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TROPICAL HARDWOOD

DPA Commodities - Document

Summary

1. Recent developments in the tropical hardwood sector in the Asia-Pacific region suggest that the structure of tropical hardwood trade in this region has changed dramatically with global implications. In the last few years, three major traditional suppliers--Indonesia, Malaysia and the Philippines, which together account for more than 80% of world exports of tropical hardwood logs--have taken a series of decisive steps to reduce log exports. The measures involve export quotas (or outright bans) and/or increased government charges (royalties, export taxes, and so forth) on log exports. Their objectives are: first, to conserve the semi-nonrenewable resources, which until recently had been exploited at a rapidly increasing pace; second, to appropriate higher levels of resource rent from the rich forest resources that they own; and, third, to secure benefits from increased local processing of logs.

2. World consumption trends in tropical hardwood logs have changed since the early 1970s. World consumption of tropical hardwood, which had grown rapidly until 1973, declined sharply in 1974-75 as a result of the first oil crisis, but escalated to a new high by 1978. Since then, however, it has not grown much both because of the relatively stagnant demand conditions and because of the increased restraints applied on the supply side. Thus, despite the lukewarm demand conditions, the measures taken by governments of major Southeast Asian producers of tropical hardwood to restrict log exports have resulted in higher lauan log and sawnwood prices in 1979-80. West African timber prices also rose in 1980, although the rise was more moderate than in Asia.

3. Given the expected future growth of world economy and the relatively high income elasticity of demand for logs, demand outlook for tropical hardwood is expected to be relatively bright. However, because of supply-side constraints and the resultant rising prices, growth of tropical hardwood consumption is likely to be very slow. It is projected to grow at 1.4% p.a. in 1980-95, compared with 3.1% experienced in 1970-80 and 6.2% in 1961-70.

4. To meet increasing demand in the next few years, additional supplies of tropical hardwood are expected to come from expanding production in the sources that do not have strict log export restrictions--for example, the Malaysian state of Sarawak, Burma, Papua New Guinea, and Equatoral Guinea. In the longer term, additional supplies are likely to come from forest resources that are largely untouched hitherto--for example, West Irian in Indonesia, Papua New Guinea, Amazonia, and Central Africa. Rising prices should stimulate exploitation in these areas despite the sharply higher cost of exploitation and transport.

5. The national average wholesale price of lauan veneerlogs in Japan, which is used as the indicator price for the Asia-Oceania region, is projected

to rise, in terms of 1981 constant dollars per cubic meter (m^3), from $144.5 in 1981 to $164 in 1985, $170 in 1990, and $190 in 1995. The sapelli log price FOB Cameroon, which is used as the indicator price for West African redwood species, is projected to decline from $212.8/$m^3$ in 1981 to $192/$m^3$ in 1982, but is expected to rise to $238/$m^3$ in 1985, $251/$m^3$ in 1990, and $270/$m^3$ in 1995. The price of tropical hardwood sawnwood, which is represented by the price of Malayan dark red meranti CIF French ports, is projected to increase from $314/$m^3$ in 1981 to $339/$m^3$ in 1985, $350/$m^3$ in 1990, and $375/$m^3$ in 1995.

Salient Features of the Tropical Hardwood Market

6. Tropical hardwood is one of the most important primary commodities for developing countries in terms of export earnings. In 1979, exports of broad-leaved (hardwood) industrial roundwood from developing countries amounted to more than $3 billion, while exports of coniferous (softwood) roundwood amounted to less than $100 million. 1/ If their derived products are taken into account, developing countries' export earnings almost double in value. Virtually all of the broad-leaved roundwood exports from developing countries are in the form of sawlogs, veneerlogs, and logs for sleepers (logs, hereafter). 2/ Only a small fraction of these exports are pulpwood and other industrial roundwood. 3/ Fuelwood exports are negligible.

7. In volume, tropical hardwood logs are a rather modest component of total world wood production (Table 1). In 1980, world wood production amounted to 3.0 billion cubic meters, of which 46% was industrial wood and the remaining 54% was fuelwood. Within industrial wood, logs are the most important sub-category. In 1980, logs accounted for 60% of world production; pulpwood and other industrial wood accounted, respectively, for 24% and 16% of the total. Only 29% of logs are broad-leaved, or hardwood, and about one-half of hardwood logs are tropical hardwood. Thus, tropical hardwood logs account for only 4% of total volume of trees harvested.

8. Within the "logs" category, however, the relative importance of tropical hardwood has been increasing. During 1961-80, the period for which consistent data are available, production of tropical hardwood logs increased at 4.8% p.a., while production of softwood and temperate hardwood logs increased at only 1.2% and 0.7% p.a., respectively (Table 1).

9. Furthermore, from the viewpoint of developing countries, tropical hardwood logs are of particular importance. Whereas industrial countries and centrally planned economies dominate softwood production, tropical hardwood, which accounts for almost one-half of world production of hardwood logs, is

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1/ In this respect, the terms "hardwood," "broad-leaved wood" and "non-coniferous wood" are used interchangeably. Similarly, "softwood" and "confierous wood" are used interchangeably. "Industrial roundwood" includes all forms of roundwood except fuelwood.

2/ "Sleepers" and "railroad ties" are used interchangeably.

3/ "Other roundwood" includes pitprops, poles, piling, scaffolding, and formwork roundwood.

TABLE 1: WORLD PRODUCTION OF WOOD

	1961	1970	1979	1980	GROWTH RATES 1961-80	GROWTH RATES 1970-80
	(MILLIONS OF CUBIC METERS)				(% PER ANNUM)	
INDUSTRIAL WOOD						
LOGS /A	638	758	862	842	1.5	1.1
SOFTWOOD /B	479	550	625	600	1.2	0.9
HARDWOOD /C	159	208	237	242	2.2	1.5
TEMPERATE	112	124	126	128	0.7	0.3
TROPICAL	47	84	111	114	4.8	3.1
PULPWOOD /D	214	315	346	341	2.5	0.8
SOFTWOOD /B	175	235	249	242	1.7	0.3
HARDWOOD /C	39	80	97	99	5.0	2.2
OTHER INDUSTRIAL /E	167	204	207	210	1.2	0.3
TOTAL INDUSTRIAL WOOD	1,019	1,277	1,415	1,393	1.7	0.9
FUELWOOD /F	1,210	1,339	1,600	1,627	1.6	2.0
GRAND TOTAL	2,229	2,616	3,015	3,020	1.5	1.5

/A SAWLOGS, VENEER LOGS, AND LOGS FOR RAILROAD TIES.
/B CONIFERS.
/C NONCONIFERS, OR BROAD-LEAVED WOOD.
/D INCLUDES ALL FORMS--ROUNDWOOD, CHIPS, ETC.
/E INCLUDES PITPROPS, TELEPHONE AND POWER TRANSMISSION POLES, ROUNDWOOD FOR SCAFFOLDING AND CONSTRUCTION FORMWORK, ETC.
/F INCLUDES ALL FIREWOOD AND CHARCOAL.

SOURCE: FAO, YEARBOOK OF FOREST PRODUCTS, VARIOUS ISSUES.

available only from developing countries except for some Asian centrally planned economies. Exports of tropical hardwood logs and their derived products from developing countries have risen rapidly over the last three decades, amounting to some $5.8 billion in 1979. 1/ The sharp rise has resulted primarily from the shortages of temperate hardwood supply in industrial countries.

10. Tropical hardwood comes from the moist forests in tropical regions. Such forests are concentrated in three regions (Table 2): 2/

(i) West and Central Africa (mainly Liberia, Ivory Coast, Ghana, Nigeria, Cameroon, Gabon, Congo, and Central African Republic; also Zaire and Equatorial Guinea).

(ii) Southeast Asia and Tropical Oceania (mainly the Philippines, Malaysia, Indonesia, Thailand, Burma, Papua New Guinea, and the Solomon Islands: also Kampuchea, Laos, and Vietnam).

(iii) Tropical Latin America and the Caribbean (mainly the Amazon region of Brazil; also scattered throughout tropical Central and South America as well as the Caribbean Islands).

TABLE 2: NATURAL TROPICAL HARDWOOD FORESTS, 1980

TROPICAL REGION	PRODUCTIVE FORESTS	UNPRODUCTIVE FORESTS
	---------MILLION HECTARES---------	
AMERICA	506.5	147.4
AFRICA	161.7	52.7
ASIA	191.9	100.1
TOTAL	860.1	300.2

SOURCE: J.P. LANLY "TROPICAL FOREST RESOURCES," FAO FORESTRY PAPER NO. 30, FAO, ROME, 1982, P. 44.

1/ "Derived products" refer to the products of first-stage mechanical processing--namely, sawnwood, sleepers, veneers, plywood, and other wood-based panel products.

2/ Table 2 shows the estimated area of natural tropical hardwood forests existing in three tropical regions as of the end of 1980.

11. While the tropical hardwood species of these moist tropical forests are, theoretically, renewable resources, how long it takes for them to grow into sizes suitable for sawlogs and veneerlogs is not clear. Forestry experts estimate that it takes from a minimum of 40 years to more than 100 years, but very little is known about the natural regeneration of these commercial species. Large concession forests are "managed" on a 25-35 year cycle basis. It is assumed that in 25-35 years, after the first "creaming" of the forest, some of the trees that were too small to be removed as sawlogs or veneerlogs will have grown large enough to be cut. Presumably, in another 25-35 years trees will be ready to be cut and so on. However, this is not much more than a working assumption. In any case, it is likely that by the time of the third round of cutting, the species being cut might be quite different from the species cut in the first round.

12. Plantation growing of preferred species has been successful for only a few species in limited locations. Under plantation conditions, some "white wood" species in West and Central Africa have been grown to a size of 50 centimeters in diameter at breast height (the minimum size for veneer production) in 20-30 years, while teak has been grown to a harvestable size in Burma and Indonesia in 40 years. At this juncture, however, tropical hardwood might well be considered a quasi-nonrenewable resource with exploitation of commercially preferred species similar to mining.

