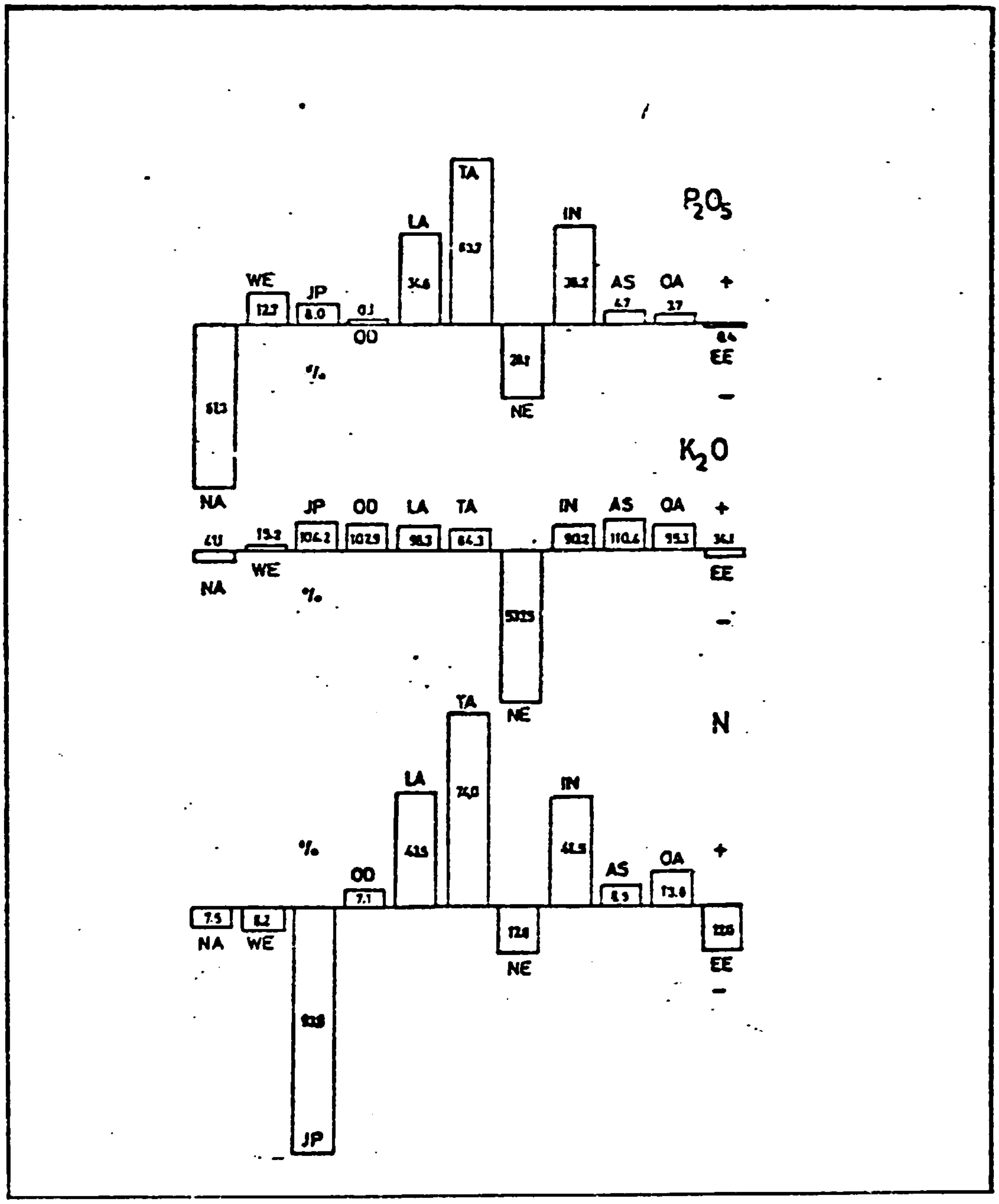


Figure 9. Net imports as a percentage of internal consumption for the 11 UNITAD regions of the three main fertilizer types, in terms of the active ingrediant (N, P O or K O), crop year 1979/80. A column on the minus side indicates that the region is a net exporter.

Source: FAO, Fertilizer Yearbook, 1980, Vol. 30, Rome 1981, FAO Statistics Series No. 36.

Table 21 New Fertilizer Production Capacities under Construction, for Startup Between 1980 and 1986.*

Region	Ammonia**	Phosphoric Acid +
	(thousand tons)	
1 NA	1767	2024
2 WE	3039	537
3 EE	6690	2045
4 JP	-	-
5 OD	221	270
6 LA	2634	623
7 TA	508	-
8 NE	3833	2795
9 IN	4560	278
10 AS	678	-
11 OA	446	-
Totals	24376	8572

* Up to 1983 in their bulk; the data probably are incomplete.

** N content + Wet process, P_2O_5

Source: Author's calculations based on FAO Fertilizer Yearbook, op.cit.

The potash fertilizer situation reflects the reserve picture: with the exception of the Near East, every developing region has a deficit, whereas NA and EE have big surpluses. Foreseeable changes in the potash supply of the South may include the recovery of potash from the Dead Sea by Jordan, a boost to Israeli production from the Dead Sea and to Chilean production from the Salar de Atacama, the reopening of the flooded potash mine in the PR of the Congo and the possibility of Brazil opening a mine at the Taquari-Vassouras deposits in Sergipe Country.[14/] For all that, intra-South trade potential in potash fertilizer appears slight.

14/ US Bureau of Mines, Mineral Facts and Problems, op. cit., o. 709.

D.3. Siting and Expansion

Fifteen developing countries export phosphate rock; 39 produce and export phosphate fertilizer; 47 produce and 28 export nitrogen fertilizer; but only three (Chile, China and Israel) produce potash fertilizer and only two (Chile and Israel) export some. Potash fertilizer being the least sophisticated fertilizer product, the constraint operating here is the shortage of viable reserves.

To judge by the number of countries engaged in it, fertilizer making appears to be an operation more sophisticated than petroleum refining (which is practised by 73 developing countries) but less sophisticated than the making of basic petrochemicals. More importantly, refinery products (alas) are a more immediate need: having more buying power behind them, they are more likely to sell under their own steam than fertilizers, whose marketing in a developing country setting probably requires more sophistication than their manufacturing. There is no immediate comparison here with basic petrochemicals, which are manufacturers' inputs.

Capacity development up to 1986/87 is presented in Table 16. Of world capacity increment, 44 per cent will be in the South in nitrogen fertilizer, 46 per cent in phosphate fertilizer and 37 per cent in potash fertilizer. This results in self-sufficiency in nitrogen fertilizer for the developing market-economy group (i.e. all developing regions except OA), but the developing world's need to import phosphate and potash fertilizer will grow, whether or not the OA group is included. All these tendencies are expected to continue up to 1990 and probably beyond.

D.4. Technology

Urea making is considered today technologically most demanding fertilizer-making process and urea plant technologocally most demanding fertilizer plant to build. Yet a good NIC firm would probably want only about a 5 per cent contribution (which would include the basic engineering) from a company of the North to build a urea plant.

On the other hand, in both phosphate and potash mining, especially in the solution mining of potash, systems consultancy (including the assessment of deposit viability, of mining and beneficiation technology, the optimization of haulage patterns, of decisions whenever international competitiveness) is at stake. Preparing such assessments requires considerable international experience and expertise, which is perhaps less easy to find even in the most developed developing countries than, say, factory engineering and construction expertise. Of the UN family, UNIDO, UNDP and DTCD may be approached for assistance. DTCD in fact has had concrete project experience in phosphates.

D.5. Other issues of South-South co-operation

"Planning fertilizer production and marketing on a regional basis has many advantages... a substantial saving in capital and operating cost can result when the planning is done on a regional rather than a national basis... When regional co-operation is not feasible, bilateral or trilateral agreements may be useful."[15/] Perhaps in no other manufacturing sphere is South-South co-operation so developed and so efficacious as in fertilizer.

In many developing countries, the procurement and distribution of fertilizer is a quasi-public concern that is fairly extensively institutionalized, with more or less state sponsorship. Let us just cite here the Fertilizer Association of India or Fertimx (ex-Guanos y Fertilizantes) of Mexico. But there are also regional and interregional associations, such as ADIFAL, the Asociacion para el Desrrollo de la Industria de los Fertilizantes de America Latine; AFCFP, the Arab Federation of Chemical Fertilizer Producers; ISMA, the International Phosphate Industry Association (the acronym refers to its former name, International Superphosphate Makers' Association), etc.. Each of these has had some co-operation with UNIDO.

India provides a good example of South-South co-operation in fertilizer industry training. The key organism is the Fertilizer Association of India, the representative body of the fertilizer industry in the country. Training is offered in marketing, agricultural sciences, production technology,

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15/ UNIDO: Fertilizer Manual, Development and Transfer of Techology Series No. 13, New York, 1980, ID/250.

including maintenance and instrumentation, in advertising and sales promotion. Courses have been attended by participants from Afganistan, Bangladesh, Egypt, Indonesia, Iran, Iraq, Jordan, Kuwait, Malaysia, Nepal, Saudi Arabia, the Republic of Korea and Sri Lanka. In both attendance and tradition, courses in marketing and distribution logistics surpass all others. Most of the countries represented being heavily populated ones greatly dependent on agriculture, this emphasis is to be very specially commended.

In Senegal, the fertilizer company SIES has been operating a 130,000 tpy complex NPK fertilizer plant since 1968, essentially for domestic distribution. In 1977, a project for a regional-interregional fertilizer project was mooted, with technical assistance from the French "Entreprise Minière et Chimique". The plant is to produce 1700 tpd of sulphuric acid, 600 tpd of phosphoric acid and the fertilizers triple superphosphate, mono and diammonium phosphate of a total P_2O_5 content of 300 tpd, using Senegalese rock phosphate and Polish sulphur. Shareholders are to include the International Finance Corporation and the Banque Islamique du Développement, the Ivory Coast, Cameroun and Nigeria. Other Arab financial institutions may contribute loans. Nigeria is expected to pay for its purchases with deliveries of ammonia. India has stated its intent to purchase phosphoric acid. The fertilizer produced would find a wide distribution in Western, Central and Equatorial Arica, in Madagascar and Réunion. SIES also organizes training courses for the maintenance technicians of the Nigerian Federal Superphosphate Fertilizer Co. Ltd. of Kaduna.[16/]

China is a remarkable example of self-reliance combined with technology absorption. In nitrogen fertilizer, an autonomous technology base capable of building and running large and smaller ammonium nitrate and sulphate plants and small ammonium bicarbonate and aqueous-ammonie plants, all using coal as a feedstock, was developed: even the large plants, however, were smallish by international standards. Both the engineering and the equipment were entirely

16/ UNIDO, Co-operation Among Developing Countries in the Fertilizer Industry, ID/WG.322/1, 11 June 1980.

Figure 10.

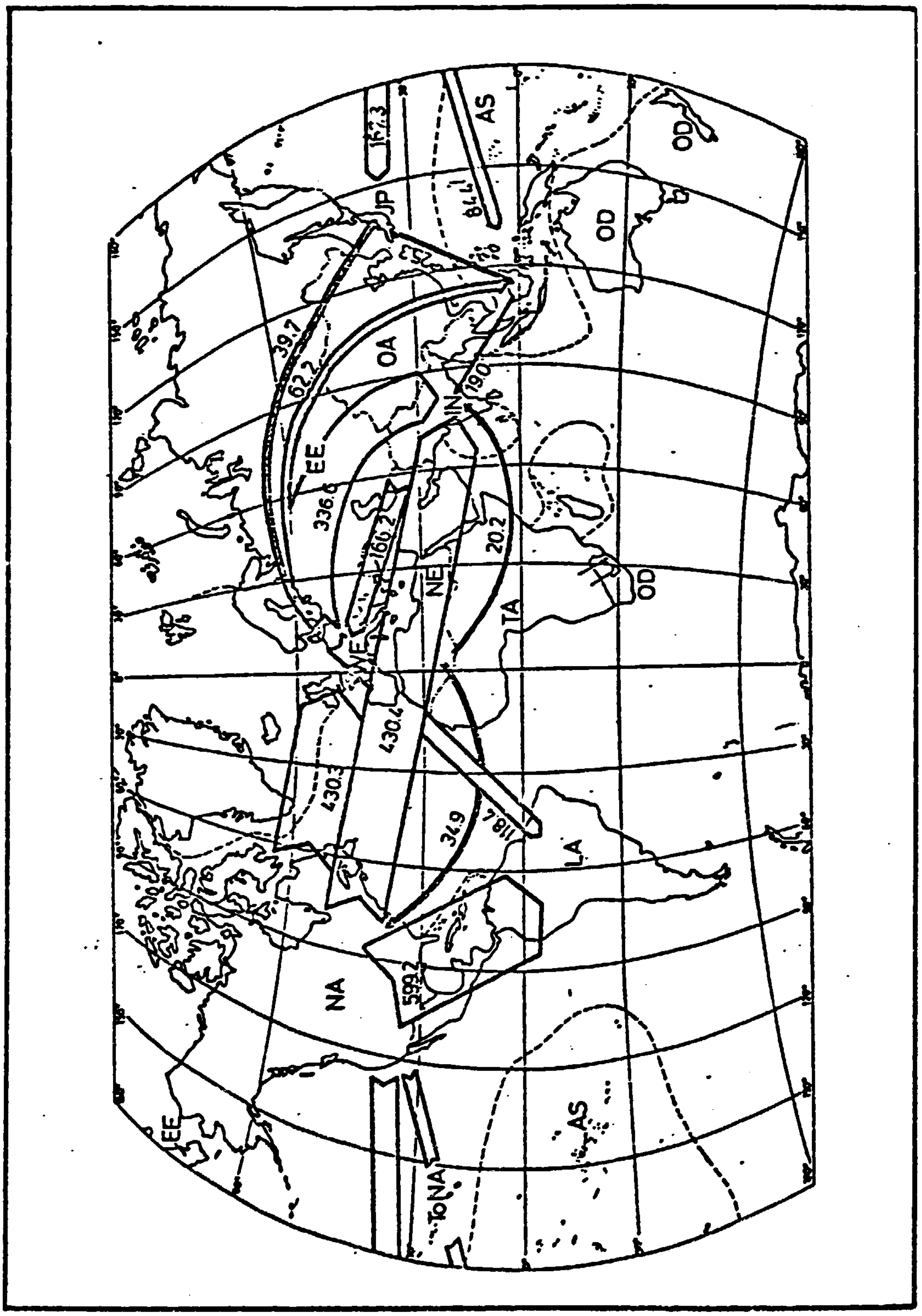
NA
599.2
LA
34.9
118.4
430.3
430.4
WE
NE
TA
OD
160.2
336.6
EE
20.2
IN
190
OA
62.2
39.7
JP
84.4
AS
OD
AS
To NA
EE

Figure 10. Manufactured fertilizers (SITC Code 562 - revised): Net interregional trade flows between market-economy regions, $ million, 1980. Flows worth less than $12.5 million and intra-regional flows not shown. Source: UN, 1980 Yearbook of International Trade Statistics, Vol. II, op. cit., pp. 1008-1009.

Regional boundaries are shown in dot-dash line on land and in dashed line on the seas. The arrows refer to entire UNITAD regions and are not intended to pinpoint actual points of loading or destination. All flows to or from the OD region are shown as ending/beginning in Australia.

domestic. In a subsequent phase, a number of new plants were built for a natural gas or refinery residue feedstock; urea and ammonium chloride production was initiated. In the early 1970s, however, it was realised that the fertilizer needs of the country could not be economically satisfied in this way: the decision was therefore taken to order 13 large nitrogen fertilizer plants on a semi-turnkey basis from foreign contractors. These big modern plants were brought onstream in slightly more than six years between them. Meanwhile, the construction of old-style plants continued with much enlarged unit sizes.

The phosphate fertilizer industry, which produces super-phosphate and Ca-Mg phosphate, was also developed on a self-reliant basis. Owing to unequal raw materials endowments, fertilizer production in China is rather lopsided: only one million tons of P_2O_5 and about 50,000 tons of K_2O fertilizer are being made a year, as against 7.6 million tons of N fertilizer (quantities stated in active ingredients).[17/]

Mexico offers geological, mining and minerals beneficiation expertise for phosphate rock and potash through Institute Mexicano del Petroleo and Fertimex (a rare case of systems consultancy offered by a developing country). It also offers training in ammonia, ammonium sulphate and nitrate, sulphuric, nitric and phosphoric acid, normal and triple superphosphate, DAP and NPK plants.[17/]

17/ UNIDO, ID/WG.322/1, op. cit.

Perhaps the most remarkable case of intra-South industry allocation is AIP, the ASEAN Industrial Projects package. It involves the construction of two urea facilities, one in Indonesia and the other in Malaysia, plus one superphosphate - ammonium sulphate fertilizer project in the Philippines and a study concerning the development of potash deposits in Northeast Thailand and their conversion into potash fertilizer. In each of these projects, the host country has 60 per cent equity and each of the other four ASEAN countries has 10 per cent.[18/]

In 1976, South-South trade in some fertilizer materials in dollar terms was as follows.[19/]

Items	South imports originating in the South	of which		
		Interregional	Regional	Subregional
	%	%	%	%
Ammonia	34.4	18.6	7.1	8.7
Nitrogen fertilizer	22.1	13.3	6.0	2.8
Phosphate fertilizer	24.0	13.3	8.9	1.8

South-South interregional phosphate rock trade currently includes Morocco to Latin America and Asia, Israel and Jordan to Asia, Senegal to Asia, Senegal to Asia, and the Pacific islands to Indonesia, the Republic of Korea, Malaysia and Singapore.

18/ UNIDO, IS/281, op. cit.

19/ UNCTAD Secretariat, TD/B/C.7/36/Add.1,2,3, op. cit. These tables count Rumania, Turkey and Yugoslavia among the developing countries.

F. Metallurgy

This chapter considers iron and steel under ferrous metallurgy and aluminium, copper, lead and zinc, and tin under non-ferrous metallurgy.

Table 22. Relative importance of the major metals, 1978

Metal	World production million t	Price+ $US	Value produced $US billion	Growth rate %*
Crude steel	710	326	282.5	2.7
Aluminium	14	1000	14.0	5.2
Copper	8.6	1200	10.3	3.6
Lead	3.4	610	2.1	2.9
Zinc	5.6	560	3.1	1.9
Tin	0.2	11430	2.3	0.9

+ US average price over the year 1978, per metric ton.

* Average yearly primary metal output growth forecase, 1978-2000.

Source: Mineral Facts and Problems, op.cit.

At the top, steel constitutes a class of its own; so does tin, at the bottom. Aluminium and copper form a second league and lead and zinc a third, but the difference between these two leagues is small enough. Aluminium stands out in regard to forecast growth; so again does tin at the other extreme. Even these scanty figures suffice to imply that, as a rule of thumb, it makes the most sense to set up distributed - subregional or country-by-country - production centers in steel, whereas in the case of tin with its high unit price and small-tonnage trade, concentrated production in just a few countries entails no particular disadvantage - the less so since this fits the reserve pattern also. The other four metals fall in between these extremes.

F.1 Ferrous metallury

F.1.1 The processes

Conventional iron-making uses the blast furnace route (denoted BF), the two essential raw materials of which are iron ore as a source of metal and coke as a reductant. A coking-grade bituminous coal is required to make coke. The product of the blast furnace is pig iron, the bulk of which is used to make steel. Most of the rest is made into cast iron objects in foundries. Depending on the equipment and the process, the blast furnace consumes 400 to 700 kg of coke per ton of pig.

Pig iron is converted into steel in an electric, an open-hearth or Siemens-Martin, a basic-oxygen or LD, or some other type of furnace. The first three types gave more than 99% of world steel production in 1976, but the open-hearth furnace has been in a rapid decline. We shall accordingly consider here only the basic oxygen furnace (BOF) and the electric furnace (EF). The inputs into all these furnaces include pig iron and iron or steel scrap. Typically, about 30% scrap and 70% pig is fed to a BOF and anything up to 100% scrap to an EF.

Big modern steelworks use the BF/BOF route. The output of a big works is in the one to ten million tpy range. It is therefore too big for the small developing countries and indeed for most medium-sized ones.

A promising non-conventional route of iron-making is direct reduction (DR). The process uses high-grade iron ore as a source of metal and some fossil fuel (coal, not necessarily coking, possibly even better-grade subbituminous; natural gas, etc.) or possibly charcoal as a reductant. Its product, called sponge iron, is an excellent pig-iron or scrap substitute in either the BOF or the EF. The advantage of the DR/EF route for developing countries is that economically viable sizes may be as small as 200,000 (or even 50,000) tpy. The steel so produced is, if anything, better-grade than BF/BOF output.

Blast furnaces using charcoal as a reductant have been developed in Brazil above all.[20/] These also may be economically viable in sizes of 150,000 or even 50,000 tpy of pig output. If fed a high-grade iron ore, they produce very pure pig. The principal problem with them is that they either

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20/ UNIDO: Charcoal Ironmaking: A Technical and Economic Review of Brazilian Experience. Prepared by Henri Meyers and R.F. Jennings. UNIDO/IOD.228/Rev.1, 2 November 1979 require a large-scale forestry operation which is not that much cheaper than imported coke, or widespread deforestation which is hard to justify environmentally.

Crude steel is fashioned into marketable shapes and sizes in the rolling mill. Big modern mills integrated with a BF/BOF unit and using its output in molten form (continuous casting) are matched in size to the BF/BOF unit and may accordingly produce up to and above ten million tpy of rolled products, including the more difficult sizes and shapes like wide heavy shipbuilding plate. For most developing countries, mini and midi mills making long products ("merchant bars"), with outputs as low as 20,000 tpy, may make good economic sense. At the low end of the range, a mini mill is typically entirely scrap-fed through an electric furnace, being too small as it is to be integrated with a BF or DR unit. It also will probably not produce any "flats" (sheet, strip, plate, coil): the investment into a flats mill is too big to be depreciated against an output as small as this. Also, flats rolling is a more demanding operation. A flats shop may be justified above a total mill output of 100,000 tpy. Such a larger unit (a midi mill) may be integrated usefully with a DR/EF steel plant (or a BF/EF one if the BF unit is charcoal-fed).

Leaving aside the forestry required for charcoal iron-making (which confines the viability of that route to regions with a warm to hot climate, adequate rainfall and good soil), the above outline permits to identify the mineral resource needs of ferrous metallurgy as iron ore, coking coal or some other reductant and possibly electric power. Considering alloying elements also would take up too much space: in any case, as long as international or at least interregional trade functions tolerably well, there is no weighty argument against importing those.[21/]

As a memorandum item, let us recall that steel mills are great consumers of water and iron-making units are even more so. A minimum of $30m^3$ or so of water is required per ton of steel, but $100m^3$ is better and $250m^3$ is best. This is another environmental constraint on ferrous metallurgy.

21/ Their reserves, resources and recent past production rates are presented in the tables of an Appendix.

As another memorandum item, scrap may be a problem in some developing countries. In many least developed countries, where even old tins may be cherished possessions (the "bidonville syndrome"), ferrous scrap generation may be very scanty. Also, scrap collection and sorting is an operation that demands skill and acumen. In Angola, for example, enough scrap to feed a 30,000 tpy mini mill used to be collected pre-Independence: with all the Portuguese scrap merchants gone, the country has solicited UNIDO assistance for rebuilding the scrap system.

E.1.2 The resource base

E.1.2.1 Iron ore

World iron ore reserves are immense, sufficient for more than a millennium at 1985 forecast consumption levels. Japan is the only world region short of iron ore (Table 23). None of the developing countries has an iron ore reserve problem, although many developing regions lack, individually taken, iron ore deposits viable on even the smallest industrial scale. The best, so-called direct-reduction grade ore is less abundant: it stands to be confined to the big high-grade deposits, and not all of those, either.

Table 23. World Iron Ore Reserves and Resources, Contained Iron Resources Inclusive of Reserves

Region	Reserves 10^9 tons+	%	Resources 10^9 tons+	%
1 NA	145	15.6	441	22.4
2 WE	69	7.4	106	5.4
3 EE	281	30.2	517	26.3
4 JP	-	-	-	-
5 OD	120	12.9	218	11.1
6 LA	192	20.6	468	23.8
7 TA)				
8 NE)	22	2.4	45	2.3
9 IN	56	6.0	79	4.0
10 AS	18	1.9	27	1.4
11 OA	27	2.9	64	3.3
Totals	930	100.0	1965	100.0

Remark: Percentages may not add up owing to rounding.
Source: Mineral Facts and Problems, op.cit.

Table 24. World Iron Ore Production, 1978, and Capacity, 1978 and 1985 Contained Iron

		Production in 1978		Capacity 1978		Capacity 1985	
		Million Tons	%	Million Tons	%	Million Tons	%
1	NA	78.9	16.4	117.0	17.4	112.5	16.0
2	WE	39.6	8.2	64.9	9.7	64.6	9.2
3	EE	131.9	27.4	154.8	23.0	163.3	23.2
4	JP	-	-	-	-	-	-
5	OD	70.1	14.6	99.3	14.8	105.7	15.0
6	LA	77.2	16.0	129.0	19.2	142.9	20.3
7	TA)						
8	NE)	20.5	4.3	28.3	4.2	30.1	4.3
9	IN	23.8	4.9	34.5	5.1	37.2	5.3
10	AS	8.0	1.7	10.9	1.6	10.9	1.5
11	OA	31.5	6.5	33.6	5.0	36.3	5.2
Totals		481.5	100.0	672.3	100.0	703.5	100.0

Source: Mineral Facts and Problems, op.cit.

Iron ore is fairly widespread the world over. The UN Statistical Yearbook lists 54 iron-ore-producing countries, only 26 of which are developing (cf. Table 24).

Table 25 presents the UNITAD regions' iron ore production compared with the pig iron production of each. Japan and WE emerge as the two regions heavily dependent on iron ore imports. The North American deficit could be balanced at small additional outlay. The only developing region expected to turn up a deficit by 1995 is AS + IN. The only unit not even remotely capable of self-sufficiency is Japan, but it can and does rely on Australian ore.

E.1.2.2 Coking coal

Coking coal reserve distribution is rather uneven and heavily biased in favour of the developed-country groups. (For want of a suitable statistic for coking coal, a table of world bituminous coal and anthracite reserves is presented instead - cf. Table 26.) Further exploration may improve the situation in Latin America, in Southern Africa and possible in India and Asia, with the NE region being the least hopeful.

Table 25 Iron Ore Production (Fe content) Minus Pig Iron Production Million Tons Per Year

Region	1970	1975	1980	1985	1990	1995
1 NA	-12.0	-12.5	-11.0	- 8.6	-13.0	-12.0
2 WE	-41.0	-64.0	-65.0	- 83.7	-95.0	-107.5
3 EE	0.0	- 2.0	- 6.0	- 0.3	8.9	9.5
4 JP	-39.5	-85.5	-83.5	-106.0	-117.3	-127.8
5 OD	8.5	48.5	60.5	90.2	114.4	142.5
6 LA	34.5	57.5	64.5	68.3	73.2	82.5
7-8 TA+NE	24.5	38.0	24.5	37.6	47.0	54.0
9-10 AS+IN	17.0	18.5	14.5	0.3	-6.1	-23.2
11 OA	2.0	0.0	1.5	3.5	2.3	8.0
World misfit*	-6.0	-1.5	0.0	1.3	14.5	26.0

* World tocal iron ore production minus world total pig iron production

Source: Author's calculation based on a variety of sources.

Table 26 World Bituminous Coal and Anthracite Reserves, Recoverable

Region	Reserves	
	10^6t	%
1 NA	108,790	22.28
2 WE	70,773	14.49
3 EE	134,005	27.45
4 JP	1,050	0.22
5 OD	50,725	10.39
6 LA	2,560	0.52
7 TA	7,130	1.46
8 NE	299	0.06
9 IN	13,320	2.73
10 AS	131	0.03
11 OA	99,450	20.37
Totals	488,233	100.00

Source: UN Yearbook of World Energy Statistics, 1980, op.cit.

Figure 11 Percentage distribution of A - world iron ore reserves and B - world iron ore production, both in terms of contained iron, 1978, over the eleven UNITAD regions. World total (100%) is 930 thousand million tons, contained iron, for the reserves and 481.5 million tons, contained iron, for the production.

Source: US bureau of Mines Bulletin 671, Mineral Facts and Prob.ems, 1980.

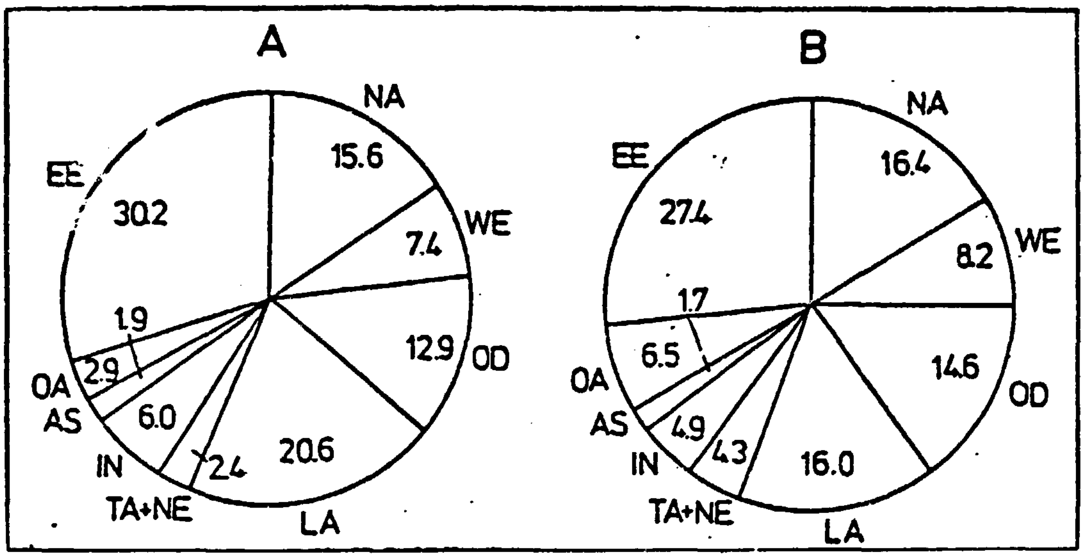

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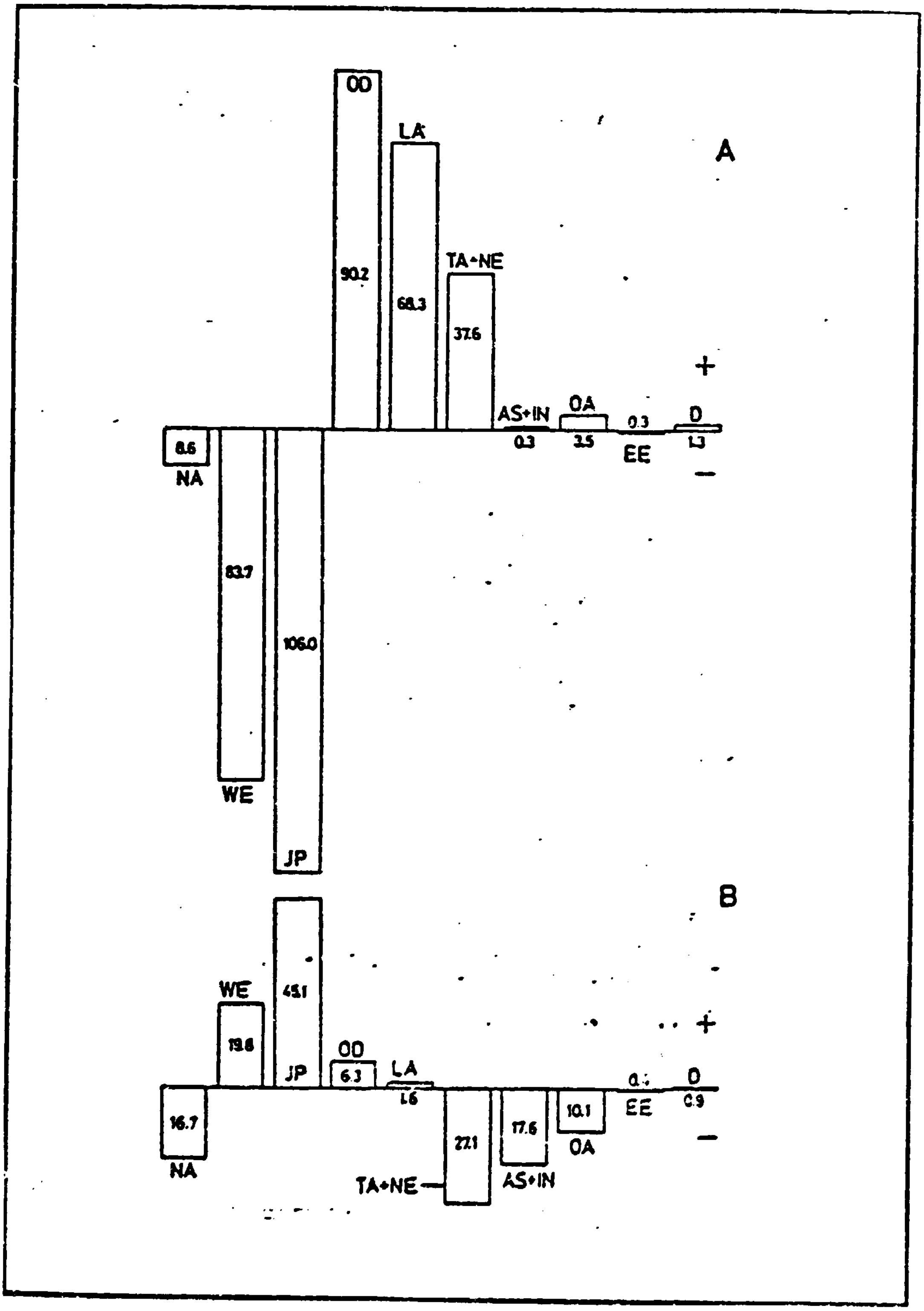
Figure 12 A - iron ore production (contained iron) minus pig iron production and B - steel production minus steel demand for each of the eleven UNITAD regions, million tons per year, 1985, forecast. D is the world misfit (cf. Tables 25 and 29). A column above the line indicates, in A, that the region is to be, by 1985, a net exporter of iron ore; in B, that the region is to be a net exporter of steel.