13. Some species are considered much more valuable than others--for example, for decorative uses such as furniture making, wall paneling, and flooring. Among the West African species, apart from the prized ebony, about a dozen species are especially preferred for their decorative characteristics, including acajou, sapelli, tiama, makore, mansonia, iroko, framire, dibetou, kosipo, niangon, and kokrodua. In Latin America, jacaranda, mahogany, virola, caoba, and cedro are examples of species preferred whenever attractive and durable wood is desired. In Asia, rosewood and teak are the classic examples of decorative-quality timber. Some species are preferred for certain nondecorative purposes. For example, balsa, which grows all over tropical America and has a very low density and a low thermal conductivity, is used for, among other things, airplane manufacture and for cores in sandwich construction. In contrast, lignum vitae and greenheart have very high densities (1.05-1.32) and are suitable for marine construction and wherever extra hardness is required (for example, propeller-shaft bearings, pulleys, rollers, and furniture casters).

14. Changing fashions affect demand for tropical hardwood. This is especially true in the "high-quality" segment of the trade in which demand for certain species fluctuates with changes in fashions. Furthermore, the nature of the demand for high-quality veneer logs entails a wide variation in price, which reflects not only the choice of specific species but also the differences in log quality and color among species from the same area. The best example of this is seen in the teak trade, but even in the case of okoume from Gabon the price paid for the most superior quality logs is sometimes as much as three times that paid for the lowest quality.

15. Tropical hardwood is used in a variety of products, many of which compete with temperate hardwood products and, some of which compete with

softwood products. Furthermore, one tropical hardwood product often competes with another; for instance, plywood substitutes for sawnwood, and particleboard substitutes for plywood. Finally, tropical hardwood products also compete with nonwood products such as aluminum, cement, plastics, and steel.

16. While some products can be made of either softwood or hardwood, the two woods are generally used for different purposes. Typically softwood is used for structural components, pulp and paper, whereas hardwood is used in making furniture and joinery for construction. Certain hardwood species are used also for pulp and paper. Although tropical hardwood has unique end-uses, it is usually put to the same end-uses as temperate hardwood and therefore is often a substitute for temperate hardwood. The final products of wood-using industries are diverse, ranging from household goods, art objects, games, toys, and musical instruments, to joinery and structural products for building and furniture. The diversity of wood products is reflected in the fragmentary structure of the industry producing them. Table 3 shows the overall end-use pattern of sawnwood and wood-based panels in Europe for 1969-71. 1/

17. The first step of the processing chain for tropical hardwood logs is the removal of logs from the forests. The logs removed from the forests contain sawlogs, veneer logs, and logs for sleepers. Sawlogs and logs for sleepers will go through sawmills to be processed into sawnwood and sleepers. Sleepers are then ready to be used as railroad ties without further processing. Sawnwood is produced in a variety of shapes—for example, boards, squared wood--and usually kiln-dried. Sawnwood then is used directly in construction or can be sent to molding plants, where various moldings for joinery in building construction or for furniture making are produced. The stages beyond sawnmilling are sometimes called "secondary woodworking industries."

18. Logs suitable for peeling or slicing go into veneer plants which produce veneer sheets. Some veneer sheets are used for plywood and blockboard (a form of plywood in which core layers are blocks of wood instead of veneers), and others are used directly as veneers in furniture making or as cladding in construction. Plywood is used with or without further processing in furniture making and in cladding for construction and packaging.

19. Logging, sawing, and veneer-making activities all produce residues and wastes, a good part of which is used in making particleboard and pulp. Particleboard in turn is used primarily in making furniture and cladding for buildings. Residues are also used for making fiberboard.

20. Broadly speaking, most of the world trade in tropical hardwood flows from the three major producing areas--West and Central Africa, Southeast Asia, and Latin America--to three main market areas--Western Europe, Japan, and North America. For logs, the rather close traditional relationship between origin and destination and the transport cost factor have strongly influenced trade developments and the trade pattern. Schematically, the major trade flows in logs have been as follows:

1/ Data for more recent years are not available.

TABLE 3: ESTIMATED CONSUMPTION OF SAWNWOOD, WOOD-BASED PANELS, AND VENEER SHEETS BY MAJOR END-USE SECTOR IN EUROPE, 1969-71 (AVERAGE)

(MILLION CUBIC METERS)

	TOTAL APPARENT CONSUMPTION	CONSTRUCTION	FURNITURE	PACKAGING	OTHER
SAWNWOOD /A	91.1	54.2	5.9	15.0	16.0
SAWN SOFTWOOD	71.8	48.8	1.9	9.0	12.1
SAWN HARDWOOD /B	19.3	5.4	4.0	6.0	3.9
WOOD-BASED PANELS /C	21.6	10.5	8.0	0.2	2.9
PLYWOOD	4.8	2.4	1.7	0.2	0.5
PARTICLEBOARD	12.6	5.4	5.6	-	1.6
FIBERBOARD	4.2	2.7	0.7	-	0.8
VENEER SHEETS	1.4	0.2	1.0	0.1	0.1

/A EXCLUDING SLEEPERS.
/B INCLUDES TEMPERATE AS WELL AS TROPICAL HARDWOOD.
/C INCLUDES NOT ONLY HARDWOOD BUT ALSO SOFTWOOD.

SOURCE: ECE/FAO, "STUDY ON THE TRADE AND UTILIZATION OF TROPICAL HARDWOODS," TIMBER BULLETIN FOR EUROPE, SUPPLEMENT 10 TO VOL. XXX (JULY 1978)

Origin		Destination
West and Central Africa	→	Western Europe
Southeast Asia	→	Japan, Republic of Korea, China (Province of Taiwan), Singapore, and Hong Kong

The United States, Canada, Australia, and New Zealand import only small quantities of tropical logs. Log exports from Latin America have been reduced to negligible quantities since the early 1970s because of the policies of the exporting countries in that region.

21. For sawnwood, the pattern of trade flows is more diversified than for logs. Schematically, major sawnwood trade flows can be illustrated as follows:

Origin		Destination
West and Central Africa	→	Western Europe
Southeast Asia	→	Japan, Australia
Latin America	→	North America

Exports of sawnwood from Southeast Asia to Western Europe have been increasing rapidly. In contrast, Japan's imports of tropical sawnwood from Asia have been rising only sluggishly, as consumption of sawn hardwood there tended to decrease during the 1970s.

22. World exports of tropical hardwood plywood take place mainly in Asia with two types of exporters--log-producing countries (Malaysia, the Philippines, and so forth) and log-importing countries (the Republic of Korea, China, Singapore, Japan, and so forth). From the 1950s through the mid-1960s, Japan was the largest exporter of tropical hardwood plywood and the United States was the main importer. As other in-transit processor exporters expanded their trade and as Japanese domestic consumption increased, Japan's exports of tropical hardwood plywood declined. Main importers have been the United States, Canada and Western Europe. The existing trade pattern in tropical hardwood plywood can be schematized as follows:

Origin		Destination
West and Central Africa	→	Western Europe
Southeast Asia	→	United States
Latin America	→	Canada, Australia, Japan

23. World trade in tropical hardwood veneers is relatively small compared with trade in logs, sawnwood, or plywood. Unlike plywood, exports of tropical hardwood veneers come mainly from the log-producing countries, with the minor exception of Singapore. The basic pattern of trade is as follows:

Origin		Destination
West and Central Africa	→	Western Europe
Southeast Asia	→	United States
Latin America	→	United States

One notable feature of tropical hardwood veneer exports is that they have been rather stagnant since the mid-1960s, except for the surge in 1971-74.

24. The world market for tropical hardwood logs is fairly competitive. There are many producers, sellers, buyers, and consumers of tropical hardwood logs. It is also true, however, that competition in the tropical hardwood log trade has been less than perfect in some respects. First, because of the heterogeneity of tropical hardwood species and the vast variety of products (different sizes of sawnwood, plywood, and so forth), there is no organized market that deals with tropical hardwood logs or tropical timber products. Information regarding "world market prices" for tropical hardwood logs, sawnwood, and plywood is not readily available; only indicative price quotations for some products in some national markets and CIF and FOB prices for some countries are regularly published. Second, trade in logs has tended to be geographically concentrated, partly because of the high transportation costs (relative to the value of the commodity). Third, companies importing South Sea logs are visibly concentrated in Japan, the world's largest importer of tropical hardwood logs. 1/ In 1977, when a total of 158 companies imported 21 million cubic meters of South Sea logs into Japan, the "top ten" firms accounted for 52% of the total imports and another ten firms for a further 24%. Considering that many of the other importing firms are affiliated with the largest 20, the degree of concentration of market power in South Sea log importing in Japan is high, although there is no evidence of collusive market distortions by importers.

25. On the supply side, a large number of producers are engaged in tropical hardwood log production. The effective number of independent companies engaged in log production in major log-exporting countries, however, is substantially smaller than the numbers of logging licenses and operations suggest, because many companies are engaged in logging operations at more than one place and there are interlocking ownership relationships. The involvement of foreign companies in logging operations is substantial. In addition to outright equity ownership, dependence of local logging firms on foreign firms through suppliers' credits for initial purchase of equipment and associated marketing arrangements for log output is pervasive.

Supply Outlook

26. During the 1970s, world production of temperate hardwood increased only marginally, at 0.3% p.a., partly because of a slowdown of world economic activity but mainly because of the relative shortage of temperate hardwood supply. In the same period, production of tropical hardwood increased at a

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1/ Tropical hardwood species (excluding teak) produced in Southeast Asia and South Pacific Islands are referred to as South Sea timber in Japan.

more rapid rate, 3.1% p.a., although this growth rate was markedly down from the 5.9% experienced in the 1960s.

27. World production of temperate hardwood logs is projected to continue to increase only slowly (at 0.3-0.5% p.a.) as the supply is constrained by the allowable cut based on the principle of sustained yield. The rapid growth in production of tropical hardwood has so far filled the potential gap in the total supply of hardwood logs. However, concern with the possibilities of overcutting relatively accessible tropical forests has grown in recent years. The concern is especially serious in some of the major producing countries in Southeast Asia and West Africa. Partly because of this concern, three major traditional Asian suppliers--Indonesia, Malaysia, and the Philippines--have taken decisive steps in the last few years to reduce log exports. The measures involve quotas (or outright bans) and/or increased government charges (royalties, export taxes, and so forth) on log exports. The objective of these actions is to conserve these quasi-nonrenewable resources and, at the same time, to collect the maximum resource rent from the forest resources that are owned by governments, and to secure benefits from increased local processing of logs.

28. The recent actions taken by governments of major supplying countries in Asia to restrict exports of tropical hardwood logs are likely to change future world supply prospects for tropical hardwood dramatically, because these countries together account for 80% of world exports of tropical logs and indeed own most of the world's "richest" tropical forest resources. In the Philippines, where the overcutting problem is most severe, environmental effects and forest denudation have occurred. In Peninsular Malaysia, log exports have been totally banned in order to secure log supply for local processors. In the state of Sabah, the policy objective is to reduce log cutting and exports in order to ensure a perpetual supply. In Malaysia, only the state of Sarawak has maintained a liberal forest exploitation policy, allowing substantial increases in log exports with modest tax and royalty charges. If continued, this policy will result in rapid exhaustion of the richest part of the local forest resources. In Indonesia, a series of recent government measures may have the effect of radically reducing log exports and encouraging local processing. However, despite the recent massive investment in mechanical wood processing facilities there, it would take some time for Indonesia to build up plywood and other wood product exports. As a result, for the next few years, at least, Indonesia's exports of processed products are not likely to increase fast enough to compensate for the losses of log exports. Papua New Guinea is believed to have a vast potential for increased production, and the government has maintained a liberal log export policy. However, because of the relatively high cost of exploitation in its forests due to difficult terrains and a low incidence of commercially attractive species per hectare, log production in Papua New Guinea is not likely to increase dramatically unless world market prices rise sufficiently to make it worthwhile.

29. In Africa, among the traditional suppliers, Ivory coast, Ghana and Nigeria have reached the limit of their production potential and their future production levels are not likely to be higher than current levels even if

world market prices increase substantially in real terms. 1/ On the other hand, Liberia, Cameroon, Gabon, and Congo do have a potential to increase production in varying degrees. In the long term, Angola, Mozambique, Equatorial Guinea, and Zaire also have potential to increase production significantly.

30. Finally, in Latin America, the resources in the Amazon area are very large. However, considering the investment costs and risks involved, for a large-scale production in the Amazon area to be profitable, world market prices would have to be significantly higher than expected in the next decade or so.

31. Projected production in 1985, 1990, and 1995 is shown in Table 4. Tropical hardwood is likely to be in short supply during the next 15 years. Limited additional exports can be expected from the established producing areas until the mid-1980s, but if the projected demand in 1990 and 1995 is to be satisfied, hitherto unexploited resources will have to be opened on a large scale. The production costs of supplies from new areas--for example, the West Irian region of Indonesia, Papua New Guinea, Amazonia in Brazil, and currently inaccessible areas in Central Africa--would, at least initially, be 50-100% higher than those in the traditional supplying regions. Since it takes 25-50 years for most marketable hardwood species to grow to minimum size for veneer production, reforestation measures could have no signficiant impact on tropical hardwood supply of decorative quality until beyond the turn of the century. 2/

Demand Outlook

32. As stated earlier, world consumption of tropical hardwood has been growing rapidly over the last three decades, compared with consumption of softwood logs and temperate hardwood. 3/ Annual growth rates over the 1961-80 period for tropical hardwood, temperate hardwood, and softwood were 4.8%, 0.7%, and 1.2%, respectively (Table 1). The main explanation for the differential growth rates is the substitution by tropical hardwood for temperate hardwood and softwood. This substitution took place during this period mainly in the industrial countries, all of which are located in the temperate zone. It, in turn, was prompted by the shortage of supply of temperate hardwood and softwood logs and the rapid increase in the availability of tropical hardwood.

33. Between 1970 and 1980, when world economic growth slowed down, supply of temperate hardwood logs actually declined and consumption of softwood logs increased at 0.3% p.a., whereas consumption of tropical hardwood logs

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1/ Nigeria recently became a net importer of timber.

2/ For the latest estimates of forest resources in the tropics, see J.P. Lanly "Tropical Forest Resources," FAO Forestry Paper No. 30, FAO, Rome, 1982.

3/ Because of lack of data on stocks, it is assumed that world consumption is equal to world production.

TABLE 4: TROPICAL HARDWOOD - EXPORTS BY CATEGORY AND DEVELOPING REGIONS

CATEGORY/REGION	ACTUAL					PROJECTED			GROWTH RATES				
	1961	1970	1975	1978	1980	1985	1990	1995	1961-80	1970-80	1980-85	1985-90	1990-95
	(MILLION M^3)								(% PER ANNUM)				
LOGS	12.7	36.6	34.4	44.9	38.4	31.0	29.3	26.3	6.0	0.5	-4.2	-1.1	-2.1
TROPICAL ASIA - OCEANIA	7.6	29.4	28.7	39.0	31.7	24.2	22.0	18.4	7.8	0.8	-5.3	-1.9	-3.5
TROPICAL AFRICA	4.7	6.8	5.2	5.7	6.5	6.5	6.6	7.0	1.7	-0.5	0.0	0.3	1.2
TROPICAL AMERICA	0.4	0.4	0.5	0.1	0.1	0.2	0.6	0.8	-7.0	-12.9	14.9	24.6	5.9
OTHER DEVELOPING /A	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
SAWNWOOD	1.8	3.7	4.7	7.1	8.2	-	-	-	8.3	8.3			
TROPICAL ASIA - OCEANIA	1.0	1.7	2.6	4.2	5.2				9.1	11.8			
TROPICAL AFRICA	0.6	0.7	0.7	0.7	0.7				0.8	0.0			
TROPICAL AMERICA	0.2	0.5	0.6	0.7	1.0				8.8	7.2			
OTHER DEVELOPING /A	0.0	0.8	0.8	1.5	1.3				0.0	5.0			
PLYWOOD	0.3	2.2	3.0	4.3	4.2				14.9	6.7			
TROPICAL ASIA - OCEANIA	0.1	0.4	0.4	0.9	1.1				13.5	10.7			
TROPICAL AFRICA	0.1	0.1	0.1	0.1	0.1				0.0	0.0			
TROPICAL AMERICA	0.0	0.1	0.1	0.2	0.2				0.0	7.2			
OTHER DEVELOPING /A	0.1	1.6	2.4	3.1	2.8				19.2	5.8			
VENEER SHEETS	0.1	0.4	0.5	0.5	0.5				8.8	2.3			
TROPICAL ASIA - OCEANIA	0.0	0.2	0.3	0.2	0.2				0.0	0.0			
TROPICAL AFRICA	0.1	0.2	0.1	0.2	0.2				3.7	0.0			
TROPICAL AMERICA	0.0	0.0	0.1	0.1	0.1				0.0	0.0			
OTHER DEVELOPING /A	0.0	0.0	0.0	0.0	0.0				0.0	0.0			
PROCESSES TOTAL (ROUNDWOOD EQUIV.)	4.1	12.5	15.7	23.7	25.1	26.3	32.7	38.3	10.0	7.2	0.9	4.5	3.2
TROPICAL ASIA - OCEANIA	2.0	4.5	6.3	10.2	12.4	14.5	19.0	22.3	10.1	10.7	3.2	5.6	3.3
TROPICAL AFRICA	1.4	2.0	1.6	1.8	1.9	1.9	2.5	3.0	1.6	-0.5	0.0	5.6	3.7
TROPICAL AMERICA	0.4	1.1	0.8	1.3	1.9	2.3	3.7	5.5	8.6	5.6	3.9	10.0	8.3
OTHER DEVELOPING /A	0.3	5.1	7.0	10.4	8.9	7.6	7.5	7.5	19.5	5.7	-3.1	-0.3	0.0
LOGS AND PROCESSED: TOTAL (ROUND. EQUIV.)	16.8	49.4	50.1	68.6	63.4	57.2	61.9	64.5	7.2	2.5	-2.0	1.6	0.8
TROPICAL ASIA - OCEANIA	9.6	33.9	35.0	49.2	44.0	38.7	41.0	40.7	9.3	2.6	-2.5	1.2	-0.2
TROPICAL AFRICA	6.1	8.8	6.8	7.5	8.4	8.4	9.1	10.0	1.3	-0.5	0.0	1.6	1.9
TROPICAL AMERICA	0.8	1.6	1.3	1.4	2.0	2.5	4.3	6.3	4.9	2.3	4.6	11.5	7.9
OTHER DEVELOPING /A	0.3	5.1	7.0	10.5	9.0	7.7	7.6	7.6	19.6	5.8	-3.1	-0.3	0.0

/A INCLUDES HONG KONG, SINGAPORE, REP. OF KOREA, ISRAEL, AND CHINA. EXPORTS OF TEMPERATE LATIN AMERICAN DEVELOPING COUNTRIES, SOUTHERN EUROPE, AND SOUTH AFRICA, ARE NOT INCLUDED BECAUSE THEIR EXPORTS ARE LARGELY BASED ON THEIR OWN TEMPERATE HARDWOOD MATERIAL.

SOURCES: FAO, YEARBOOK OF FOREST PRODUCTS TAPES (ACTUAL); WORLD BANK, ECONOMIC ANALYSIS AND PROJECTIONS DEPARTMENT (PROJECTED).

increased at 3.1% p.a.. In 1981, however, world consumption of hardwood logs, and tropical hardwood in particular, appear to have declined and it is likely to remain at a low level in 1982. The recent decline is mainly attributable to the particularly depressed conditions of the building industry in industrial countries. 1/

34. The income elasticity of demand for logs of all species (coniferous and broad-leaved) has been estimated at between 0.4 and 0.7. For broad-leaved species (tropical as well as temperate), the income elasticity of demand is estimated in the range of 0.5 to 0.7, but for those of decorative quality (for instance, walnut, oak, teak, rosewood, mahoganies, and "bois rouges" from West Africa) demand elasticities are greater than unity. The income elasticity of demand has been greater than unity in the case of plywood, but below 0.5 for sawnwood, and varies with per capita income level.