Source: Author's calculations based on a variety of sources.

Figure 12.


A
OD
90.2
LA
68.3
TA+NE
37.6
+
AS+IN
0.3
OA
3.5
0.3
EE
D
1.3
−
8.6
NA
83.7
WE
106.0
JP
B
WE
19.8
45.1
JP
OD
6.3
LA
1.6
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0.9
EE
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16.7
NA
27.1
TA+NE
17.6
AS+IN
10.1
OA

While the bituminous coal market has been a buyers' market practically all the time since the Korean War, coking coal, which is not abundant, has tended to fetch much better prices. In fact, about 80% of the 250 or so million tons of coal moving in international trade is coking grade.[22/]

E.1.2.3 Electric power

Developing countries which, on the strength of their developable or developed hydro power resources, could go in for electrometallurgy (electric steelmaking, aluminium electrolysis, etc.) include:

- in Latin America: Argentina, Brazil, Chile, Colombia, Costa Rica, El Salvador, Venezuela;
- in Tropical Africa: Angola, Ethiopia, Malawi, Mozambique, Nigeria;
- Egypt in the Near East;
- India
- in Asia: Indonesia, the Republic of Korea, Malaysia, Papua New Guinea, the Philippines and Thailand.

In addition, large quantities of natural gas-based electricity could be generated in the NE group.

E.1.3 Technology and siting pattern

The two variables of the siting pattern are distance from tidewater (which boils down in essence to whether a country is land-locked or not) and the size of the economy in GDP terms. A country at the small-size end of the land-locked group (very roughly up to an annual GDP of $1.5 bn:[23/] Laos, Mali or the Central African Republic, to name just a few) will probably prefer to set up one or a few efficient all-purpose (iron, steel plus

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22/ Coke consumption per ton of pig can be reduced by introducing into the blast furnace other fuels (gas, fuel oil, etc.) where cheaply available. Another recent innovation is the use of formed coke (non-coking coal cemented into a coking-coal matrix).

23/ As stated in 1980 dollars in the IBRD's World Development Report 1982.

non-ferrous-metal) foundries and a number of simple but non-artisanal forges to make agricultural implements, etc. At the bottom end of the range, however, even these may turn out (or, in fact, intended), to be non-profitable, utility-type facilities. (A country with a railway usually has a foundry and possibly a forge in the rolling-stock maintenance shops).

It is roughly at the $2 billion to $2.5 billion GDP level that a rolling mill for long products starts to be justified, using imported ingot eked out with scrap or the other way around. Later on, if demand picks up, a DR/EF or a BF (charcoal)/EF unit may be added on upstream, if the inputs are available. There is an obvious potential for joint subregional development here, especially if none of the participating countries is big enough to go it alone or none has all the necessary inputs. On the other hand, a big country the size of Nigeria may prefer to set up several rolling mills in the country, possibly supplied out of a large centrally placed BF works.

All this applies to flats-rolling mills, too, on a larger scale (beginning at the $5 billion to $8 billion GDP level). Hence, a flats rolling mill is even more likely to be a subregional (or possibly even a regional) project.

The smallest-size economy to the writer's knowledge that has a fully integrated (one million tpy) steelworks, partly BF/BOF and partly BF/open-hearth, is Zambia ($3.6 bn), owing no doubt to its being an ex-white-settler economy. The concept seems somewhat obsolete, however. Today, the smallest economy building a one-million-tpy greenfield works is Pakistan ($21.4 bn). Trinidad and Tobago ($5.3 bn) and Paraguay ($4.5 bn), on the other hand, are building mini mills, of 0.5 and 0.12 million tpy output, respectively. All greenfield mini and midi plants a-building today are scrap/EF or DR/EF, except the Paraguayan one, which is BF/BOF, presumably charcoal-fed.

Of the major greenfield plants currently being built or designed, only one is in a developed country (Canada). The 13 others are in NICs or NICs-to-be (Algeria, Brazil, Taiwan Province of China, India, Indonesia, Iran, Republic of Korea, Libya, Mexico, Nigeria and the Philippines). Their total initial capacity is to be 28.5 million tpy in crude steel terms, 9.0 million tpy of it by the DR/EF route.

Table 27 Developing-country Steel Producers Among the World's Top Fifty or Likely to Join That Group by 1985

Name	Country	World Rank	Capacity			Million Tons Per Year				
			BOF	BOF	OH	OH	EF	EF	Pig	Pig
		1977	1977	1985	1977	1985	1977	1985	1977	1985
Usiminas	Brazil	43	3.00	3.50	-	-	-	-	3.40	3.40
Pohang	Korean Rep	46	2.60	9.60	-	-	-	-	2.37	8.00
Somisa	Argentina	47	1.40	1.40	1.10	1.10	-	-	2.08	3.34
Bhilai	India	48	-	1.30	2.50	2.50	-	-	2.97	3.97
Zenica	Yugoslavia	49	1.30	1.75	1.10	1.10	0.03	0.15	1.90	1.90
Sidor	Venezuela	50	-	-	1.20	1.20	1.20	3.60	0.92	0.92
Cospia	Brazil		2.30	3.50	-	-	-	-	2.27	2.84
CSN	Brazil		0.80	3.00	1.00	1.00	-	-	3.50	4.32
Bokaro	India		1.70	4.00	-	-	-	-	2.70	3.72
Sicartsa	Mexico		1.25	1.25	-	-	-	2.00	1.10	1.10
China Steel	Insular China		-	-	-	-	-	-	1.50	2.80
Total, Million Tons/Year			14.35	29.30	6.90	6.90	1.23	5.75	24.71	36.31
Total % of World Total			3.4	6.4	9.2	20.6	0.9	3.1	5.1	7.5

Source: Peter F. Marcus and Karlis M. Kirsis, World Steel Dynamics, Core Report R, Paine Webber Mitchell Hutchins Inc., June 1982.

Table 28: Intra-South Steel Trade in 1976, Million Dollars

SITC Group	Item	Southern Imports From World	South	of Which Interregion	Regional	Subregional
673.2	Longs	1386.0	166.0	124.6	17.9	23.5
274	Flats	3514.0	98.5	11.4	32.6	54.5
677.0	Wire	360.0	31.7	16.9	8.5	6.3
678	Tubes, pipe	3125.0	237.6	68.0	117.5	52.6
691.1	Structures	1365.0	102.8	32.6	57.7	12.5

Remark: Rumania, Turkey and Yugoslavia figure as developing countries.

Source: TD/B/C.7/36/Add.3, op.cit.

Table 29 Steel Production Minus Steel Demand. Million Tons Per Year.

Region		1970	1975	1980	1985	1990	1995
1	NA	-15.0	-14.5	-17.5	-16.7	-14.2	-12.5
2	WE	13.5	19.0	19.5	19.8	17.1	15.0
3	EE	2.5	-1.5	-5.0	-0.4	2.3	1.5
4	JP	12.0	35.0	42.0	45.1	41.1	43.0
5	OD	0.0	-0.5	4.0	6.3	8.8	10.2
6	LA	-4.0	-9.5	-8.0	1.6	6.7	9.0
7-8	TA+NE	-6.5	13.5	-20.5	-27.1	-33.0	-41.2
9-10	AS+IN	-5.0	-10.5	-11.5	-17.6	-13.5	-9.7
11	OA	-2.0	-3.5	-3.5	-10.1	-11.9	-11.8
World misfit*		-4.5	0.5	-0.5	0.9	3.4	3.5

* World total steel production minus world total steel demand.

Source: Author's calculation based on a variety of sources.

There is no wide gap between the major steelworks of the developing and the developed countries (Table 27). The developing-country steelmakers belonging to the top 50 of the world may by 1990 produce about 10% of both world pig iron and world crude steel output. They will be eager to find markets in the developing countries; their works sited on tidewater will export rolled steel, whereas the inland works of major economies like Bhilai and Bokaro in India will supply engineering industries aggressive in their marketing. These latter will be keen to export steelworks equipment among other things; they will thus serve as secondary steel technology sources on their way to becoming primary ones. Mexico's proprietary HyL direct reduction process is a pointer in that direction.

E.1.4 Scope for Expansion

That scope is best characterized in terms of the figures in Tables 28 and 29.

Table 28 reveals that the share of flats of Southern origin in Southern imports is outstandingly low at 2.8 per cent (it is lowest of all in the items listed in the source, metal or non-metal).

Table 29 reveals that

- as things stand now, all developed regions except NA are expected to produce more steel than they consume; the Northern excess is, of course, expected to be absorbed by the South;

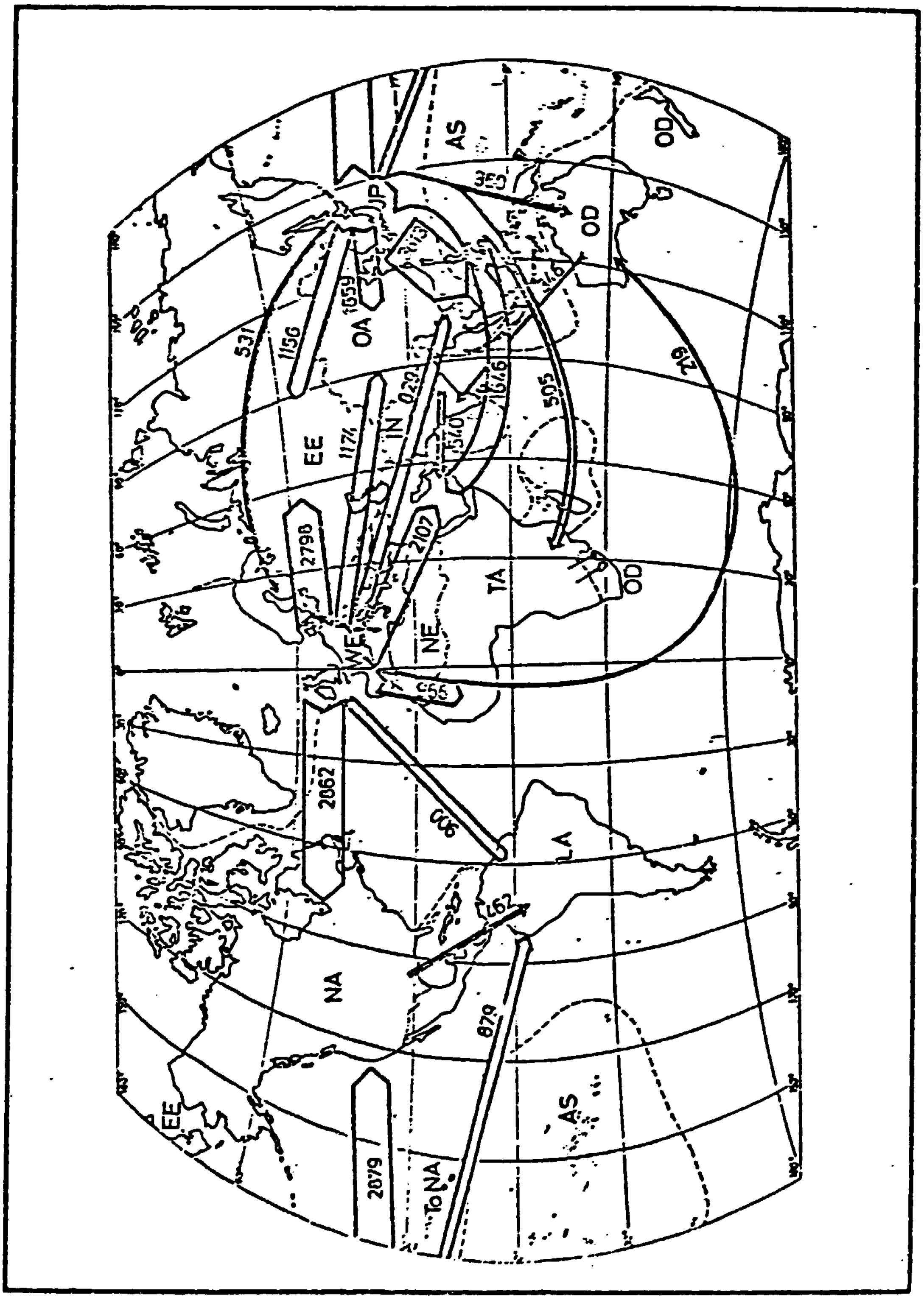
- Latin America is seen as another region with a clear-cut and increasing excess, whereas the other developing regions are seen to remain in deficit.

The actual evolution might differ from this forecast in that, under the impact of the market forces, the Northern surplus will probably shrink as time proceeds: yet the Southern deficit will probably shrink even faster, leaving a world surplus overall. In addition to LA, AS+IN may also progress to self-sufficiency by 1995.

Figure 13. Iron and steel (SITC Code 67 - revised). Net interregional trade flows, $million, 1979. Flows worth less than $200 million and intra-regional flows not shown. Source: UN, 1980 Yearbook of International Trade Statistics, Vol. I, ST/ESA/STAT/SER.G/29, pp. 1150-115. Does not include exports by the USSR that could not be attributed by destination.

Regional boundaries are shown in dot-dash line on land and in dashed line on the seas. The arrows refer to entire UNITAD regions and are not intended to pinpoint actual points of loading or destination. All flows to or from the OD region are shown as ending/beginning in Australia.

Figure 13.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For the present, the Southern situation could be improved by phasing out most of the Northern imports of longs, replacing them with the output of strategically sited and sized national or subregional mini or midi mills. Doing the same for flats would not be unfeasible, either, but it would require more of a regional or interregional approach.

E.1.5 Other Issues of South-South Co-operation

As far as this writer is aware, South-South co-operation in iron and steel beyond simple trade (including some trade in production equipment) is conspicuous by its absence. A project under UNIDO auspices to combine the iron and steel development projects of Angola and Mozambique is all the more to be welcomed.

There is, on the other hand, a growing awareness in some regions that such co-operation is desirable. Specifically, GOIC, the Gulf Organization for Industrial Consulting of the Arab Gulf States, has, as a contribution towards adopting a co-ordinated regional approach to the iron and steel industry, closely scrutinized supply and demand trends in the Arab world and found that Arab supply and demand would balance out by 1990 provided productive capacity is brought by then to a level of 19 million tons in crude steel terms. A GOIC seminar at Doha in Mar . 1981 recommend a major increase in steel making capacity in the region and co-operation among member states in raw materials supply, technical advisory committee to deal with the ways and means of developing the iron and steel industry and related industries and to enhance regional co-operation in these. The Committee includes experts from all seven member states of GOIC and also from the Arab Iron and Steel Union.[24/]

E.2 Non-ferrous Metallurgy

The metals to be discussed here are aluminium, copper, lead, zinc and tin. Their relative importance was presented on p. 65.

24/ Gulf Organization for Industrial Consulting, op.cit.

In 1978, the South gave 52.0 per cent of world bauxite output but only 20.2 per cent of world alumina production and 10.7 per cent of world primary aluminium metal production. (Cf. Table 31.)

In the same year, the South gave about 50 per cent of world copper ore output; its share of refinery output was less than 40 per cent (Cf. Table 34.)

In contrast, the South's share of world lead and zinc mine output was only 26.7 and 26.5 per cent, respectively; its share of lead smelting and refining was 18.0 and 18.7 per cent, and its share of primary zinc production was 14.7 per cent. (Cf. Tables 36 and 38.)

Tin is a different story again: in 1978, its share of world tin mining output was 77.8 per cent and its share of tin smelter production was 72.0 per cent. (Cf. Tables 40 and 41.)

The reasons for these divergences are set forth in the detailed discussion.

The inferior share of the South in the world production of the first four of these five metals is compensated, more or less, by the South's modest demand. The differences between Southern production and consumption are presented in Table 30 and Fig. 16.

Figure 14 presents the net interregional trade flows of non-ferrous metals.

Figure 14. Non-ferrous metals (SITC Code 68 - revised): net inter- regional trade flows, $ million, 1979. Flows worth less than $100 million and intra-regional flows not shown.

Source: op. cit. in Fig. 14, pp. 1154-1159. For other pertinent information cf. the caption to Fig. 14.

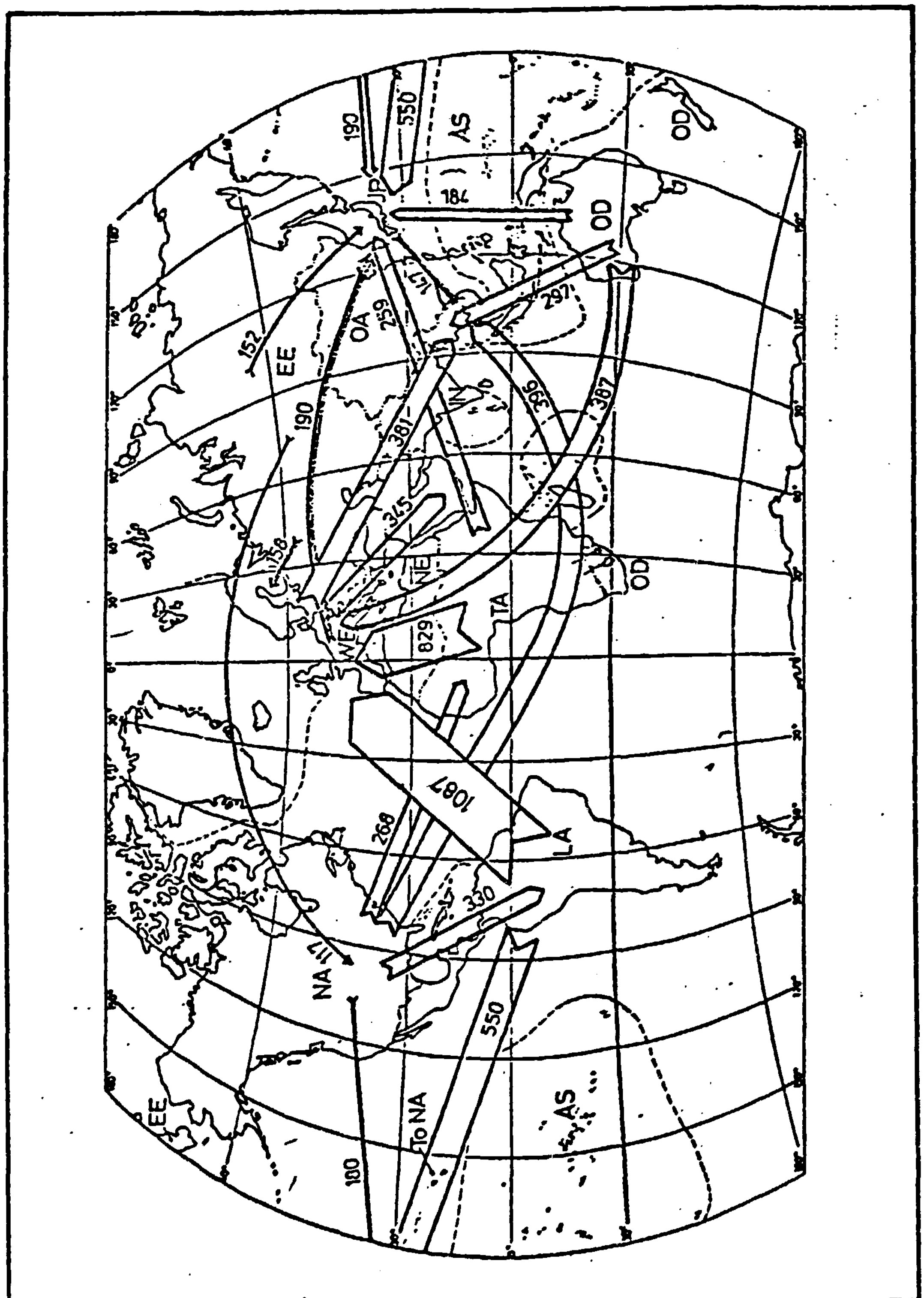

Figure 15. Regional imbalances, production minus consumption, of the five "older major (non-ferrous) metals", 1979. D - statistical difference; ND - net deficit of the South, NS - net surplus of the South. Columns above the line mean that the region is a net exporter.

Source: Metallgesellschaft AG, Metal Statistics 1969-1979, 67th Edition, Frankfurt/Main, 1980.

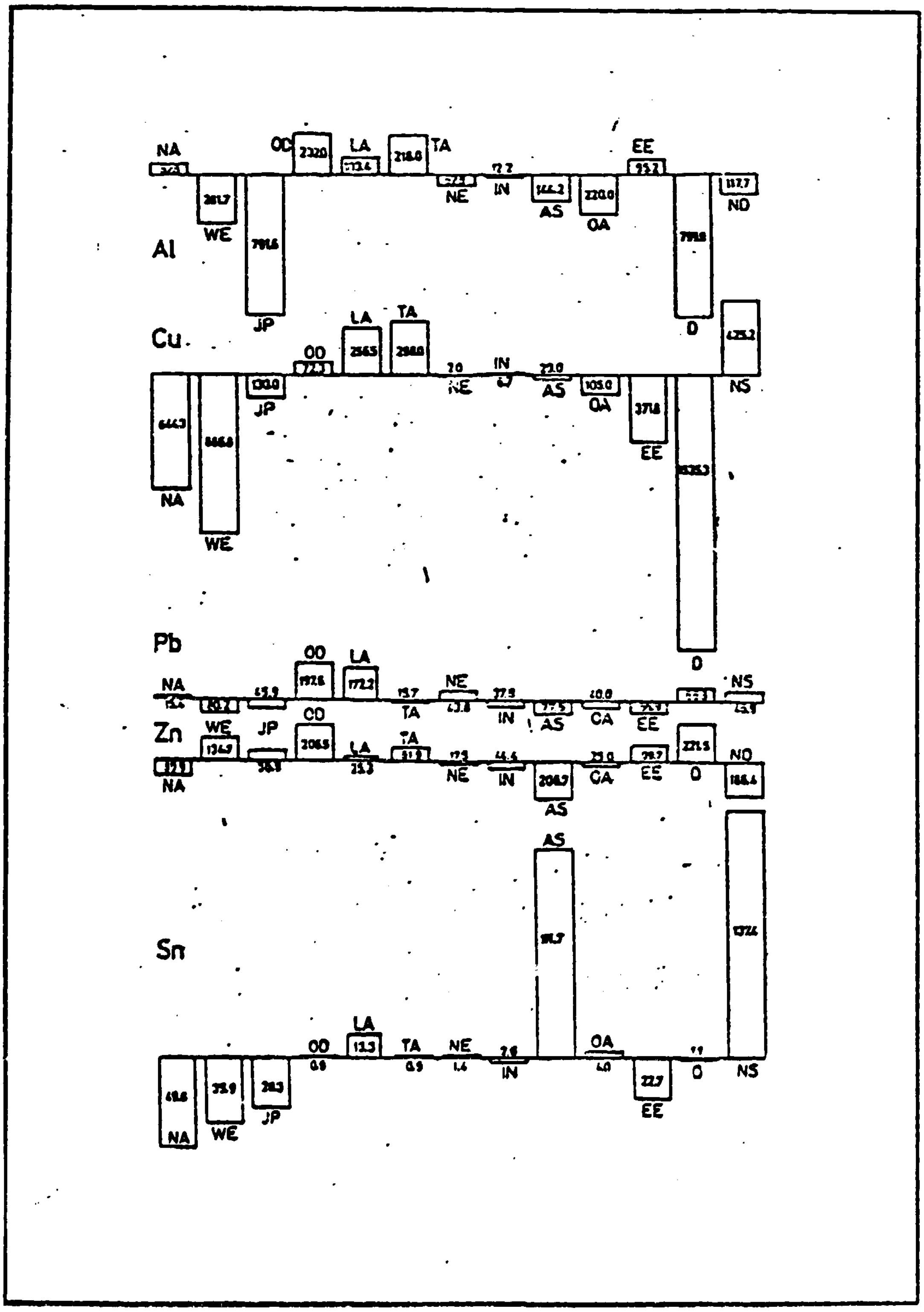

Table 30. Regional Gaps Between the Production and Consumption of Five Non-ferrous Metals, 1979. (Thousand Tons)

Negative signs indicate consumption uncovered by production.

Region		Aluminium	Copper	Lead	Zinc	Tin
1	NA	62.8	-644.3	15.4	-89.9	-49.3
2	WE	-281.7	-886.8	-80.2	134.7	-35.9
3	EE	95.6	-371.8	-66.9	99.7	-22.7
4	JP	-791.6	-130.0	-45.9	56.9	-28.3
5	OD	232.0	72.3	197.6	206.5	0.9
6	LA	103.4	256.5	174.2	25.3	13.3
7	TA	218.8	298.0	-15.7	81.9	0.9
8	NE	-62.8	-2.0	43.8	-17.5	1.4
9	IN	-12.2	6.7	-37.8	-44.4	-2.6
10	AS	-144.2	-29.0	-77.6	-206.7	111.7
11	OA	-220.0	-105.0	-40.0	-25.0	4.0
(1)		-799.9	-1535.3	66.8	221.5	-1.1
(2)		-117.7	425.2	46.9	-186.4	137.4

Remarks: (1) is the difference between world total production and world total consumption. It piles up in inventories, bonded warehouses etc., or flows out of those.
(2) is the South's net position.

Source: Author's calculations based on Metallgesellschaft Aktiengesellschaft, Metal Statistics 1969-1979, 67th Edition, Frankfurt am Main, 1980.

E.2.1 Aluminium

The aluminium industry today uses bauxite almost exclusively as the ore from which to prepare the metal. Bauxite is converted into alumina (aluminium oxide) in a process of hydrometallurgical beneficiation; alumina is converted into the metal in a process of igneous electrolysis (electrosmelting), a great consumer of electric power (typically, 15.000 to 17,000 kWh per ton of metal, all told). Up to the 1960s, electric power used to be considered cheap enough for aluminium smelting at about 3 US mills (0.3 US cents) per kWh; nowadays; 3 US cents per kWh is considered to be on the favourable side. Hence, clearly, it is best to site smelters where cheap hydro-power is available (although today gas-based electricity in the big gas-producing and gas-flaring countries is a viable alternative). Alumina plants are sited as a rule either next to the smelter or next to the bauxite mine; there is no clear-cut transportation-cost advantage either way, but the stence of the bauxite-mining countries on a higher-degree processin. their product militates for the latter option.

E.2.1.1 The Reserve Situation

Tropical Africa and Latin America possess more than 60 per cent of the world reserve between them. In the developed world, Australia is rich enough to satisfy all Northern needs at a pinch.

Cheap non-tied sources of electricity available for aluminium smelting are largely confined to the developing world today. For a list of developing countries so endowed, cf. F.1.2.3.

Table 31. World Bauxite Reserves and Resources, 1979. Dry Weight and Recoverable Aluminium Content; Resources Inclusive of Reserves.

Region		Reserves Dry Weight		Reserves Recoverable Aluminium Content		Resources Recoverable Aluminium Content	
		Million Tons	%	Million Tons	%	Million Tons	%
1	NA	40	0.2	9.1	0.2	45.3	0.6
2	WE	1145	5.0	231.3	4.9	412.8	5.1
3	EE	645	2.8	127.0	2.7	258.5	3.2
4	JP	-	-	-	-	-	-
5	OD	4520	19.9	911.7	19.3	1437.8	17.9
6	LA	6200	27.3	1369.8	29.0	2268.0	28.2
7	TA	8205	36.2	1687.4	35.8	2603.0	32.4
8	NE	-	-	-	-	-	-
9	IN	1000	4.4	204.1	4.3	408.3	5.1
10	AS	765	3.4	149.7	3.2	403.7	5.0
11	OA	150	0.7	27.2	0.6	190.5	2.4
Total		22570	100.0	4717.3	100.0	8028.4	100.0

Remark: Percentages may not add up owing to rounding.

Source: Mineral Facts and Problems, op. cit.

E.2,1.2 Siting and Technology

Economies of scale are considerable in aluminium smelting, and even more so in alumina refining and bauxite mining. A modern alumina plant is in the

0 [illegible] to 2.4 million tpy range; a modern smelter, in the 100,000 to 500,000 tpy range. There is no mini alumina plant or smelter in sight. Even when run by a fairly large regional economic community, such facilities must be at least partially export-oriented if they are to profit fully by the economies of scale attainable. In any case, the South's smelter capacity, small as it is, can almost satisfy the South's modest aluminium metal demand (in fact, if OA is disregarded, the South has a metal surplus). The problem is that most of the metal consumed in the South comes from Northern smelters, a great deal of it in semi-fabricated form, whereas metal from the Southern smelters is taken North as a rule for semi-fabrication. In 1976, only 23 per cent of the aluminium semis imported by the South came from Southern sources.[25/] (For example, India in 1980/81 imported some 130,000 t of aluminium as against a home production of 200,000 t.) Yet at least 40 developing countries have semi-fabricating plants may be viable at very small sizes (less than 10,000 or even 100 tpy, depending on what products they make).

E.2.1.3 Scope for South-South Co-operation

(a) Trade

Short-circuiting the trade flows that pass through the North today is a viable opportunity. It could boost South-South trade by about 100,000 tons of semis and somewhat more metal per year.

(b) Siting and Expansion

At the regional co-operation level, GOIC, the Gulf Organization for Industrial Consulting of the Arab Gulf states, has been [illegible]rmulating a strategy for the aluminium industries of the member states. This envisages by 1995 the production in the Arab Gulf region of up to one millio[illegible] per year of primary aluminium, 300,000 tons per year of aluminium sem[illegible] [illegible]ssibly two million tons per year of alumina. The strategy document emphasises the need for unified energy pricing policies, group purchase of alumina, joint acquisition of technology, smelting technology in particula[illegible] group marketing

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25/ TD/B/C.7/35/Add.3, [illegible] [illegible]ania, Turkey and Yugoslavia are counted as develop[illegible] countri[illegible] [illegible]urce.

of primary aluminium, efforts toward developing a regional common market, and adoption of policies apt to protect local aluminium products from foreign competition. As a first step, GOIC in 1980 established the viability of an aluminium rolling mill of 40,000 tpy capacity, to be built in Bahrain and co-owned by Bahrain, Saudi Arabia, Iraq, Kuwait, Qatar and Oman. It has further prepared feasibility studies concerning the joint production of petroleum coke, a smelter input at Abu Dhabi, and of an alumina plant which might use bauxite imported from India.[26/] Interregional co-operation on the pattern of one UNIDO-assisted project (by which India is to finance a smelter in Mozambique and supply it with Indian alumina, and to buy back the bulk of the metal produced) is viable and should be promoted. Bringing together countries that have cheap energy but no bauxite with others endowed the other way round does seem fairly hopeful.

26/ Gulf Organization for Industrial Consulting, op. cit.

Table 32 World Bauxite, Alumina and Aluminium Production (estimated) and Capacity, both 1978. (Million tons of aluminium or aluminium equivalent.)

Region	Bauxite				Alumina				Aluminium			
	Production		Capacity		Production		Capicity		Production		Capacity	
	10^6 t	%	10^6 t	%	10^6 t	%	10^6 t	%	10^6 t	%	10^6 t	%
1 NA	0.4	2.1	0.5	2.5	3.6	23.7	4.4	23.2	5.4	38.4	5.8	33.8
2 WE	1.5	8.7	2.1	9.6	2.5	16.1	3.5	18.3	3.7	26.6	4.2	24.3
3 EE*	1.5	8.7	1.9	8.5	1.9	12.1	2.3	12.0	1.9	13.8	3.0	17.8
4 JP	-	-	-	-	0.8	5.1	1.3	7.2	1.1	7.5	1.6	9.6
5 OD	4.9	28.6	6.1	27.6	3.5	22.9	3.6	19.3	0.4	2.9	0.4	2.3
6 LA	4.7	27.6	6.9	31.4	2.[illegible]	3.9	2.6	13.6	0.4	2.9	0.7	3.9
7 TA	3.1	18.2	3.3	14.9	0.3	2.1	0.4	1.9	0.3	2.4	0.4	2.6
8 NE	-	-	-	-	-	-	-	-	0.1	0.7	0.1	0.6
9 IN	0.3	2.0	0.4	1.6	0.3	1.7	0.3	1.9	0.2	1.5	0.4	2.1
10 AS) 11 OA)	0.7	4.2	0.9	3.9	0.4	2.5	0.5	2.6	0.5	3.2	0.5	3.0
Totals	17.1	100.0	22.1	100.0	15.4	100.0	18.9	100.0	14.0	100.0	17.1	100.0

* The nepheline syenite and alunite mined in the USSR are excluded.