35. At constant real prices, on the basis of the estimated income elasticities of demand and the expected growth in economic activity, especially in building activity, demand for hardwood logs can be expected to grow at a reasonably high rate. However, because of very tight supply potential for softwood and temperate hardwood logs, log prices are likely to rise in real terms, unless tropical hardwood logs are readily available. Since the exportable supply of tropical hardwood logs from major producing countries is likely to continue to be restricted, potentially significant rises in the demand for hardwood logs are likely to be "choked off" by sharply rising log prices, resulting in acceleration of substitution of nonwood materials for hardwood.

36. In certain end-uses, past trends in the substitution of cheaper wood and wood products for high-quality wood, and in the substitution of nonwood materials for wood, are expected to continue. In several construction uses, for example, wood is being displaced by aluminum, plastics, cement and steel. Although production costs of aluminum and plastics have increased as a result of the increased prices of hydrocarbons, it is not certain that the ongoing substitution of aluminum and plastics for wood will decelerate.

37. Equilibrium world consumption of hardwood logs is projected to grow at only 0.9% p.a. during the 1980-95 period. The annual growth rate in 1980-95 for consumption of temperate hardwood logs is projected to be a mere 0.5% p.a.; that for consumption of tropical hardwood, 1.4% p.a.. These projections

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1/ In the United States, for example, housing and construction account for 60-65% of sawnwood and plywood consumption. See U.S. Department of Agriculture, Forest Service, An Analysis of the Timber Situation in the United States 1952-2030, review draft, no date.

reflect the price increase that will bring consumption growth in line with the constrained supply of hardwood. 1/

38. Consumption of tropical hardwood in producing countries is projected to grow faster than that in importing regions (Table 5). During 1980-95, consumption in the producing regions is projected to grow at 1.7% p.a., while consumption in the temperate developing countries, centrally planned economies, and industrial countries is expected to grow at 1.7%, 0.5%, and 0.7% p.a., respectively. Consequently, the share of producing countries in world consumption of tropical hardwood will increase from 55.6% in 1980 to 58% by 1995.

Trade Outlook

39. The bulk of tropical hardwood exports from the log-producing developing countries has traditionally been in the form of logs with the remainder in sawnwood, veneers, and plywood. The share of processed products in the total tropical hardwood exports of log-producing countries has been relatively low (Table 6). Having remained constant in the 1960s, the share increased during the 1970s, rising to 39.6% in 1980. Given the determined efforts on the part of tropical hardwood producing countries to coordinate their export policies and to restrict log exports, it is likely that an increasing proportion of future exports will be in processed form. Thus, the volume of exports of tropical hardwood logs is projected to decline, while exports of processed timber (in roundwood equivalent terms) are expected to increase at 3-4% p.a. in 1985-95 (Table 4).

Price Outlook

40. Prices of tropical logs in real terms are projected to rise substantially, to close the gap between potential demand at constant real prices and available supply. 2/ The expected price increases are also consistent with the notion that, as production moves to the untapped natural forest resources in the interior regions of Amazonia, Papua New Guinea, Zaire, Cameroon and Central African Empire, production costs will rise considerably. The price of Lauan logs in Japan (the national average wholesale price as reported by the Forestry Agency) and the price of Sapelli logs (the best quality, FOB Cameroon ports, as reported by the Marche Tropicaux et

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1/ See section on Price Outlook. The prices of tropical hardwood are projected to increase by 30% in 1981 constant dollars between 1981 and 1995. Those of temperate hardwoods are assumed to go up by the same amount, because their availability--particularly of high quality temperate hardwood--is also limited. Softwood prices are also assumed to increase proportionately.

2/ Price elasticities of demand are notoriously difficult to estimate. Available estimates (for example, U.S. Forest Service) indicate short-term price elasticities of demand of around -0.1, medium term (five years) elasticities of about -0.3, and long-term (ten years) elasticities of about -0.5.

TABLE 5: TROPICAL HARDWOOD - CONSUMPTION BY ECONOMIC REGIONS

(ROUNDWOOD EQUIVALENT)

COUNTRIES/ECONOMIES	ACTUAL						PROJECTED			GROWTH RATES				
	1961	1970	1975	1978	1979	1980	1985	1990	1995	1961-80	1970-80	1980-85	1985-90	1990-95
	(MILLION CUBIC METERS)									(% PER ANNUM)				
DEVELOPING	33.0	44.1	61.0	70.8	68.6	74.9	80.6	89.0	96.0	4.4	5.4	1.5	2.0	1.5
PRODUCING REGIONS	31.7	39.5	53.4	58.6	55.7	63.0	68.1	75.2	80.6	3.7	4.8	1.6	2.0	1.4
TROPICAL ASIA-OCEANIA	16.3	18.8	26.0	27.0	23.9	28.3	30.6	33.7	35.7	3.0	4.2	1.6	2.0	1.2
TROPICAL AFRICA	3.6	6.7	8.1	10.1	9.6	12.6	13.5	14.5	16.0	6.8	6.5	1.4	1.4	2.0
TROPICAL AMERICA	11.8	14.0	19.3	21.6	22.2	22.1	24.0	27.0	28.9	3.4	4.7	1.7	2.4	1.4
IMPORTING REGIONS	.3	4.6	7.6	12.2	12.9	11.9	12.5	13.8	15.4	12.4	10.0	1.0	2.0	2.2
SOUTHERN EUROPE	0.1	1.0	1.3	2.2	2.3	2.5	2.6	2.7	2.9	18.5	9.6	0.8	0.8	1.4
TEMPERATE DEVELOPING AMERICA	0.3	0.4	1.1	0.2	0.5	0.5	0.5	0.5	0.5	2.7	2.3	0.0	0.0	0.0
ASIA	0.6	2.5	4.6	9.2	9.5	8.3	8.8	10.0	11.4	14.8	12.8	1.2	2.6	2.7
SOUTH AFRICA	0.3	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6	3.7	-1.5	0.0	0.0	0.0
INDUSTRIAL	14.4	38.5	32.4	40.4	41.1	37.1	38.5	39.5	41.5	5.1	-0.4	0.7	0.5	1.0
UNITED STATES	2.0	7.5	6.9	9.2	5.4	3.4	4.0	4.5	5.0	2.8	-7.6	3.3	2.4	2.1
WESTERN EUROPE	6.8	9.3	8.4	12.5	14.7	13.4	13.5	13.8	14.2	3.6	3.7	0.2	0.4	0.6
CANADA-AUSTRALIA-NEW ZEALAND	0.1	1.0	1.5	1.9	2.4	2.0	2.1	2.2	2.3	17.1	7.2	1.0	0.9	0.9
JAPAN	4.6	20.1	17.6	22.6	18.6	20.1	18.9	19.0	20.0	8.1	0.0	-1.2	0.1	1.0
(RESIDUAL)	(0.9)	(0.6)	(-2.0)	(-5.8)	(0.0)	(-1.8)	(0.0)	(0.0)	(0.0)	-	-	-	-	-
CENTRALLY PLANNED	1.1	1.0	1.0	1.2	1.4	1.4	1.4	1.5	1.5	1.3	3.4	0.0	1.4	0.0
WORLD TOTAL	48.5	83.6	94.4	112.4	111.1	113.4	120.5	130.0	139.0	4.6	3.1	1.2	1.5	1.4
MEMO ITEM:														
INDUSTRIAL AND DEVELOPING	47.4	82.6	93.4	111.2	109.7	112.0	119.1	128.5	137.5	4.6	3.1	1.2	1.5	1.4

SOURCES: FAO, YEARBOOK OF FOREST PRODUCTS TAPES; ECE/FAO TIMBER BULLETIN, VARIOUS ISSUES. US FOREST SERVICE DATA; JAPAN FORESTRY AGENCY (ACTUAL); WORLD BANK, EPD (PROJECTED).

TABLE 6: PERCENTAGE SHARE OF PROCESSED PRODUCTS IN TOTAL TROPICAL TIMBER EXPORTS OF DEVELOPING REGIONS /A

REGIONS	1961	1970	1978	1980	1985	1990	1995
ALL EXPORTING REGIONS	24.4	25.3	34.5	39.6	46.0	52.8	59.4
TROPICAL ASIA-OCEANIA	20.8	13.3	20.7	28.2	37.5	46.3	54.8
TROPICAL AFRICA	23.0	22.7	24.0	22.6	22.6	27.5	30.0
TROPICAL AMERICA	50.0	68.8	92.9	95.0	92.0	86.0	87.3
TROPICAL PRODUCING REGIONS	23.0	17.2	22.9	29.8	37.8	46.4	54.1

/A PROCESSED PRODUCTS INCLUDE SAWNWOOD, VENEERS AND PLYWOOD ONLY. THE SHARE IS BASED ON THE ROUNDWOOD EQUIVALENT VOLUME.

SOURCE: FAO, YEARBOOK OF FOREST PRODUCTS STANDARD TAPES, TABLE 6.

Mediterranee) are used as the indicator prices for the East Asian and West African markets, respectively (Annex Table 3). These indicator prices in 1981 constant dollars are expected to be 30% higher in 1995 than in 1981. Among the West African species, Sapelli is taken to represent "red woods (bois rouge)," but "white woods (bois blanche)" tend to have different market trends. To represent the latter, Samba has been chosen and the historical prices given. In addition, selected series of export unit values for the historical period are also shown.

41. Similarly, prices of sawn tropical hardwood are projected to rise in the projection period. The price of Malaysian Red Meranti sawnwood (select and better quality, standard density, CIF French ports) is used for projection purposes. In the long-term, the indicator price in 1981 constant US dollars is projected to rise from $\$314/m^3$ in 1981 to about $\$375/m^3$ by 1995, or by 20%.

Policy Issues

42. Tropical hardwood consists of a vast number of species with an enormous range of physical properties. Although hundreds of species are classified as commercial and additional hundreds as potentially commercial "lesser-used" species, at present only 40 or 50 species are involved in international trade. 1/ It is not likely that, even by the year 2000, the number of major internationally traded species will exceed 100, unless massive attempts are made by the industries and governments concerned to promote the use of other species.