Remark: Percentages may not add up owing to rounding.

Source: Mineral Facts and Problems, op. cit.

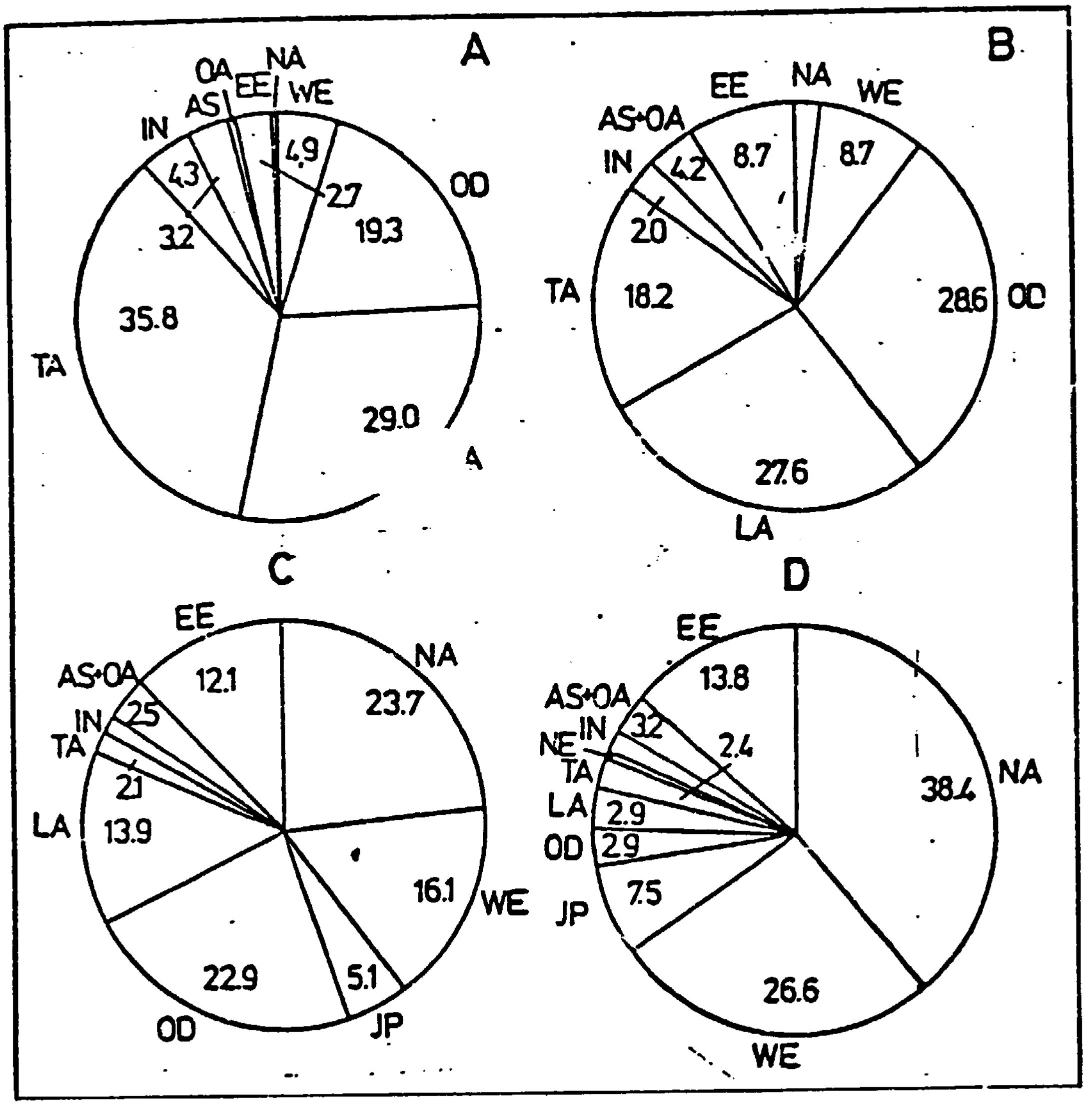

Figure 16. Percentage distribution of A - world bauxite reserves, B - world bauxite production, C - world alumina production, all in terms of contained metal, and D - world aluminium production in 1978, over the 11 UNITAD regions. The percentages not shown are, A - 0.2% for NA, 0.7% for OA; B - 2.1% for NA; C - 1.7% for IN; and D - 0.7% for NE and 1.5% for IN. World totals (100%) are, 4717.3 million tons of recoverable aluminium content for the reserves; 17.1 million tons of contained metal for the bauxite production; 15.4 million tons of contained metal for alumina production; and 14.0 million tons for metal production.

Source: Mineral Facts and Problems, op.cit.

(c) Technology

The reader is referred to Section E.3.

E.2.2. Copper, Lead and Zinc.

These metals are lumped together because of a common siting feature. Ever since the beginnings of their overseas mining, it has been usual to site the smelters of these ores next to their mines. Accordingly, whereas only 12.2 per cent of world aluminium smelting capacity is in the South (Table 32), 47 per cent of world copper smelting capacity is (Table 34). For lead (22 per cent) and zinc (14 per cent), the situation is less clear-cut, but that is so because the bulk of these two is mined in the North (Tables 36 and 38).

Table 33. World Copper Reserves and Resources*. Contained Copper Resources Inclusive of Reserves.

Region	Reserves		Resources	
	Million Tons	%	Million Tons	%
1 NA	124	25.1	523	32.1
2 WE and NE	22	4.5	58	3.6
3 EE and OA	60	12.1	232	14.3
4 LA	169	34.2	469	28.8
5 AF	69	14.0	178	10.9
6 AS	27	5.5	91	5.6
7 OC	23	4.7	77	4.7
Totals	494	100.0	1627	100.0

*The regions in the statistic (which was preferred to others for reasons of consistency) do not coincide with the UNITAD regions. AF means all Africa; OC means all Oceania; AS includes IN and JP.

Source: Mineral Facts and Problems, op.cit.

As regards the refining of copper, lead and zinc, only a minor percentage takes place next to the smelters: a fair amount of unrefined metal and some ore concentrate enters international trade, South to North. The stage with the greatest value added, semifabrication, is predominantly Northern, although recently countries like Chile have been setting up or expanding semis capacities. To avoid the tariff barriers which are much high against semis than against metal in the developed world, some developing countries embark upon joint semifabricating ventures in Northern countries (e.g. Zambia and Chile in Western Europe).[27/]

E.2.2.1 The Resource Base

Copper. The Americas are outstandingly rich; apart from that, the distribution is fairly even. This in itself makes the viability of CIPEC operating as a cartel questionable: to work, it would need substantial Northern backing (say, from Australia and Canada).

Lead, Zinc. The two metals are most often mined together. In both, Northern reserves are predominant, but Latin America has enough to satisfy the South's rather modest needs at a pinch.

E.2.2.2 Siting and Expansion

Of the six million tpy of copper refining capacity to be built between 1975 and 1990, 1.15 million tpy is forecast to be in LA, one million tpy in TA+NE, and the rest in the North; capacity additions in the Asiatic sphere are not expected to be significant.

27/ UNIDO: Mineral Processing in Developing Countries, op. cit., ID/253.

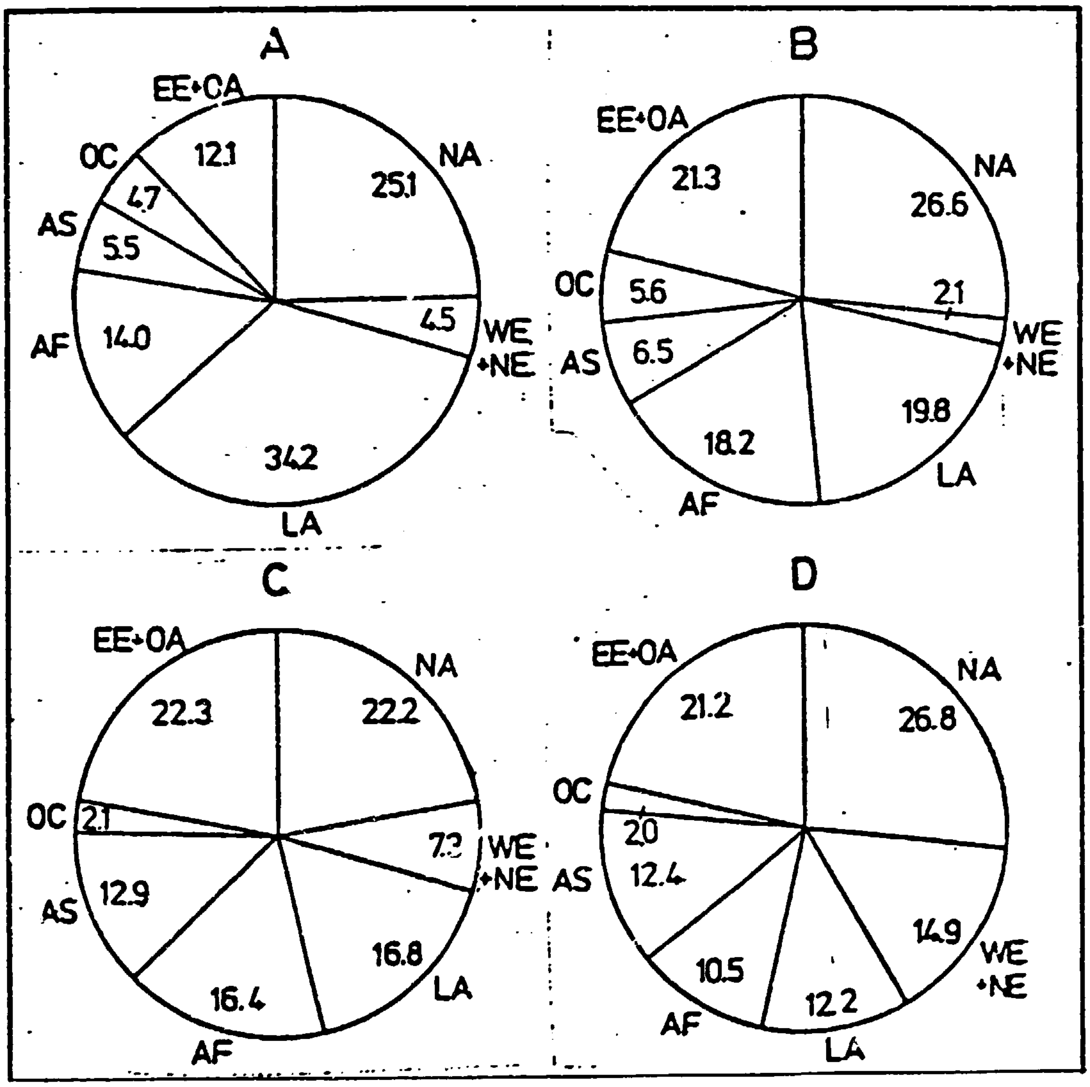

Figure 17. Percentage distribution of A - world copper reserves, B - world copper mine output, C - world smelter production and D - world refinery production production of copper in 1978 over seven world regions. AF includes South Africa, Tropical and Mediterranean Africa. OC includes both developing and developed Oceania. AS includes India and Japan. NE does not include Africa North of the Sahara. The other symbols used are those for the UNITAD regions. World totals (100%) are 494 million tons for the reserves, 7.5 million tons for mining (metal content), 8.0 million tons for smelting and 8.5 million tons for refining.

Source: Mineral Facts and Problems, op. cit.

Table 34. World Copper Mine, Smelter and Refinery Output and Capacity,* 1978.

Region	Mine**				Smelter				Refinery			
	Production		Capacity		Production		Capacity		Production		Capacity	
	10^3 t	%	10^3 t	%	10^3 t	%	10^3 t	%	10^3 t	%	10^3 t	%
1 NA	2005	26.6	2760	29.6	1768	22.2	2510	25.3	2315	26.8	3250	28.9
2 WE+NE	157	2.1	220	2.4	579	7.3	620	6.2	1286	14.9	1670	14.8
3 EE+OA	1601	21.3	1810	19.4	1774	22.3	1910	19.2	1832	21.2	2400	21.3
4 LA	1491	19.8	1640	17.6	1341	16.8	1510	15.2	1052	12.2	1100	9.8
5 AF	1368	18.2	1710	18.3	1310	16.4	1730	17.4	909	10.5	1220	10.8
6 AS	486	6.5	770	8.2	1030	12.9	1420	14.3	1073	12.4	1410	12.5
7 OC	418	5.6	430	4.6	169	2.1	230	2.3	175	2.0	210	1.9
Totals	7526	100.0	9340	100.0	7971	100.0	9930	100.0	8642	100.0	11260	100.0

* The regions in this statistic (which was preferred to others for reasons of consistency) do not coincide with the UNITAD regions. AF means all Africa; OC means all Oceania; AS includes IN and JP.

** Contained copper.

Source: Mineral Facts and Problems, op, cit.

Table 35. World Lead Reserves and Resources. Contained Lead Resources Inclusive of Reserves.

Region	Reserves		Resources	
	Million Tons	%	Million Tons	%
1 NA	32	25.2	84	29.2
2 WE	18	14.2	35	12.2
3 EE	21	16.5	44	15.2
4 JP	-	-	-	-
5 OD	23	18.1	44	15.2
6 LA	20	15.7	48	16.7
7 TA	2	1.6	8	2.8
8 NE	4	3.1	10	3.5
9 IN 10 AS	4	3.1	8	2.8
11 OA	3	2.4	7	2.4
Totals	127	100.0	288	100.0

Source: Mineral Facts and Problems, op. cit.

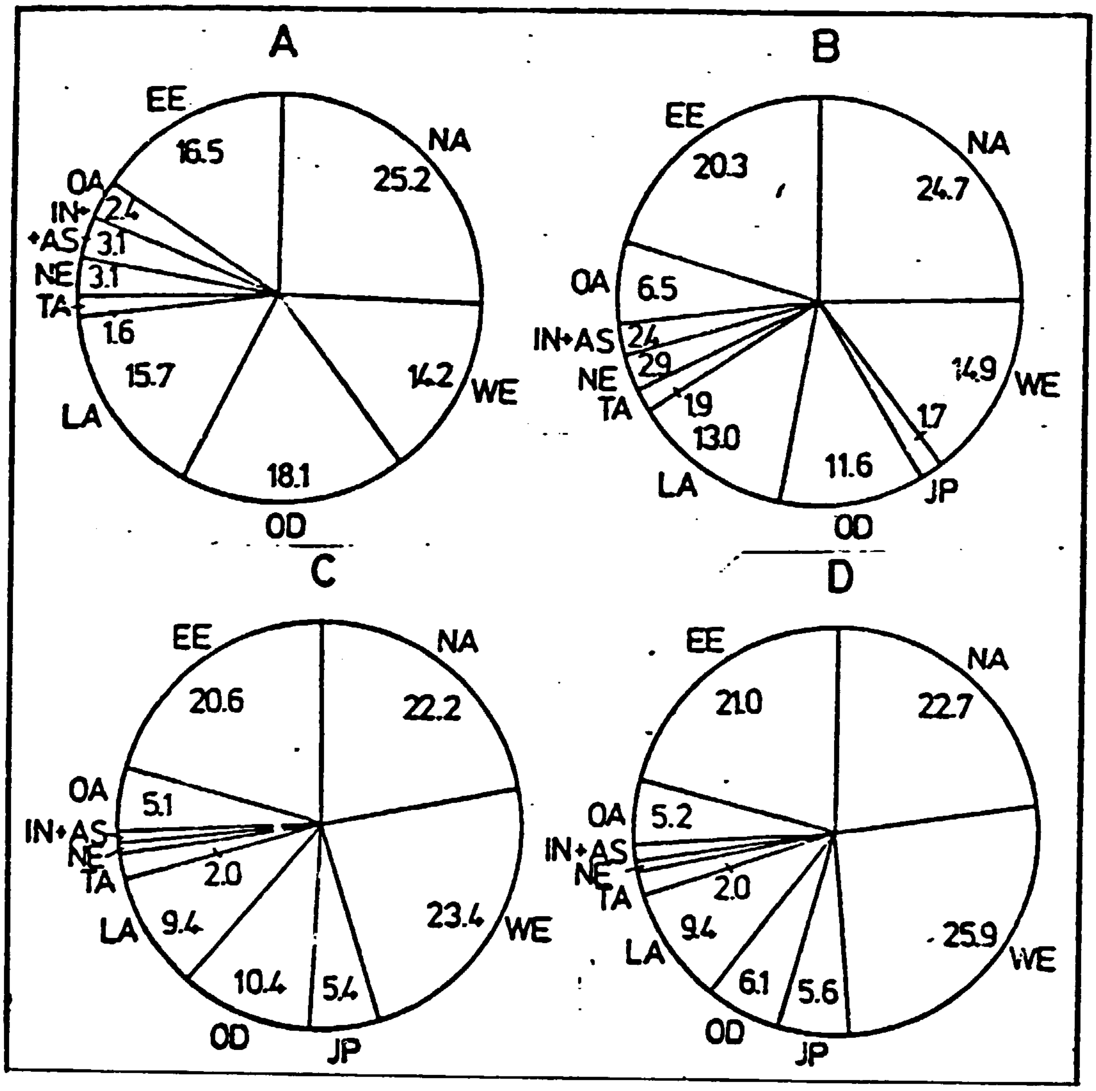

Figure 18. Percentage distribution of A - world lead reserves, B - world lead mine production, C - world smelter production and D - world refinery production of lead in 1978 over the eleven UNITAD regions. The percentages not shown are, C - 0.8% for NE and 0.7% for IN+AS; D - 0.8% for NE and 1.3% for IN+AS. World totals (100%) are, 127 million tons for the reserves, 3.4 million tons for mining (metal content), 3.4 million tons for smelting and 3.3 million tons for refining.

Source: Mineral Facts and Problems, op. cit.

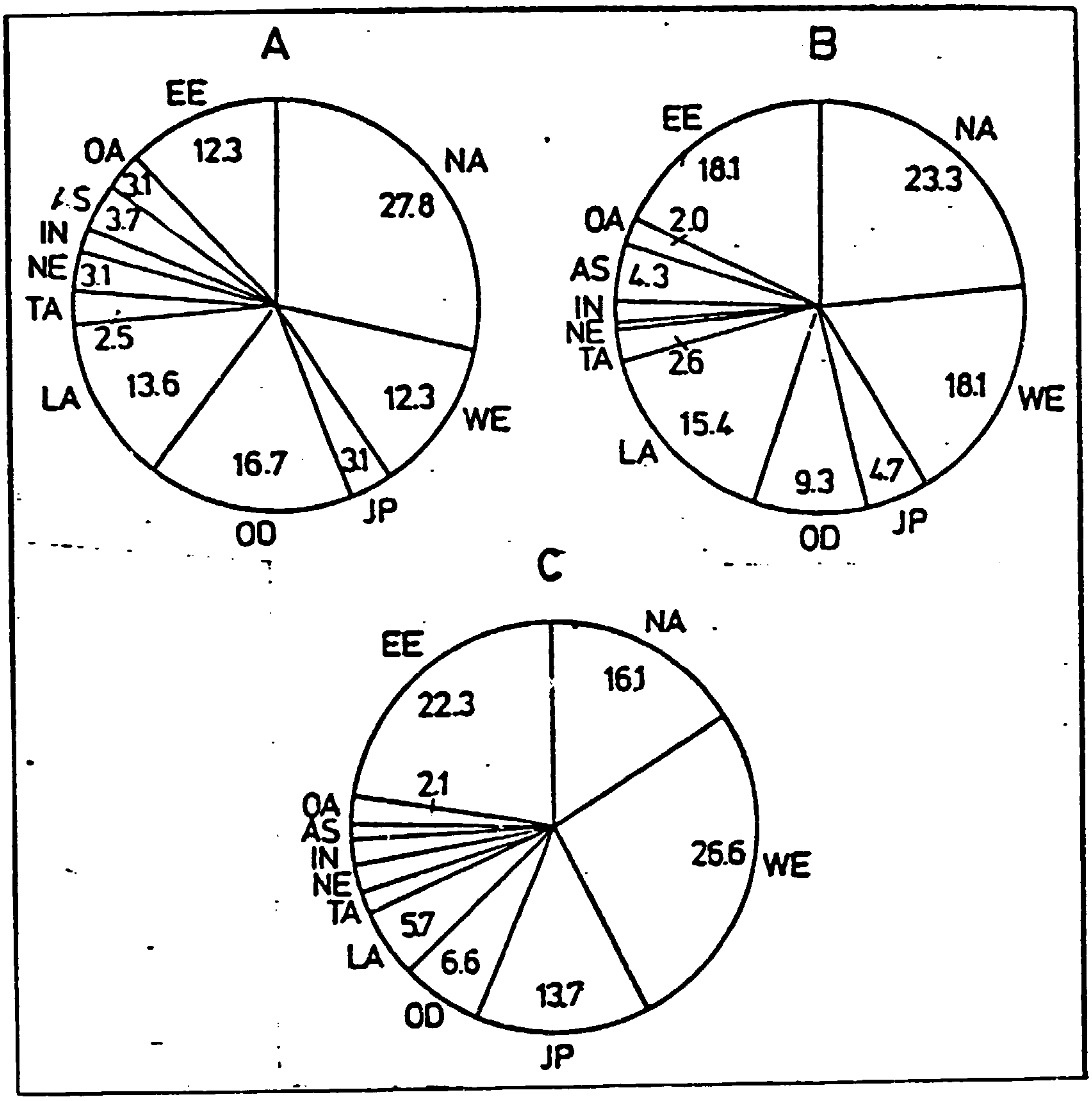

Figure 19. Percentage distribution of A - world zinc reserves, B - world zinc mine production and C - world primary zinc production in 1978 over the eleven UNITAD regions. The percentages not shown are, A - 1.9% for IN: B - 0.5% for NE and 1.7% for IN; C - 1.5% for TA, 2.2% for NE, 2.1% for IN; C - 1.5% for TA, 2.2% for NE, 2.1% for IN and 1.1% for AS. World totals (100%) are, 162 million tons for the reserves, 5.9 million tons for the mine production (both metal content) and 5.6 million tons for primary metal output.

Source: Mineral Facts and Problems, op. cit.

Table 36. World Lead Mine, Smelter and Refinery Production and Capacity 1978; Metal and Metal Equivalent.

Region	Mine				Smelter				Refinery			
	Production		Capacity		Production		Capacity		Production		Capacity	
	10^3 t	%	10^3 t	%	10^3 t	%	10^3 t	%	10^3 t	%	10^3 t	%
1 NA	850	24.7	965	23.5	759	22.2	931	19.6	759	22.7	931	19.9
2 WE	515	14.9	615	15.0	801	23.4	1228	25.9	866	25.9	1268	26.9
3 EE	701	20.3	725	17.7	703	20.6	810	17.1	703	21.0	925	19.7
4 JP	57	1.7	75	1.8	186	5.4	319	6.7	186	5.6	319	6.8
5 OD	400	11.6	450	11.0	356	10.4	410	8.6	204	6.1	230	4.9
6 LA	449	13.0	566	13.8	320	9.4	512	10.8	313	9.4	543	11.5
7 TA	66	1.9	175	4.3	67	2.0	135	2.8	67	2.0	135	2.9
8 NE	100	2.9	130	3.2	27	0.8	35	0.7	27	0.8	35	0.7
9 IN												
10 AS	82	2.4	135	3.3	25	0.7	63	1.3	45	1.3	63	1.3
11 OA	225	6.5	270	6.6	174	5.1	302	6.4	174	5.2	275	5.5
Totals	3445	100.0	4106	100.0	3418	100.0	4745	100.0	3344	100.0	4706	100.0

Source: Mineral Facts and Problems, op. cit.

Table 37. World Zinc Reserves and Resources, Contained Zinc. Resources Inclusive of Reserves.

Region	Reserves		Resources	
	Million Tons	%	Million Tons	%
1 NA	45	27.8	128	39.4
2 WE	20	12.3	30	9.2
3 EE	20	12.3	36	11.1
4 JP	5	3.1	7	2.2
5 OD	27	16.7	59	18.7
6 LA	22	13.6	32	9.8
7 TA	4	2.5	6	1.8
8 NE	5	3.1	6	1.8
9 IN	3	1.9	4	1.2
10 AS	6	3.7	10	3.1
11 OA	5	3.1	7	2.2
Totals	162	100.0	325	100.0

Source: Mineral Facts and Problems, op. cit.

Of the four million tpy of slab zinc refining capacity to be built between 1975 and 1990, only about 0.8 million tpy is expected to be in the South as a whole.

Of the three million tpy or so of lead refining capacity to be built in the world between 1975 and 1990, only 0.6 million tpy is expected to be in the South as a whole.

This pattern is explained by the fact that the sort of investment referred to above, attracted as it is by the biggest and most viable ore deposits, reflects, by and large, the reserve distribution. There is, however, no denying the fact that, in recent times, investment into the development of these ores has tended to withdraw into the North. Southern co-operation in the prospection for viable deposits of these ores, possibly with DTCD or UNRFNRE assistance, and possible backing for the ongoing development projects, is therefore recommended.

Table 38. World Zinc Mine and Primary Production, 1978

Region	Mine				Primary Metal			
	Production		Capacity		Production		Capacity	
	10^3 t	%	10^3 t	%	10^3 t	%	10^3 t	%
1 NA	1370	23.3	2050	25.8	902	16.1	1360	17.7
2 WE	1066	18.1	1475	18.6	1495	26.6	2242	29.1
3 EE	1064	18.1	1135	14.3	1251	22.3	1630	21.2
4 JP	275	4.7	345	4.3	768	13.7	1010	13.1
5 OD	545	9.3	755	9.5	369	6.6	414	5.4
6 LA	906	15.4	1150	14.5	322	5.7	394	5.1
7 TA	150	2.6	260	3.3	86	1.5	123	1.6
8 NE	30	0.5	60	0.8	126	2.2	140	1.8
9 IN	100	1.7	150	1.9	117	2.1	130	1.7
10 AS	252	4.3	425	5.4	59	1.1	81	1.1
11 OA	120	2.0	130	1.7	120	2.1	175	2.3
Totals	5878	100.0	7935	100.0	5615	100.0	7699	100.0

Source: Mineral Facts and Problems, op. cit.

E.2.2.3 Trade

The reader is referred to Table 32. The net position of the South is seen to be negative in zinc, slightly positive in lead, and one of considerable surplus in copper. There is a substantial scope for short-circuiting the copper trade flows passing through the North, whereas in the case of lead and zinc the effort seems rather unrewarding.

E.2.3 Tin

In comparison with the other "older major metals", tin is a minor commodity; yet it is remarkable for a number of politico-economic features. Admittedly, these would probably not be there if the commodity were a more important one. One of these features is the International Tin Agreement; another one is the takeover of the Southeast Asian deposits by the countries in which they are situated and the successful development, on that basis of a tin smelting industry which, by the process of input starvation, has led to the quasi-total phase-out of the exports of Southeast Asian tin-in-concentrates and of the smelting of those concentrates in Britain or elsewhere, and to a considerable shrinking of Northern tin smelting overall.

Table 39. World Tin Reserves and Resources, Thousand tons. Resources Inclusive of Reserves.

Region	Reserves		Resources	
	000 t	%	000 t	%
1 NA	70	0.7	440	1.2
2 WE	300	3.0	2230	6.1
3 EE	1000	10.1	2900	7.9
4 JP	-	-	-	-
5 OD	470	4.8	1210	3.3
6 LA	1400	14.2	6930	18.9
7 TA	590	6.0	3380	9.2
8 NE	-	-	-	-
9 IN	-	-	-	-
10 AS	4560	46.1	14100	38.4
11 OA	1500	15.2	5500	15.0
Totals	9890	100.0	36700	100.0

Remark: Percentages may not add up owing to rounding.

Source: Mineral Facts and Problems, op. cit.

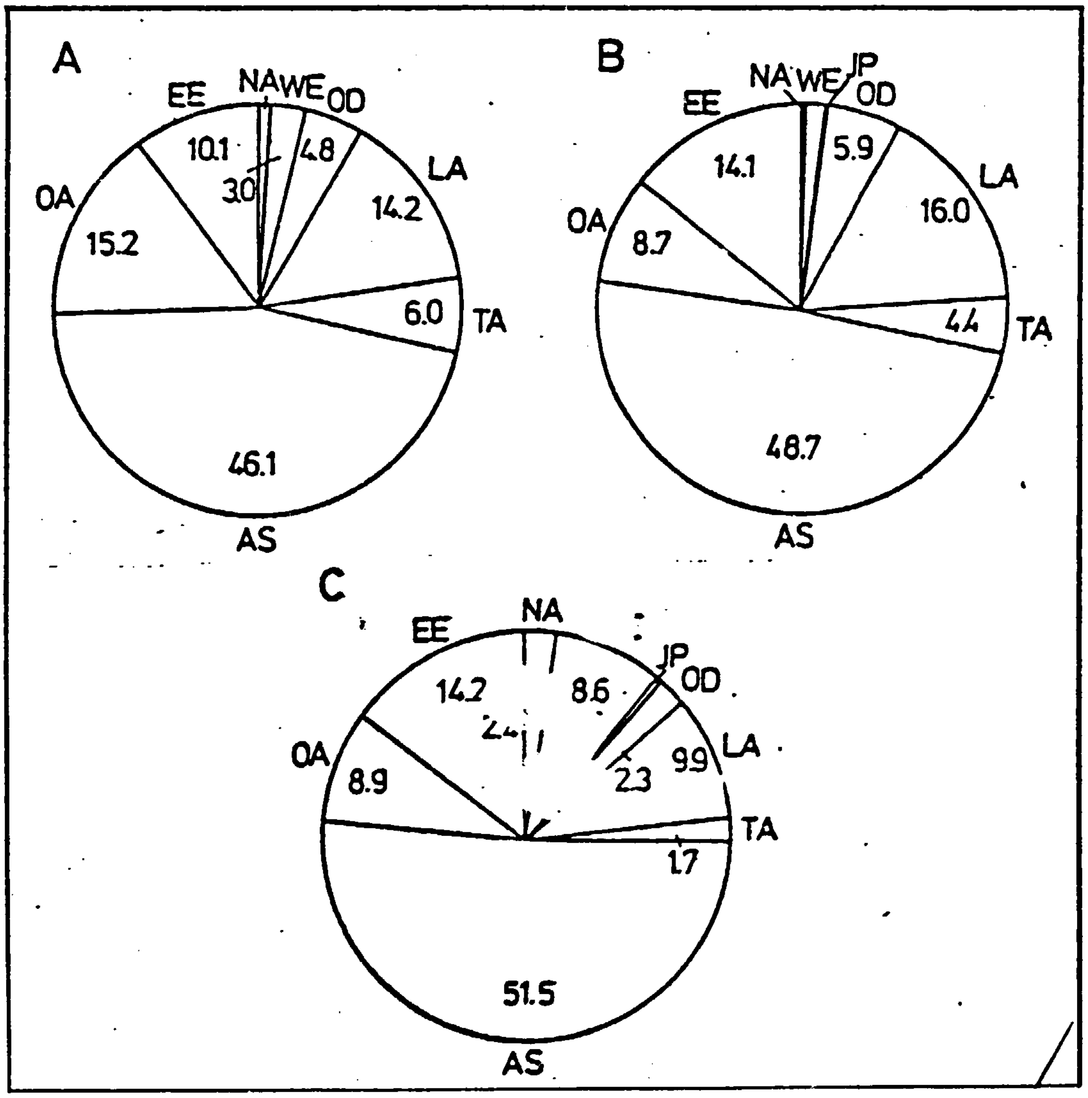

Figure 20. Percentage distribution of A - world tin reserves, B - world tin mine production and C - world tin smelter production in 1978 over the eleven UNITAD regions. The figures not shown are, A - 0.7% for NA; B - 0.2% for NA, 1.6% for WE and 0.2% for JP. World totals (100%) are, 9.9 million tons for the reserves, 251,700 tons for the mine production (both metal content) and 247,200 tons for the smelter output.

Source: Mineral Facts and Problems, op. cit.

E.2.3.1 The Reserve Situation

This is another heavily biased distribution, with the main concentration in Asia. The North is not self-sufficient in any sense of the term. The life of what are considered viable reserves today is running out: this is one of the reasons why the price of tin has been rising faster than the prices of the other metals.

Table 40. World Tin Mine Production, 1978, and Capacity, 1978 and 1985, Thousand Tons.