43. Given the obvious prospects of chronic shortages of tropical hardwood supply, it is necessary to take steps to increase tropical hardwood supply. In the short- to medium-term, one measure to increase the supply of tropical hardwood is to promote the use of tropical hardwood species that have not been utilized so far. There have been a series of international attempts to promote so-called secondary species, or lesser-used species. The latest attempt is included in the proposed program for an international agreement for tropical timber within the framework of UNCTAD Integrated Program for Commodities.

44. In the longer term, it might be economically feasible to undertake reforestation programs to grow desirable tropical hardwood species that have been proven to be grown on plantations. Teak obviously is a candidate for such a program. Ocoume is another. Pilot projects are also under way in such countries as Ivory Coast and Congo, using species of Triplochiton, Terminalia and Cedrela. The proposed UNCTAD program mentioned above also includes such a proposal for international action.

1/ All those species produced at the rate of at least 1,000 cubic meter per annum are called "commercial" species and all other species are called "lesser-used." Information has been taken from: UNCTAD, Research and Information on Use Properties of Tropical Wood Species, UNCTAD, Consideration of International Measures Relative to Research and Development on Tropical Timber, p. 8. Also see: T. Erfurth and H. Rusche, The Marketing of Tropical Wood: (A) Wood Species from African Tropical Moist Forests; (B) Wood Species from South American Tropical Moist Forests; (C) Wood Species from East Asian Tropical Moist Forests.

ACRONYMS

NC	Non-conifers
UNCTAD	United Nations Conference on Trade and Development

ANNEX TABLE 1: SAWLOGS & VENEER LOGS-NC /A - PRODUCTION BY MAIN COUNTRIES AND ECONOMIC REGIONS

COUNTRIES/	ACTUAL				PROJECTED			GROWTH RATES/B				
ECONOMIES	1961	1970	1975	1980	1985	1990	1995	61-80	70-80	80-85	85-90	90-95
	('000 CUBIC METERS)							(% PER ANNUM)				
INDUSTRIAL	64,512	72,745	59,613	71,626	74,000	77,000	77,000	-0.1	-0.4	0.7	0.8	-
N. AMERICA	33,360	38,931	32,125	42,316	44,000	46,000	46,500	0.3	0.6	0.8	0.9	0.2
UNITED STATES	31,010	34,551	27,895	35,700	..	..	..	0.0	0.1	..	..	..
EEC-10	14,610	17,592	14,806	16,524	17,000	17,500	17,500	0.4	-0.6	0.6	0.6	-
FRANCE	6,975	7,493	7,882	8,374	..	..	..	1.2	0.3	..	..	..
OCEANIA	7,402	6,992	6,490	6,105	6,500	7,000	7,000	-1.0	-1.9	1.3	1.5	-
CENTRALLY PLANNED	33,787	36,356	37,663	35,451	36,700	37,500	38,300	0.3	-0.3	0.7	0.4	0.4
USSR	23,750	23,350	23,940	21,100	..	..	..	-0.3	-1.0	..	..	..
E. EUROPE	8,587	11,730	12,409	12,632	..	..	..	1.6	0.5	..	..	..
DEVELOPING	60,257	98,103	112,232	134,146	136,200	147,760	160,700	4.7	3.1	0.3	1.6	1.7
ASIA	32,895	60,351	70,357	81,833	77,000	79,760	82,900	5.6	3.2	-1.2	0.7	0.8
MALAYSIA	6,346	18,658	21,579	31,469	28,000	26,000	22,000	8.8	6.0	-2.3	-1.5	-3.3
INDONESIA	3,944	10,700	16,296	21,200	18,000	20,000	25,000	13.2	5.9	-3.2	2.1	4.6
CHINA	7,150	8,552	10,939	13,753	15,300	17,000	18,200	3.9	5.1	2.2	2.1	1.4
PHILIPPINES	6,940	10,680	8,441	6,352	6,000	6,000	6,000	-1.0	-4.5	-1.1	-	-
AFRICA	9,277	15,190	14,296	19,874	21,000	23,000	25,000	3.5	1.6	1.1	1.8	1.7
AMERICA	14,716	17,384	21,770	25,324	30,000	35,500	42,000	3.4	4.0	3.4	3.4	3.4
BRAZIL	6,760	7,470	10,168	13,349	17,000	21,000	26,000	4.6	7.4	5.0	4.3	4.4
WORLD	158,556	207,204	209,508	241,223	246,900	262,260	276,000	2.3	1.4	0.5	1.2	1.0
MEMO ITEM: INDUSTRIAL & DEVELOPING	124,769	170,848	171,845	205,772	210,200	224,760	237,700	2.7	1.8	0.4	1.3	1.1

/A NON-CONIFERS.
/B LEAST SQUARES TREND FOR HISTORICAL PERIODS (1961-80); END-POINT FOR PROJECTED PERIODS (1980-95).
SOURCES: FAO, YEARBOOK OF FOREST PRODUCTS TAPES (ACTUAL);
WORLD BANK, ECONOMIC ANALYSIS & PROJECTIONS DEPARTMENT (PROJECTED).

ANNEX TABLE 2: SAWLOGS & VENEER LOGS-NC /A - GROSS EXPORTS BY MAIN COUNTRIES AND ECONOMIC REGIONS

COUNTRIES/	ACTUAL				PROJECTED			GROWTH RATES/B				
ECONOMIES	1961	1970	1975	1980	1985	1990	1995	61-80	70-80	80-85	85-90	90-95
	('000 CUBIC METERS)							(% PER ANNUM)				
INDUSTRIAL	1,317	1,678	1,742	2,733	2,800	2,950	3,050	3.4	3.4	0.5	1.0	0.7
EEC-10	847	1,083	1,023	1,347	1,400	1,500	1,550	2.5	0.6	0.8	1.4	0.7
CENTRALLY PLANNED	191	320	358	411	500	550	600	5.4	2.1	4.0	1.9	1.8
DEVELOPING	12,799	36,743	34,279	38,762	31,200	29,740	26,800	6.9	0.8	-4.2	-1.0	-2.1
ASIA	7,673	29,050	28,182	31,079	23,170	20,380	16,600	8.7	1.3	-5.7	-2.5	-4.0
MALAYSIA	2,754	11,353	10,792	15,146	14,000	11,000	8,000	8.9	4.5	-1.6	-4.7	-6.2
INDONESIA	105	7,834	12,532	14,884	8,000	8,000	7,000	40.8	5.9	-11.7	-	-2.6
PHILIPPINES	4,581	9,606	4,596	715	300	200	..	-7.8	-22.1	-15.9	-7.8	..
AFRICA	4,726	6,833	5,192	6,547	6,470	6,640	7,000	1.3	-1.9	-0.2	0.5	1.1
IVORY COAST	1,019	2,511	2,419	3,199	2,700	2,400	2,100	5.2	0.9	-3.3	-2.3	-2.6
GABON	1,224	1,634	975	1,200	1,400	1,500	1,600	0.0	-3.2	3.1	1.4	1.3
WORLD	14,307	38,741	36,379	41,906	34,500	33,240	30,450	6.6	0.9	-3.8	-0.7	-1.7
MEMO ITEM: INDUSTRIAL & DEVELOPING	14,116	38,420	36,022	41,495	34,000	32,690	29,850	6.6	0.9	-3.9	-0.8	-1.8

/A NON-CONIFERS.
/B LEAST SQUARES TREND FOR HISTORICAL PERIODS (1961-80); END-POINT FOR PROJECTED PERIODS (1980-95).
SOURCES: FAO, YEARBOOK OF FOREST PRODUCTS TAPES (ACTUAL):
WORLD BANK, ECONOMIC ANALYSIS & PROJECTIONS DEPARTMENT (PROJECTED).

ANNEX TABLE 3: TIMBER - PRICES, 1955-81 (ACTUAL) AND 1982-95 (PROJECTED)

($/CUBIC METER)

	LAUAN LOGS /A		SAPELLI LOGS /B		SAWNWOOD /C	
	CURRENT $	1981 CONSTANT	CURRENT $	1981 CONSTANT	CURRENT $	1981 CONSTANT
ACTUAL						
1955	25.3	98.1	NA	NA	NA	NA
1956	24.4	92.4	36.0	136.4	NA	NA
1957	23.5	84.8	33.2	119.5	NA	NA
1958	22.4	76.7	33.2	113.7	74.3	254.4
1959	26.4	94.9	29.5	106.1	68.0	244.6
1960	29.0	101.7	34.8	122.1	84.9	297.9
1961	30.0	105.3	39.3	137.9	68.6	240.7
1962	32.9	116.7	37.5	133.0	71.8	254.6
1963	32.1	112.6	39.1	137.2	76.5	268.4
1964	27.4	94.8	39.5	136.7	82.5	295.5
1965	31.7	107.4	39.5	133.9	81.4	275.9
1966	33.3	110.3	38.0	125.8	73.1	242.1
1967	35.6	116.3	37.5	122.5	76.9	251.3
1968	36.5	127.2	42.0	146.3	84.1	293.0
1969	35.2	121.8	49.6	171.6	90.2	312.1
1970	37.2	116.6	43.0	134.8	92.9	291.2
1971	38.0	109.8	44.5	128.6	92.5	267.3
1972	37.6	98.9	52.5	138.1	109.5	288.1
1973	65.6	144.5	133.6	294.3	156.1	343.8
1974	78.6	139.8	120.5	214.4	143.1	254.6
1975	59.3	92.1	126.6	196.6	166.4	258.4
1976	79.6	121.5	142.3	217.2	168.1	256.6
1977	89.8	126.3	158.8	223.3	154.1	216.7
1978	91.8	109.0	191.3	227.2	205.4	243.9
1979	160.2	170.2	211.5	224.8	339.1	360.4
1980	192.9	186.2	251.7	242.9	365.1	352.4
1981	144.5	144.5	212.8	212.8	314.1	314.1
PROJECTED						
1982	150.0	144.0	200.0	192.0	315.0	303.0
1983	165.0	150.0	235.0	213.0	350.0	318.0
1985	208.0	164.0	302.0	238.0	430.0	339.0
1990	289.0	170.0	426.0	251.0	594.0	350.0
1995	431.0	190.0	613.0	270.0	852.0	375.0

Continued.....