Region	Production in 1978		Capacity 1978		Capacity 1985*	
	000 t	%	000 t	%	000 t	%
1 NA	0.6	0.2	0.8	0.3	0.8	0.3
2 WE	4.1	1.6	6.6	2.4	7.3	2.4
3 EE	35.6	14.1	38.7	13.9	42.7	14.3
4 JP	0.6	0.2	0.9	0.3	1.0	0.3
5 OD	14.9	5.9	17.0	6.1	19.0	6.4
6 LA	40.2	16.0	44.1	15.9	48.6	16.3
7 TA	11.2	4.4	14.4	5.2	15.0	5.0
8 NE	-	-	-	-	-	-
9 IN	-	-	-	-	-	-
10 AS	122.5	48.7	130.0	46.8	134.0	44.9
11 OA	22.0	8.7	25.0	9.0	30.0	10.1
Totals	251.7	100.0	277.5	100.0	298.4	100.0

*Author's estimate of the distribution of totals stated in the source.

Remark: Percentages may not add up owing to rounding.

Source: Mineral Facts and Problems, op. cit.

E.2.3.2 Siting and Expansion

Much of what has been said about copper, lead and zinc holds for tin, too. The expected capacity addition between 1975 and 1990 is about 80,000 tpy for the smelter phase; it is to be fairly evenly distributed, with Japan the only "region" in which a capacity reduction is forseen. The greatest additions will be where the reserves are, in Southeas Asia, Latin America and Austrialia.

Table 41. World Tin Smelter Production, 1978, and Capacity, 1978 and 1985, Thousand Tons.

Region	Production in 1978		Capacity 1978		1985*	
	000 t	%	000 t	%	000 t	%
1 NA	5.9	2.4	7.3	1.8	7.3	1.6
2 WE	21.3	8.6	50.7	12.7	52.7	11.9
3 EE	35.2	14.2	40.5	10.1	41.8	9.3
4 JP	1.1	0.4	3.5	0.9	2.0	0.5
5 OD	5.7	2.3	12.0	3.0	20.0	4.5
6 LA	24.5	9.9	37.5	9.4	53.5	12.1
7 TA	4.3	1.7	18.2	4.6	19.0	4.3
8 NE	-	-	-	-	-	-
9 IN	-	-	-	-	-	-
10 AS	127.2	51.5	194.8	48.8	208.0	46.9
11 OA	22.0	8.9	35.0	8.8	40.0	9.0
Totals	247.2	100.0	399.5	100.0	443.8	100.0

*Author's estimate of the distribution of totals stated in the source.

Remark: Percentages may not add up owing to rounding.

Source: Mineral Facts and Problems, op. cit.

E.2.3.3 Trade

Referring again to Table 32, every region of the South except IN is a net exporter of tin. In the North, OD is the only region with a surplus (albeit a very slight one), thanks to Australian production. Significantly, about 80 per cent of the tin and tin alloys imported by the Southern countries comes from other Southern countries.28/

E.2.4 Other South-South Co-operation in Non-Ferrous Metals

The two producers' associations, the International Bauxite Association (IBA) and the copper producers' association (CIPEC) come to mind first. Although not confined in membership to the South (Australia is a member of both), they certainly were Southern Initiatives. The principal striving of

28/ TD/B/C.7/36/Add.3, op. cit.

these associations so far has been to safeguard mineral and metal prices, but they are the right sort of institutional background for future co-operation in metallurgy, semifabrication etc. also.

The International Tin Agreement (ITA) is a broad-based producer-consumer agreement whose signatories include the EE countries. It has been instrumental in keeping tin prices mobile and letting them rise in step with the growing scarcity of ore.

Co-operation in copper semifabrication within Africa, as exemplified by the UNIDO-assisted negotiations now underway between Zambia and Nigeria on the one hand and Zambia and Egypt on the other, seems to be one of the best ways of expanding South-South trade in copper.

E.3 Availability of Smelter Technology in the South

Metallurgical Plantmakers of the World, a publication of the Metal Bulletin,[29/] lists 89 metallurgical plantmakers in the South, all except three in NICs:

- 7 in Argentina,
- 29 in Brazil,
- 26 in India,
- 11 in the Republic of Korea
- 8 in Mexico,
- 2 in the Philippines,
- 1 in Singapore,
- 4 in Taiwan Provence of China
- 1 in Zimbabwe.

This corroborates our thesis that technology is in fact available from NIC sources. Many of these plantmakers are associated with Northern companies in ways which give them access to the most modern developments in technology. For an example, Indian metallurgical plant is on offer in a broad range of Southern countries. Dastur GmbH is a subsidiary registered in the FRG of a renowned Indian metallurgical engineering company, a quasi-permanent consultant to UNIDO.

29/ Second edition, 1981; ed. Richard Serjeantson.

F. Some General Considerations

F.1 Tarrif Barriers

It is a fairly widely known fact that, for most mineral based commodities, tariffs of entry into most Northern market-economy countries increase with the degree of processing, and quite steeply so in some instances. Perhaps the most striking example is zero percent on copper concentrates and 7 per cent on unwrought copper as against 23 per cent on wrought copper in Japan, but the general situation is not much different for other metals in other market-economy countries, either.[30/]

Similarly, in petrochemicals, there is a considerable tariff differential between basic and more elaborate products: the importation of most basics is duty-free in most Northern countries, whereas intermediates carry a duty of about 10 per cent on average.[31/]

The implication is that, as far as the comparatively modest markets of the South permit, a system of GSTP (Global System of Trade Preferences among developing countries) may give a major boost to the setting up of facilities for the higher processing of minerals and mineral-based commodities in the South.

F.2 South-South Trade

Progress so far in South-South Co-operation has largely been in trade. Between 1970 and 1979, the share of goods of Southern origin in Southern imports overall rose from 18.9 per cent to 27.4 per cent. South-South trade splits about evenly between the interregional and the intraregional. One of the reasons for this growth has been the evolution of a sizeable solvent Southern market, made up largely of the oil-exporting countries and of the NICs; South-South manufactures trade has appeared and grown; intra-South

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30/ For details cf. UNIDO, Mineral Processing in Developing Countries, ID/253, op. cit., p. 100.

31/ For details cf UNIDO, Second World-wide Study on the Petrochemical Industry, ID/WG.336/3, op,cit.

technology transfer has begun, with India and Brazil as the main donors, etc. Trade has been promoted by the steps taken toward GSTP. Trade structure has also improved: the share of manufactures in South-South non-oil trade rose from 26.9 per cent in 1960 to 51.6 per cent in 1979; within it, the share of machinery, equipment and vehicles rose from 3.6 per cent to 17.5 per cent. All these trends are expected to continue; according to UNCTAD,[32/] in 1990, more than 30 per cent of the South's SITC Group 3 exports and more than 50 per cent of its SITC Groups 5 to 8 exports are to be absorbed by the South.[33/]

It is important to gain a clear idea of what South-South trade can and what it cannot do. A Southern country importing, say, co per semis from another Southern country cannot expect to be quoted a price below the world market price prevailing at the time, that which it would have to pay any supplier, Northern or Southern. In fact, it can expect less than most-favoured treatment (in the business rather than in the trade-policy sense of the term) if the Southern seller has other fish to fry. The Southern buyer's potential advantage is in its ability (if any) to pay for its purchases of goods as the seller wants. In this way, some hard-currency expenditure can be short-circuited; the intra-South exchange of goods will reduce the overall hard-currency expenditure of the South if supported by a special financing arrangement. There is, of course, also an economy-of-scale advantage: larger (or more fully utilized) plants working into more extensive markets can produce a unit of output more cheaply. Some freight costs may be saved; mutual tariff advantages may be secured. In this respect, the experience of intra-cmea trade is worth studying.

A question to be asked with great insistence is, in what ways should the benefits of South-South trade and co-operation be split?

32/ Trade and Development Report, 1981, TD/B/863, July 31, 1981, p 207.

33/ For this section I have relied heavily on a paper by my colleague Dr. Judit Kiss, A fejlődő országok egymás közötti együttműködése (Intra-Developing-Country Co-operation), a manuscript, World Economy Institute, Hungarian Academy of Sciences, Budapest, Nov.rmber 1981.

For one thing, dismantling tariff barriers is not positive-sum game. CEAO (the Commission Economique de l'Afrique Occidental) has, for example, pointed out that trade liberalization involved loss of fiscal earnings as a major problem, resulting in a growing tendency to limit such liberalization and to exact compensation in other, non-tariff ways.34/

For another thing, who in the South should benefit from the value added in the higher degrees of processing? Consider the example of rock phosphate and phosphate fertilizer. Rock phosphate producers strive to set up new fertilizer capacity with the Southern markets in mind. Yet much the same case can be made out for the countries with a fertilizer deficit importing rock phosphate and setting up their own fertilizer plants. In the final reckoning, some sort of balance should be expected to emerge, depending, among other things, on which country will have the finance to invest in fertilizer plant. The issue as a whole, however, is liable to remain just as controversial intra-South as it is in the North-South relation.

Thirdly, there is the issue of the quid pro quo. What can a Southern country offer in exchange for the goods it buys from the other Southern countries? The richer countries of the South with their comparatively big and developed economies will have no particular difficulty in identifying promising complementarities, possibly down to the intra-branch level. The poorest countries of the South, on the other hand, whose poverty is for one reason at least precisely that their insufficient endowments preclude any more intensive integration into the world economy, will find it no less difficult to offer marketable goods to the other Southern countries than to the Northern ones. Let us recall that much of the Southern countries' indebtedness has resulted from the high prices of petroleum and the petroleum products, that is, essentially from an intra-South trade flow.

34/ UNCTAD Trade and Development Board, Committee on Economic Co-operation among Developing Countries: Report of Working Party on Trade Expansion and Regional Economic Integrations among Developing Countries (2nd Session), TD/B/C.7/55, 30.7.1982, p.7.

Table 42 Brazilian Foreign trade with Africa*

	1966-69 average	1970	1975	1980
Total exports, FOB				
World, $ million	1897	2739	8670	20132
- Africa, %	1.4	2.2	4.6	5.7
Manufactures exports				
World, $ million	-	416	2585	9028
- Africa, %	-	4.5	6.6	8.3**
Total imports, CIF				
World, $ million	1890	2849	13592	22955
- Africa, %	1.7	3.2	4.0	4.8
African surplus/deficit on overall trade, $ million	7	32	144	-206

* 1979.
** Includes South Africa.
Source: Tom Forrest, "Brazil and Africa: Geopolitics, Trade, and Technology in the South Atlantic", African Affairs, January 1982.

F.2.1 Brazil: A Case Study[35/]

Brazil's trade with Africa is best presented in terms of the figures in Table 42.

In 1980, five countries of developing Africa imported more than $100 million worth of goods each from Brazil: Algeria, Angola, Egypt, Nigeria and Zaire. Nigeria had pride of place at $272 million. The countries which exported more than $100 million worth to Brazil were Angola, Gabon and Libya; Gabon was at the top with $301 million. Remarkably enough, Brazil's mineral trade with Africa is a one-way street: it imports phosphates from Morocco and copper from Zaire, and has expressed the intention to buy copper from Zambia, alumina from Guinea and phosphates from Senegal. The main item, though, is crude oil, which makes up about 70 per cent of Brazilian purchases in Africa. On the other hand, Brazilian direct investment in and plant and equipment

35/ Cf. Tom Forrest, "Brazil and Africa: Geopolitics, Trade, and Technology in the South Atlantic", African Affairs, January 1982.

exports to mineral resource-based industries in Africa are minor. The Brazilian CVRD (Companhia Vale do Rio Doce) has set up a steel plant in Egypt. Petrobras, the Brazilian state petroleum company, has invest in Algeria and Libya; it has a share in one Angolan petroleum concession and has applied for a share in another. Brazil does sell iron and steel semis and petroleum refinery products to Nigeria, and a joint venture in aluminium products has been envisaged between the two countries. Petrobras has undertaken to assist the Angolan petroleum industry.[36/]

Brazil places a great emphasis on technical assistance to the Portuguese-speaking countries of Africa, where the common language is a considerable advantage. Brazil is an enthusiastic supporter of the South-South co-operation concept: in 1980, it set up a fund for the promotion of TCDC activities. In 1979, UNIDO hired a Brazilian consultancy company to survey food processing plants in Angola.[37/] UNIDO relies a great deal on Brazilian expertise in charcoal ironmaking.

This concise case history, largely based on Tom Forrest's paper cited on the foregoing page, permits to draw a number of relevant inferences.

- Complementarity between the economy of Brazil and those of the African countries permitted trade to grow by 25 per cent a year between 1970 and 1980, despite a considerable overlap of product patterns (coffee, cocoa, iron ore, diamonds, etc. are key products on both sides of the Atlantic).

- The division of labour is basically of the developed - vs. - developing-country type: manufactures made up about 80 per cent of Brazilian exports to Africa in 1979.

- There is a considerable scope for expansion: to concentrate on the subject of the present paper, Brazil may well become one of the major sources of equipment for African investment into mineral

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36/ Ibidem.

37/ Ibidem.

resources-based industries, either as a direct holder of equity or as an arms-length supplier, either on its own or in tripartite deals with a supplier or suppliers from a developed market-economy or a centrally-planned-economy country. Brazil could absorb without any difficulty the bulk of the minerals that are being offered today to the developed market-economy suppliers in payment for such supplies and/or participation.

F.3 Manpower

Of this issue, widely discussed both within and outside the UN family, we shall consider only two aspects here; skills and international movements of labour.

(1) Skills

All the industries described here are skill-intensive; they require practically no unskilled labour and few semi-skilled workers. On the other hand, they require comparatively many plant engineers and skilled technicians. Clearly, it is the simpler to muster this workforce, the more developed and the bigger the economy of a country. Overall, however, there is a shortage of manpower with these skills in practically every developing country, most NICs included.

This in turn raises the issue of training. One of the most promising experiences of South-South co-operation so far has been in the training of the nationals of one Southern country in another: Angolan oilmen in Algeria, Fertilizer plant operators from Bangladesh in Indonesia, etc. One much-discussed argument is that people so trained "will not acquire Western attitudes to plant operation". The question as to whether this is an advantage or a shortcoming is a matter for discussion: it would require study, possibly by UNIDO and ILO.

(2) Movements of Labour

The only intra-South labour movement on any major scale so far has been from North Africa and South Asia into the Arab Gulf. In 1979, it resulted in expatriates' remittances to the tune of $10 billion, flowing in the reverse directions. The movement involves both skilled and unskilled labour, as well as numerous persons with engineers' business or managerial qualifications. While this might benefit the host country, it is no boon to the country of origin. Egyptian steelmen complain that their maintenance personnel leaves them for the Gulf about as fast as they can train them. An intra-South brain drain?

F.4 Institutional Issues

As we have seen, two sets of institutions are in existence that may be expanded in response to the call of the times: (1) country and regional fertilizer institutions and (2) mineral and metal producers' associations which, albeit not closely connected with our subject here, are exemplary in many ways.

It follows that:

- Regional and interregional centres should be set up as nuclei for associations in petroleum refining (including non-OPEC developing countries or, indeed, especially those), in basic petrochemicals or petrochemicals at large, in ferrous and non-ferrous metallurgy;

- it is important to create an awareness of the need for such associations and of the problematiques they are expected to tackle - a task befitting the UN family, particularly UNIDO;

- the way the benefits of South-South co-operation are expected to arise and be divided is a group of issues in need of thorough study, to be undertaken by the associations referred to above, presumably under some form of UN sponsorship.

Finally, and most importantly, a dialogue should be initiated with the interested Northern counterpart associations, in order to minimise the unfavourable impact (if any) upon the North of South-South co-operation and of the gradual delinking that it would entail.

F.5 Technology

All the industries considered here are roughly at the same level of technological sophistication; it is therefore indicated to look at them together from the technological point of view.

The facilities of these industries are often next door to a mine and/or a port facility. We shall not consider those here, but it is useful to remember that siting and developing a mine, developing a haulage pattern between the mine and the processing facilities, providing project identification and basic engineering studies for these latter, and optimising the entire system so constituted inclusive of adapting it to the accessible markets (which involves endowing it with sufficient flexibility to adapt to the foreseeable changes in its parameters), a group of activities which we shall call systems consultancy here, is something for which developing countries - even the most developed NICs - are less equipped as a rule than for straightforward engineering design. Systems consultancy includes in any competitive situation the sort of project identification study and basic engineering which is needed to optimise a project with keen world market competition in mind, and the selection, from the full range on offer, of the process or processes and of the process parameters most apt to attain that end. As an obvious corollary, all these conditions may be relaxed if, and to the extent that, world market competitiveness becomes a secondary consideration or falls by the wayside altogether.

It is in systems consultancy that the South most needs the assistance of disinterested organizations like UNIDO.

In engineering, UNIDO's First Global Study on the Capital Goods Industry[36/] sets up a six-level ranking for capital goods, from hand tools (Level 1) to twin-engined jet aircraft (Level 6). It states (p. 120) capital goods for the chemical and petrochemical industries to overlap from Level 3 to Level 4 and those for heavy metallurgy to occupy Level 4 (whereas, significantly, oil drilling equipment is at Level 5). It further points out

36/ ID/WG.342/3, 3 July 1981.

(p. 112) two discontinuities in technological sophistication, the first between Levels 3 and 4 and the second between Levels 4 and 5. It takes a considerable effort to overstep either of these discontinuities.

In terms of the above complexity ranking, there are at present at least nine Southern countries that can manufacture, with the qualifications to be stated below, Level 4 equipment, that is, the overwhelming bulk of the equipment needed by the industries being considered here: Argentina, Brazil and Mexico in LA, Egypt, India, Hong Kong, The Republic of Korea and Singapore in AS, and China.

Countries with incomplete Level 4 capital goods industries, some of them embryonic, include Chile, Colombia, Jamaica, Peru, Uruguay, Venezuela, Nigeria, Algeria, Iran, Iraq, Pakistan, Sri Lanka, Indonesia, Malaysia, The Philippines and Thailand.

One major qualification referred to above is that even the most developed of these national industries are probably unable to design/produce/supply certain sophisticated components (some of the instrumentation, most of telemetering, control and automation systems and equipment, catalysis processes and catalysts, high-performance process compressors, process pumps, turbines or at least rotors for the same).

Another major qualification is that, given their current capacities, these industries would certainly be unable to satisfy <u>all</u> the needs of the South at once.

At an estimate,

- the first group of the two described above would be able to provide detailed engineering designs for, and to produce, 90 to 95% of the capital goods (machinery, equipment and processes) for the industries considered here, except probably for the most recent and most sophisticated goods required,

- the second group would be able to execute, and in part to design, the masonry, concrete and metal constructions and steel structurals required for the plants in question, to do (but perhaps not design except at the detailed working drawing level) most of the boilerwork (which makes up a high percentage of process equipment in petroleum refining, petrochemicals, alumina and fertilizer manufacturing, some mineral beneficiation and the like). It could also provide a miscellany, albeit a more or less incomplete one, of equipment common to all industries (the simpler pumps and electric motors, transformers, some switchgear, etc.).

Consider some examples.[39/]

- Brazil can manufacture domestically, for all these industries, all boilerwork up to 80 mm wall thickness, all the piping, joints and flanges, all the valves except some high-precision ball valves, most of the pumps up to throughput ratings of 10,000 m^3/h at 6 to 7 bars to API chemical standard specifications, steam turbines up to 40 bars pressure, and a new-complete range of electricals (only some variable-speed motors have to be imported). On the other hand, much of the instrumentation required is not available domestically.

- India imported all the process equipoment, 96 per cent of structurals and 78 per cent of refractories for its first steel complex (Rourkela). For the last one so far (Bokaro-Expansion), imports amounted, respectively, to 12, 0 and 0 per cent. The Korba alumina plant, the tendering for which took place in 1969, imported only digester drives, pumps and pump drives whose cost amounted to just about 5 per cent of total process equipment cost; for the Patnagiri aluminium smelter (cancelled in the event), imported process equipment would have made up about 10 per cent. Indian companies can design and manufacture all the boilerwork required by the industries considered here. Bharat Heavy Electricals of India is one of the top ten manufactures of electrical equipment in the world: it can make 500 MW power station turbogenerator sets and is tooling up for 1000 MW. Ninety per cent of the valves needed in industrial plant is produced domestically; so are pumps (although some are imported because of insufficient domestic production capacity), air and gas

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39/ ID/WG.342/3, op. cit.

compressors; a co-operation agreement concerning gas turbines has been signed with Worthington of the US. India exhibited at the 1978 ACHEMA world fair for capital goods in the chemical industry. It should be pointed out, however, that most Indian manufacturers have "technology maintenance" agreements with companies of the developed market-economy countries (e.g. Bharat Heavy Electricals with Kraftwerk Union of the FRG).

- In the Republic of Korea, all boilerwork up to 100 mm plate thickness and practically all the electrical equipment for chemical plant can be made domestically. Blast furnaces, convertors and rolling mills, tanks, heat exchanger towers, compressors and filters etc. are being built at the Changwon industrial complex which can at present cover about 70 per cent of total Korean heavy industrial project demand. Built on tidewater, it is export-oriented: in 1978, it exported for more than one billion dollars out of a total production worth $2.9 billion.

For examples of the second group of countries, let us cite the following.

- Algeria is equipped to produce boilerwork, steel constructions and structurals and simpler machinery like mechanical speed reducers.

- Tunisia has constructed on its own the steel structures for a small iron and steel plant; it has set up fairly complete maintenance facilities for its phosphate fertilizer industry; etc.

Let us point out that the importation of this or that item on the capital goods or parts list does not necessarily imply that it cannot be built in the importing country. For example, India imported digester drives for the Korba alumina plant, basic-engineered by ALUTERV of Hungary, not because there was no Indian firm able to make them; Hungarian drives were imported because Hungarian industry was producing those units routinely while any Indian manufacturer chosen for the purpose whould have had to tool up from scratch.

What are the implications of all this?

(1) There is considerable scope for expanding intra-South trade in

capital goods. Let us recall that intra-South trade in the broader category of engineering goods in fact expanded 15-fold in current dollars between 1970 and 1980 (that is, by about 30 per cent per year). Yet even such an expansion raised its share of world trade in engineering goods from 0.5 to 1.4 per cent only and its share of engineering goods imports into the South from 2.2 to 4.7 per cent only. For this latter figure to attain 10 per cent by 1990, intra-South trade in engineering goods would have to grow by more than 23 per cent per year at a rough estimate (on the assumption that simultaneous expansion in engineering exports to the South would be 15 per cent per year from the developed market economies and 10 per cent per year from the developed centrally planned economies). Such a development is not at all unfeasible either. However, if the intra-South share in the South's engineering goods imports were to attain 20 per cent by 1990, that trade should grow by almost 35 per cent per year, which seems highly unlikely. And even assuming that capacity is being underutilized today, which is certainly the case with the capital goods industries of a number of developing countries, providing 20 per cent of the trade is a far cry yet from the South itself being able to satisfy its own demand when de-linked from the North.

(2) The bulk of capital goods produced by the first above-mentioned group of countries would be absorbed by themselves and by the developing countries rich in resources and comparatively well-endowed with capital (the "high absorbers" of OPEC and some other countries would be taken by the second above-mentioned group (the countries with embryonic capital goods industries). The capital goods demand of the remaining more than 100 countries would be stymied by lack of cash, credit worthiness or goods acceptable in payment.

(3) The comparative advantages/disadvantages of developing-country suppliers will depend on (a) their access to Northern consultancy services, ongoing innovation and the most sophisticated items and components that go into complete plant; gradually reducing dependence rather than simply cutting loose from the North will be the watchword there; (b) on the supplier credits and other financial preferences they will be able to extend in what promises to become an export subsidies competition among suppliers world-wide; in this, the capital-surplus countries of the South, if any, may help by providing financial backing, to the benefit of both the suppliers and themselves.

F.6 Impact on the North

The thing to be remembered here is that world trade is overwhelmingly intra-North. With the world economy functioning normally, the North would take in its stride the minor shifts in trade that a gradual de-linking would entail. But times today are (let us hope) not normal. At a time of deep recession, any downward pressure on capacity utilization is harmful and resented. True, the enhanced economic growth in the South resulting from enhanced intra-South co-operation would boost trade with the North in the long or perhaps the medium term; but the immediate consequences would not be that favourable, especially for those Northern industries, such as petroleum refining, petrochemicals and some forms of metallurgy (aluminium, tin) that are liable to be squeezed by the developments in the South. It would therefore be naïve to submit that, at present, an enhanced South-South co-operation would bring nothing but benefits to the North.

The flow of minerals-based commodities from the South to the North would not be jeopardized by enhanced South-South co-operation: in fact, it would be more likely to expand, while shifting towards products of higher processing.

F.7 UNIDO's Role

(a) Studies

Points on which further thought or further fact-finding is required include;

- at the purely technical level, economically viable mini-plants permitting developing countries or sub-regional groupings of such to make their own mineral-based commodities without coming up against hurtful diseconomies of scale, especially in fertilizers but also in petrochemicals (and possible in aluminium);

- enquiries, probably jointly with ILO, into South-South movements of labour;

- ditto, into the issues and the possible ways and means of expanding training for Southern nationals in Southern countries not their own;

- enquiries, probably jointly with UNCTAD and GATT, into the philosophy of how to split the benefits of South-South co-operation among the parties involved.

(b) Institutional

To initiate the organization of consultative bodies called upon to prepare the setting up, bas ! upon, among other things, the experience of the analogous fertilizer bodies, of asociations of the developing producers and would-be producers in petroleum refining, basic petrochemicals (or petrochemicals at large) and in metallurgy.

To set up a body supervising and sponsoring the training of labour for these industries within the South proper, no matter whether at home or abroad, such supervision and sponsoring to confer upon the institutes so covered a hallmark of quality, on the principle of the UNESCO-associated schools of general learning; possibly in co-operation with ILO and/or UNESCO.

To promote the provision of non-commerical (non-profit) systems consultancy services such as the one mooted by the Socialist International, and to considerably expand UNIDO's role as a general clearing-house for such services.

To set up, probably in co-operation with DTCD and UNRFNRE, a consultative body looking into the feasibility of industry-oriented (domestic or subregional-processing-oriented) regional mineral resource exploration and development bodies (potash reserves could be a first priority for such exploration).

APPENDIX

Reserve Situation in Steel Alloying Elements

Tables

Table App. 1 World Cobalt Reserves and Resources, Thousand Tons. Resources Inclusive of Reserves.

Region	Reserves Tons	Reserves %	Resources Tons	Resources %
1 NA	27.2	1.1	1025.1	18.9
2 WE	18.1	0.7	22.7	0.4
3 EE	226.8	9.4	249.5	4.6
4 JP	-	-	-	-
5 OD	68.1	2.8	322.0	5.9
6 LA	181.4	7.5	1134.0	20.8
7 TA	1569.4	65.1	2027.6	37.3
8 NE	45.4	1.9	68.0	1.2
9 IN	-	-	-	-
10 AS	272.1	11.3	589.7	10.8
11 OA	-	-	-	-
Total	2408.5	100.0	5438.6	100.0

Source: Mineral Facts and Problems, op. cit.

Remark: Percentages may not add up owing to rounding.

Table App. 2. World Cobalt Mine and Primary Refined Metal and Chemical Compound Production, 1978; Mine Production Capacity, 1978 and 1985.

Region	Cobalt Mine Production 1978 tons	%	Primary Refined Metal and Chem. Compound Prod. 1978 tons	%	Cobalt Mine Capacity 1978 tons	%	Cobalt Mine Capacity 1985 tons	%
1 NA	1233.8	4.9	811.0	3.6	1633.0	5.7	2268.0	5.9
2 WE	1296.4	5.1	3121.6	13.9	1315.4	4.6	1587.6	4.2
3 EE	1950.5	7.7	1950.5	8.7	1995.8	7.0	2041.2	5.3
4 JP	-	-	1864.3	8.3	-	-	-	-
5 OD	1451.5	5.8	-	-	1451.5	5.1	2041.2	5.4
6 LA	1633.0	6.4	-	-	1633.0	5.7	1814.4	4.8
7 TA	15294.6	60.3	14691.2	65.5	17962.6	62.7	24948.0	65.5
8 NE	1134.0	4.5	-	-	1134.0	4.0	1134.0	2.9
9 IN	-	-	-	-	-	-	-	-
10 AS	1345.4	5.3	-	-	1496.9	5.2	2268.0	5.9
11 OA	-	-	-	-	-	-	-	-
Total	25339.2	100.0	22438.6	100.0	28622.2	100.0	38102.4	100.0

Remark: Mine production refers to estimated recovered cobalt content. Primary refined etc. refers to estimated contained cobalt.
Percentages may not add up owing to round.

Source: Mineral Facts and Problems, op. cit.

Table App. 3 World Manganese Reserves and Resources, Million Tons. Resources Inclusive of Reserves

Region	Reserves		Resources	
	Tons	%	Tons	%
1 NA	-	-	82.7	3.0
2 WE	0.2	0.0	0.2	0.0
3 EE	352.4	26.2	896.7	32.2
4 JP	0.6	0.0	0.6	0.0
5 OD	834.6	61.9	1555.8	55.9
6 LA	44.1	3.3	83.6	3.0
7 TA	83.4	6.2	103.9	3.7
8 NE	0.4	0.0	0.4	0.0
9 IN	19.5	1.4	30.4	1.1
10 AS	0.4	0.0	3.4	0.1
11 OA	13.6	1.0	29.0	1.0
Total	1349.2	100.0	2486.7	100.0

Source: Mineral Facts and Problems, op.cit.

Table App. 4 World Manganese Production, 1978, and Capacity, 1978, 1979 and 1985. Thousand Tons of Manganese Content.

Region	Production in 1978		Capacity 1978		Capacity 1979		Capacity 1985	
	000 t	%	000 t	%	000 t	%	000 t	%
1 NA	34.5	0.4	45.4	0.4	45.4	0.4	45.4	0.4
2 WE	-	-	-	-	-	-	-	-
3 EE	3229.6	37.2	3515.3	31.2	3510.8	31.2	3850.9	31.7
4 JP	29.9	0.3	31.8	0.3	27.2	0.2	27.2	0.2
5 OD	2364.1	27.1	3547.0	31.6	3547.0	31.6	4000.6	33.0
6 LA	1007.0	11.6	1442.4	12.8	1442.4	12.8	1542.2	12.7
7 TA	973.4	11.2	1406.1	12.5	1360.7	12.1	1496.9	12.3
8 NE	67.1	0.8	77.1	0.7	77.1	0.7	27.2	0.2
9 IN*	548.8	6.3	725.7	6.4	725.7	6.4	635.0	5.2
10 AS	57.2	0.7	63.3	0.5	63.5	0.5	49.9	0.4
11 OA*	381.0	4.4	399.2	3.5	453.6	4.0	453.6	3.7
Total	8692.6	100.0	11253.5	100.0	11253.4	100.0	12128.9	100.0

* Th[illegible]n and Chinese Figures include manganese in manganiferous ore.

Source: Mineral Facts and Problems, op. cit.

Remark: Percentages may not add up owing to rounding.

Table App. 5 World Nickel Reserves and Resources, Million Tons. Resources Inclusive of Reserves.

Region	Reserves Tons	Reserves %	Resources Tons	Resources %
1 NA	82.2	15.2	331.1	16.0
2 WE	-	-	-	-
3 EE	73.5	13.6	193.2	9.3
4 JP	-	-	-	-
5 OD	50.8	9.4	79.8	3.9
6 LA	55.9	10.3	246.8	11.9
7 TA*	20.9	3.9	81.6	3.9
8 NE	-	-	-	-
9 IN	-	-	-	-
10 AS	258.5	47.7	1134.9	54.9
11 OA	-	-	-	-
Totals	541.8	100.0	2067.4	100.0

Source: Mineral Facts and Problems, op. cit.

Remark: Percentages may not add up owing to rounding.

* Includes, in this case, South Africa and Africa North of the Sahara.

Table App. 6 World Nickel Mine Production, 1978, and Capacity, 1978 and 1985. Thousand Tons.

Region	Production in 1978 000 t	Production in 1978 %	Capacity 1978 000 t	Capacity 1978 %	Capacity 1978 000 t	Capacity 1978 %
1 NA	1403	21.2	2658	28.4	2639	21.9
2 WE	301	4.5	680	7.3	1043	8.7
3 EE	1587	24.0	1669	17.8	2214	18.4
4 JP	-	-	-	-	-	-
5 OD	1044	15.8	1089	11.6	1297	10.8
6 LA	568	8.6	865	9.2	1388	11.5
7 TA*	321	4.9	362	3.9	1381	3.2
8 NE	1	0.0	60	0.6	200	1.7
9 IN	-	-	-	-	-	-
10 AS	1291	19.5	1868	20.0	2684	22.3
11 OA	100	1.5	109	1.2	181	1.5
Totals	6616	1.00	9360	100.0	12047	100.0

* Includes, in this case, South Africa and Africa North of the Sahara.

Source: Mineral Facts and Problems, op. cit.