ANNEX TABLE 3: TIMBER - PRICES (CONTINUED)

($/CUBIC METER)

	SAMBA LOGS /D		(UNIT VALUE)* HARDWOOD LOGS			SAWN HARDWOOD
	CURRENT $	1981 CONSTANT $	DEVELOPING COUNTRIES	PHILIPPINES	IVORY COAST	DEVELOPING COUNTRIES
ACTUAL						
1955	NA	NA				
1956	23.6	89.4				
1957	21.7	78.3				
1958	20.4	69.9				
1959	18.6	66.9				
1960	22.9	80.3				
1961	25.7	90.2	22.5	19.3	30.0	57.0
1962	25.8	91.5	23.1	21.2	28.5	56.6
1963	27.2	95.4	23.9	21.0	38.6	56.8
1964	26.8	92.7	22.8	20.0	34.8	56.0
1965	24.6	83.4	22.4	20.0	31.9	58.0
1966	24.1	79.8	22.2	20.4	33.0	56.7
1967	24.4	79.7	22.8	21.6	33.3	55.9
1968	25.3	88.1	23.5	25.0	33.1	55.5
1969	27.9	96.5	23.2	25.0	35.0	59.4
1970	25.1	78.7	21.7	25.5	33.7	59.2
1971	26.3	76.0	22.5	26.5	31.8	59.6
1972	31.0	81.6	24.1	25.3	40.1	65.9
1973	65.5	144.3	38.1	39.1	68.5	104.4
1974	56.6	100.7	42.2	46.0	71.3	122.3
1975	56.0	86.9	37.4	36.3	67.3	119.7
1976	66.9	102.1	49.1	58.0	80.9	127.4
1977	69.7	98.0	51.5	65.4	87.1	133.1
1978	74.2	88.1	53.6	65.8	95.3	144.9
1979	106.0	112.6	87.6	115.7	95.0	195.8
1980	117.9	113.8	93.2	128.7	95.0	223.1
1981	98.2	98.2	NA	NA	NA	NA

* DEVELOPING COUNTRIES' EXPORT UNIT VALUE (CURRENT $).

/A LAUAN FOR PLYWOOD AND VENEERS, LENGTH OVER 6.0M AND DIAMETER OVER 60M, AVERAGE WHOLESALE PRICE IN JAPAN.

/B WEST AFRICAN, HIGH QUALITY (LOYAL AND MARCHAND), FOB CAMEROON.

/C MALAYAN DARK RED MERANTI, SELECT AND BETTER QUALITY, STANDARD DENSITY, CIF FRENCH PORTS.

/D L&M QUALITY, FOB IVORY COAST, TRIPLOCHITON SCLERXYLON, A REPRESENTATIVE "BOIS BLANCH" IN WEST AFRICA, COMMERCIALLY ALSO CALLED AYOUA, OBECHE, AND WAWA.

SOURCE: JAPAN, MINISTRY OF AGRICULTURE, FORESTRY AND FISHERIES; NIHON KEIZAI SHIMBUN; MARCHE TROPICAUX ET MEDITERRANEE (ACTUAL); UNIT VALUE SERIES FROM FAO YEARBOOK OF FOREST PRODUCTS TAPES; WORLD BANK, ECONOMIC ANALYSIS AND PROJECTIONS DEPARTMENT (PROJECTED).

Commodity Note No. 15

SOFTWOOD PRICES: TRENDS AND OUTLOOK

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* NOTES *

Definitions

"Lumber" and "Sawnwood" are used synonomously.

"Pulpwood" includes chips and particles.

Billion = 1,000 million.

Conversion Factors

Logs: 1000 bd. ft. = 4.53 m^3

Sawnwood: 1000 bd. ft = 2.36 m^3

Pulpwood: 1 cord = 2.55 m^3

Roundwood Equivalents (r)

1 m^3 sawnwood = 1.8 m^3 roundwood equivalent.

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SOFTWOOD PRICES: TRENDS AND OUTLOOK

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SUMMARY AND CONCLUSIONS

World trade in softwood logs and sawnwood in 1976 amounted to 129.7 million m^3 roundwood equivalent or US$6.8 billion. This compares with exports of 64.3 million m^3 roundwood equivalent or US$3.7 billion in the hardwood trade. Seventy-eight percent of these softwood exports occurred in the form of sawnwood. At present the developing countries account for only a small fraction of world softwood exports, though their potential for expanding production and exports is considerable. Currently world trade mostly involves exports from the softwood surplus regions of North America, Scandinavia, and the USSR to the softwood deficit regions of Western Europe and Japan.

As world trade in softwood occurs predominately in the form of sawnwood, this is the appropriate level at which to follow world price trends. Analysis of nine different price series for softwood sawnwood reveals a remarkable degree of uniformity of price trends worldwide. Though price increases varied from species to species, real prices grew at an average rate of between 3.0% and 3.5% per annum during the 1961-76 period. Because of its similarity to the sawnwood produced from plantation softwood stands in developing countries, the price of Southern Pine dimension No. 1, wholesale US, would be the most suitable series to be used as an indicator price.

World production and consumption of coniferous sawnwood is projected to grow at a rate of 1.6% to 1.7% per annum from 318 million m^3 in 1974/76 to around 405 million m^3 in 1990 and 450 million m^3 by 2000. North America and the USSR will continue to be the major producers with Canada remaining the world's largest exporter. Consumption in developing countries is expected to increase at a rate of around 4.3% per annum from 14 million m^3 in 1974/76 to around 40 million m^3 by 2000, remaining net importers.

Real prices of softwood lumber are expected to increase at a rate of between 2-3% per annum between 1977 and the end of the century. This is somewhat below the average annual rate of price increase of 3.0% to 4.0%, depending on species and grade, forecast for tropical hardwood over the same period. The principal cause of this rapid rate of increase is the growing pressure on the softwood resource base.

I. INTRODUCTION

1. In the past the World Bank has not followed prices for softwood products on the grounds that softwood was a commodity produced, traded, and consumed largely by industrialized and centrally planned countries and hence had little operational significance for project lending. In recent years, however, it has become apparent that many regions of the developing world are well-suited for growing selected species of softwood on a short-rotation, plantation basis, thus offering considerable opportunities for exports of logs, semi-processed and processed softwood products. It has therefore become necessary to begin monitoring softwood prices and to select a price that can serve as a world indicator price.

2. Softwood is by its nature an extremely heterogeneous commodity. It includes a variety of species and a number of grades within each species. To further complicate matters, different countries use different systems of grading. Furthermore, softwood has a variety of end-uses ranging from residential housing to newsprint to rayon shirts; the demand for different types of softwood thus being influenced by a number of divergent factors. This heterogeneity is reflected in prices as well. For example, in the US in 1975 pulpwood sold for around $\$11/m^3$ while a high quality Douglas fir peeler log sold for $\$207/m^3$. Softwood is also traded at various levels of processing, e.g., logs, lumber, pulpwood, veneers, plywood, wood pulp, paper, etc. For the purpose of this exercise only trade in logs, lumber, and pulpwood will be considered, the more processed forms being somewhat arbitrarily defined as "manufactures." It is well to point out, however, that being as most softwood products are produced in industrialized countries by integrated concerns, a large portion of the total softwood trade is involved in those secondary or tertiary products.

II. STRUCTURE OF THE SOFTWOOD TRADE

3. As is apparent from Table 1, production of softwood logs is concentrated into three regions: North America, the USSR, and Scandinavia, which together currently account for 75% of world production.

Table 1: SOFTWOOD LOG PRODUCTION

		1974	1975	1976
		-------(million m^3)-------		
WORLD		567.7	535.8	576.9
of which:	United States	157.0	152.8	176.6
	USSR	144.7	146.7	144.3
	Canada	80.6	69.3	77.3
	Scandinavia	46.5	34.6	38.3

Source: FAO, Yearbook of Forest Products, 1976.

Of total world production of softwood logs, roughly 20% of the total enters into world trade in the form of logs or sawnwood. Total world trade in softwood in logs and sawnwood amounted to almost 130 million m^3(r) or about $6.8 billion in 1976. To illustrate the difference between the hardwood and softwood trade, one can compare export statistics for 1976 (Table 2).

Table 2: WORLD EXPORTS OF SOFTWOOD AND HARDWOOD IN 1976

	Volume		Value	
	Softwood	Hardwood	Softwood	Hardwood
	------(million m^3(r))------		-------(US$ million)-------	
WORLD TOTAL	130 (100.0%)	64 (100.0%)	6,755 (100.0%)	3,720 (100.0%)
of which:				
Logs	28 (21.8%)	45 (69.5%)	1,472 (21.8%)	2,218 (59.6%)
Sawnwood	102 (78.2%)	19 (30.5%)	5,283 (78.2%)	1,502 (40.4%)

Source: FAO, Yearbook of Forest Products, 1976.

In short, the softwood trade is rather the reverse of the hardwood trade. Trade occurs at the sawnwood level rather than at the log stage, with the special exception of Japan.

A. Log Trade

4. At the risk of a slight oversimplification, it may be said that the international trade in softwood logs is comprised of Japanese imports from industrial countries. Table 3 gives the volume of imports of softwood logs for 1974-1976:

Table 3: IMPORTS OF SOFTWOOD LOGS

		1974	1975	1976
		--------('000 m^3)-------		
WORLD		26,960	24,027	28,420
of which:	Japan	17,591	17,238	18,771
	Canada	1,530	1,417	1,720
	Italy	1,326	933	1,128
	Finland	909	698	571
	Korea, Rep.	771	458	746

Source: FAO, Yearbook of Forest Products, 1976.

Of these five major importers, imports into Canada, Finland, and to a lesser degree Italy, represent what might be better described as intra-regional trade. Canada's imports come entirely from the US. Finland, a softwood surplus nation, imports exclusively from the USSR, and Italy's imports come mostly from Australia, Switzerland, and Southern Germany.

5. Japan's imports come predominantly from the Pacific Northwest of the United States and Siberia. In 1976, a reasonably typical year, the US and the Soviet Union provided 53% and 39% of Japan's softwood log imports respectively, with New Zealand accounting for 4%. In total, Japan accounts for around 65% to 70% of world softwood log imports, the bulk of the remainder being "intra-regional" trade. It is interesting to note that the Japanese seem to be willing to pay quite a premium for softwood logs. Referring to Table 2, one can see that in the hardwood trade, exports of logs comprise around 70% of the export volumes and 60% of export values of combined log and sawnwood exports. In the softwood trade, however, export volumes and values represent the same percentages of the total. Thus, the importers, principally Japan, of softwood logs are paying roughly as much for logs as they would for the roundwood equivalent of sawnwood. The efficiency of Japanese sawmilling coupled with protectionist measures enable this pattern of trade to remain profitable. Many US exporters to Japan find it more profitable to export logs than semi-processed or finished products. 1/

6. Consistent, well-defined price or value series for Japanese softwood log imports are notoriously difficult to obtain. In the US, the federal government has imposed a number of restrictions on log exports, including a ban of logs from national forests and controls on the export of logs from private lands by companies purchasing cutting rights in national forests. The numerous plys invoked to circumvent these restrictions make neither the exporters nor the Japanese particularly anxious to provide detailed, accurate information on prices paid or received for a specific species/grade of log. Work done by the US Forest Service indicates that log exports to Japan are concentrated in the No. 2 saw-log grade. 2/ To provide a rough indication of the differential paid by Japanese importers, one can compare prices of No. 2 Hemlock saw-logs in Western Washington and Northwestern Oregon with prices received for exports sales (Table 4).

1/ For more detail see Darr, David, Softwood Log Exports and the Value and Employment Issues, USDA, 1975.

2/ See Darr, op. cit., p. 4.

Table 4: PRICES OF WESTERN HEMLOCK SAWLOGS, NO. 2

(US/m^3)

Year	Water and Inland Sales	Export Sales	Percent Premium
1970	14.61	25.69	76%
1971	17.04	24.39	43%
1972	20.35	28.39	39%
1973	26.27	63.44	142%
1974	34.02	52.25	53%
1975	33.02	46.98	42%
1976	33.40	56.23	68%
1977	40.30	60.07	1.49%

Source: Rudermann, Florence, Production, Prices, Employment and Trade in Northwest Forest Industries, First Quarter, USDA, 1978.

7. Thus Japanese imports stand out as the exception to the general pattern of the world softwood trade, importing logs and producing lumber and paper products domestically. The fact that Japan is able to do this while paying high prices for logs is indicative of the particular character of the Japanese situation among developed countries. The ability of Japan to continue to import large volumes of logs form its traditional suppliers must be open to question. The current high value of the yen is making foreign-produced lumber ever more competitively priced. Restrictions on log exports from the US have been driving up export prices, and the Japanese trade literature cites difficulty in purchasing adequate quantities of good quality logs from the USSR. It can therefore be expected that the Japanese will look to diversify their sources of supply in the future, particularly in such nations as New Zealand and Chile.

B. Sawnwood Trade

8. As alluded to earlier, the majority of the softwood trade takes place at the sawnwood level. As will be demonstrated below, even though softwood lumber is traded in a great variety of species, grades, and sizes, there does seem to be a relatively unified world market with fairly uniform differences in prices between grades. Statistics of international trade in softwood lumber reflect a great

deal of intra-regional trade, particularly among the EEC nations, as the freight costs involved make purchasing from the closest possible supplier advantageous. Basically, however, the overall flow of trade is apparent. The softwood deficit regions of Western Europe and Japan import from the softwood surplus regions of Scandinavia, North America, and the Soviet Union. Although the United States is far and away the largest importer of softwood lumber, virtually all of its imports come from Canada. Tables 5 and 6 give an overview of the largest importers and exporters of softwood lumber:

Table 5: IMPORTS OF SOFTWOOD LUMBER

		1974	1975	1976
		('000 m^3)		
WORLD		51,734	42,580	53,639
of which:	United States	15,886	13,314	17,712
	United Kingdom	8,482	5,239	7,212
	Italy	3,362	3,050	3,537
	Germany, F.R.	2,453	2,422	2,907
	Japan	3,021	2,404	3,013

Source: FAO, Yearbook of Forest Products, 1976.

Table 6: EXPORTS OF SOFTWOOD LUMBER

		1974	1975	1976
		('000 m^3)		
WORLD		51,830	43,208	56,329
of which:	Canada	19,271	15,305	22,613
	USSR	7,790	7,826	8,550
	Sweden	7,394	5,290	6,610
	United States	3,673	3,248	3,715
	Finland	4,289	2,829	3,824

Source: FAO, Yearbook of Forest Products, 1976.

Of the principal importers the US and Japan are involved in one-way trade patterns. The US, as mentioned, imports almost entirely from Canada, and Japan imports overwhelmingly from the US and Canada. Italy tends to import around two-thirds of its softwood lumber from neighboring Austria, but the UK and the Federal Republic of Germany have extremely diversified sources of supply. For the latter two countries the single largest supplier has been Sweden, which usually provides between 20% to 25% of their total imports. Thus one might presume, ex ante, that it would be in these large consuming countries having diversified sources of supply that prices would best approximate "world market prices" reflecting the forces of supply and demand.

C. Pulpwood Trade

9. While the pulp and paper industry is an important end-user of softwood, pulpwood is not a commodity that is heavily traded on the international market. Trade statistics separating softwood from hardwood pulpwood are not readily available, nor are statistics that differentiate between pulpwood in the rough and wood chips. In recent years 70% to 75% of total pulpwood production has come from coniferous species. Table 7 gives a rough indication of the major markets for softwood pulpwood, though the statistics include hardwood pulpwood as well.

Table 7: MAJOR IMPORTERS OF PULPWOOD AND PARTICLES

		1974	1975	1976
		--------('000 m^3)--------		
WORLD		33,629	31,137	31,062
of which:	Japan	11,731	9,605	10,839
	Finland	4,381	4,313	4,443
	Sweden	1,165	3,355	2,490
	Norway	2,163	2,285	1,387
	United States	1,535	1,303	1,848

Source: FAO, Yearbook of Forest Products, 1976.

10. Japan is clearly the largest importer, importing primarily from North America (in the form of chips) and the Soviet Union. This is consistent with Japan's general practice of raw material imports. Finding the Scandinavian countries as major importers appears at first glance rather more surprising, Scandinavia being known as a major softwood surplus region. Analyzing these figures in more depth, it becomes apparent that Finland imports mainly from the USSR, Sweden from the two Germanys, and Norway from Sweden. Pulpwood is by far the lowest value wood product, thus having a very low ratio of value to freight cost. For this reason, it is generally uneconomic to transport pulpwood any great distance. Most of the international trade in pulpwood is therefore confined to intra-regional trade, again with Japan being the special case.

11. The pulp and paper industry is, on the other hand, a highly capital intensive industry with substanital economies of scale. Furthermore, much of the pulpwood produced is generated as an industrial residue from sawmilling operations or from thinnings during forest maintenance. Thus it occurs that certain regions, e.g., British Columbia or the Southeastern United States, often generate greater quantities of pulpwood (often in the form of chips) than are required for local consumption. This pulpwood can frequently undersell its competitors on the world market. One therefore finds that some pulpwood flows into the timber surplus nations where the large pulp and paper concerns are established. The advent of special vessels for transporting chips and the depreciation of the US and Canadian dollars can be expected to encourage this practice.

12. Ideally one would like to compare the volume of exports of pulpwood, woodpulp, and paper to determine the level of processing at which international trade occurs. Unfortunately the great variety of pulps and papers all having different specific gravities make it extremely difficult to express trade flows in a common volume denominator such as roundwood equivalent. To give an overview of the trade, however, one can look at the value of exports for recent years in Table 8.

Table 8: VALUE OF WORLD EXPORTS

	1974	1975	1976
	----------(million US$)----------		
Pulpwood and Particles	732 (4%)	789 (5%)	785 (4%)
Woodpulp	5,557 (33%)	5,323 (34%)	5,776 (33%)
Paper and Paperboard	10,486 (63%)	9,559 (61%)	10,931 (63%)

Source: FAO, Yearbook of Forest Products, 1976.

From this table it can be seen that pulpwood accounts for around 4% of the value of exports of the pulp and paper industry. Notwithstanding the fact that value of pulpwood is much lower than that of pulp or paper, it is still fair to conclude that world trade does not occur preponderately at the level of pulpwood, but rather at more processed stages.

13. In looking at trends in pulpwood prices, one is struck by their relative constancy in real terms compared with the increasing price trends for softwood logs and lumber. In Table 9, one can see that there has been little increase in pulpwood prices in Norway and Louisiana (US), two major producing regions. This constancy is occasioned by a number of technological factors tending to increase the supply of softwood pulpwood available and decrease the demand for it. Improved technology is now recovering parts of the tree that were previously wasted, e.g., branches, stumps and sawmill wastage. Improved silviculture has resulted in the development of monoculture that can be grown on very short rotations in warm climates. Modern pulping technologies are increasingly able to utilize the short-fibered tropical hardwoods in ways previously unfeasible, thus vastly increasing the supply of a partial substitute for softwood pulpwood. Furthermore, the trend towards recycling of waste paper, now in its infancy, could substantially offset the demand for "virgin" pulp.

Table 9: LEAST-SQUARES AVERAGE ANNUAL GROWTH RATES FOR REAL SOFTWOOD PRICES, /a 1965-1976

(percent)

Lumber	Percent
Scandinavian Pine /b c.i.f. Germany	3.4
Douglas Fir /b c.i.f. Germany	2.3
Parana Pine /b c.i.f. Germany	5.7
Russian Whitewood /c c.i.f. UK	3.7
Douglas Fir (Canada) /d wholesale	2.7
Southern Pine (US) /d wholesale	1.4
Douglas Fir (US) /d wholesale	3.4
Swedish Redwood /b Export Price, f.o.b.	3.6

/a The choice of one deflator for all the series proved unworkable. Use of the International Index of Inflation caused the growth rates for North American lumber to appear low or negative during a period of record growth. Use of the US Wholesale Price Index for all the series caused growth rates for European lumber to appear astronomically high. For the UK series (Sterling paid for Russian lumber) neither dollar-denominated deflator produced sensible results. Hence it was necessary to express the series in Sterling and deflate by the UK Wholesale Price Index.

/b Deflated by the International Index of Inflation, World Bank.

/c Expressed in Sterling, deflated by the UK Wholesale Price Index.

/d Deflated by the US Wholesale Price Index.

Continued....

Table 9: (continued)

(percent)

Logs	Percent
Douglas Fir No. 2 /a Peeler logs, USA Inland and water sales	3.5
Douglas Fir No. 2 /a Sawlogs, USA Inland and water sales	5.5
Douglas Fir No. 2 /a Sawlogs, USA Export sales	9.3
Southern Pine /a Sawlogs, f.o.b. mill Louisiana, USA	3.5
Hemlock Logs /b Import Price Index Japan	4.5
Pulpwood	
Pine /c Norway	0.4
Southern Pine /a Louisiana, USA	0.3
Softwood Chips /a Average Value, Exports Oregon, USA	0.3

/a Deflated by the US Wholesale Price Index.
/b Deflated by the Japanese Wholesale Price Index.
/c Deflated by the International Index of Inflation, World Bank.

Source: World Bank, Economic Analysis and Projections Department, Commodities and Export Projections Division, 1979.

III. SELECTION OF A WORLD INDICATOR PRICE

A. Criteria for Selection and Methodology

14. From the viewpoint of forestry development project work, it would be most relevant to monitor and forecast a price series of softwood exported by a developing country that produces it on a short-rotation, plantation basis. This, however, is not feasible at the present time. A second-best alternative may be to choose a species produced in the developed countries that as closely as possible resembles species produced in developing countries with respect to physical properties, end-uses, length of rotation, and level of prices. It is also desirable to choose a series for a species that is produced in large quantities and traded in a market where prices are determined by the forces of supply and demand.

15. In addition to the aforementioned theoretical criteria, one must attach prime importance to the statistical characteristics of the series. It is highly desirable to have a series extending far enough back in time to perform the normal statistical analyses used in price forecasting. Further, one wants a series that would not be biased due to some vested interest on the part of the publisher. And, finally, one desires a series that is compiled in a workmanlike fashion and is likely to be published regularly for the foreseeable future.

16. To ascertain the degree of interrelationship between softwood lumber prices in the major supplying and importing regions, the following eight price series were collected over the period 1965-76: Scandinavian Pine, Douglas Fir and Parana Pine, CIF Germany; Russian Whitewood, CIF UK; Douglas Fir, FOB Canada; Southern Pine and Douglas Fir, wholesale US; and Redwood, average export price, FOB Sweden (see Annex I). No consistent Japanese series were available, so a Japanese import price index for North American lumber was selected and converted into a US dollar index. From these nine series an unweighted composite index was constructed. These ten series were then correlated with each other to determine the degree to which the forces of supply and demand create a unified world market.

17. In addition to determining the correlation coefficients for the several series, the price series were also deflated and their real growth rates calculated through least-squares regression to determine if any of the growth rates were substantially out of line with the others. Indexes of fluctuation were also calculated to see if any of the series were particularly prone to short-term variations in price.

B. Results of the Analysis

18. When looking at the results of the correlation of the price series, one is struck by the uniformity of the price trends. In almost all cases the correlation coefficients were above 0.9 and in some cases verge upon 1.0.

Of the ten series examined, the most irregular is that of Russian Whitewood battens, CIF UK. This is most likely due to the trading practices of the Soviet Union. The Soviets often base their offering price on the prices being realized by the Scandinavian exporters. Thus one could expect the prices of Russian lumber to lag behind other prices by some fraction of a year. Furthermore, the price series for the UK is not a well-specified series and there is the likelihood that the composition of the import mix changed from year to year. Annex II gives the complete matrix of correlation coefficients.

19. The growth rates of the deflated sawnwood prices are shown in Table 9. The lowest rate of growth was that of US Southern Pine lumber (1.4% per annum), which is also the lowest quality of lumber among the series considered. The highest growth rate was registered by Parana Pine from Brazil (5.7% per annum), which was the highest quality of lumber of those sampled. This is consistent with the conventional wisdom that the better stands of timber have already been largely cut over and hence the prices of higher quality lumber are rising relatively faster than those of lower quality lumber. Indeed, stumpage prices for Douglas Fir, a high-quality softwood, in the US have been rising at 8.5% per annum in real terms. Eventually much of this increase will be shifted forward onto the price of Douglas Fir lumber, though the linkage between stumpage and lumber prices is by no means a straight-forward one.

20. In general, however, softwood lumber prices increased at slightly above 3% per annum in real terms over the period 1965-1976. The unweighted average of the growth rates of the eight price series was 3.3% per annum. It is well advised, however, to view these growth rates as imperfect indicators of price trends, as variations in exchange rates and differential rates of inflation surely account for some of the divergencies in growth rates.

1. Sawnwood

21. Given the relative uniformity of the various lumber price series analyzed, several of them might be adequate for use as an indicator price. Of these, however, the US wholesale price of Southern Pine Dimension No. 1 seems to be the most suitable.

22. Of all the softwood lumber price series considered, Southern Pine most resembles those species that are, or will be, grown in developing countries. Many of the forestry development projects involve growing Caribbean or Radiata Pine on short rotations (20-30 years for sawtimber) in the tropics or subtropics. Southern Pine is grown on 30-year rotations with climatic conditions approaching the subtropical, producing small diameter logs. Much of the timber is grown on plantations managed by the major forestry companies. Furthermore, the price levels for Southern Pine, which are substantially lower than those for Scandinavian Pine or Douglas Fir (actually not a true fir) lumber, are more in line with the price levels that lumber from the developing countries can be expected to fetch. The higher priced lumbers contain a built-in quality premium that would not be reflected in the plantation pine grown at lower latitudes.

23. The US is a major producer, importer, and exporter of softwood, and there is no apparent reason to believe that the prices paid for Southern Pine lumber reflect the effects of non-competititve market forces. Southern Pine prices correlate highly with all of the other series analyzed and thus seem to be an accurate indicator of worldwide trends in the softwood lumber market. Indeed Southern Pine seems to be relatively less affected by short-term price fluctuations than many other species (see Annex III).

24. The final justification for choosing the series of wholesale prices for Southern Pine, Dimension No. 1, pertains to its statistical quality. The series is of sufficient length to facilitate econometric analysis, and is quoted on a monthly basis in "Producer Prices and Price Indexes." It is compiled by the US Bureau of Labor Statistics which enjoys an excellent reputation for the accuracy of their statistical series. Furthermore, as this price series is for a very common grade of lumber from a traditional supplying region, it is reasonable to assume that it will continue to be quoted for some time.

2. Logs

25. As mentioned above, the heart of the softwood log trade consists of Japanese imports from the US and USSR. At the present time, however, the future of Japanese log importation is open to question. The appreciation of the yen against the US dollar and several other currencies in recent years has made it difficult for Japanese sawmillers to remain competitive. Indeed, the Japanese sawmillers and importers have decided to adopt a new policy of "co-existence" with North American lumber, importing dimension lumber while gearing their production toward made-to-order products and grades of lumber specific to the Japanese market.

26. It would be ideal to be able to monitor the course of softwood log prices CIF Japan. Unfortunately there seem to be no quotations that are sufficiently well-specified by species and grade, and published on a timely basis, to serve as a commodity indicator price. Length of series is also a problem with Japanese import statistics. Many of the purported "price" series are in fact import unit values.

27. There do exist, however, a number of series that provide an indication of the course of softwood log prices. In Annex V there are three US domestic log price series, one for No. 2 Douglas Fir peeler logs, one for No. 2 Douglas Fir sawlogs and one for Southern Pine; a series of Douglas Fir No. 2 export prices for logs exported from the US to Japan; a Japanese price index for Hemlock logs imported from North America; and a short series of import unit values in Japan for Radiata Pine. Of these only the three Douglas Fir price series are specified by grade, though they are not uniform as to the point of transaction, i.e., at the roadside, at the log pond, delivered to the mill, etc.

28. The series of import unit values of Radiata Pine in Japan is a statistical series of potentially great use in project evaluation, as Radiata Pine is one of the principal plantation species. This series was taken from the Chilean Forestry News which also quotes domestic prices for Radiata Pine sawlogs and pulpwood. Unfortunately this publication has only been in existence for about a year. Hence the reliability and consistency of the series quoted are yet to be ascertained.

29. Table 4 above contains price series for No. 2 Hemlock sawlogs (the principal log imported by the Japanese) both for sales in the US domestic market and for export sales. Exports go almost exclusively to Japan. While such series are quite useful for studying the trends of the Japanese market for logs, they are unfortunately not published on a periodic basis.

30. Given the data problems surrounding the softwood log trade it would not seem advisable to attempt to monitor log prices in a formal and systematic manner. Rather, it would appear more feasible to collect series of prices and unit values as they become available and use them in analytical exercies as needed.

3. Pulpwood

31. Three price series for softwood pulpwood and two export unit value series for softwood chips are listed in Annex VI. These price series are representative of trends in two of the major pulpwood-producing regions of the industrialized countries, Scandinavia and the Southern US, and Chile, a major producer among developing nations. As price data for softwood chips from the Pacific Northwest are unavailable, export unit values for Oregon and British Columbia are given. Of these two areas, Oregon is the larger exporter, exporting primarily to Japan. British Columbia exports primarily to the United States. As can be seen, there has been little movement in real prices during the period covered by these time series (see Table 9). This trend is generally expected to continue over the medium term. Further, as mentioned above, pulpwood does not involve a great volume of trade, due to the low value to freight-cost ratio.

32. In the longer term, however, scarcity of supply will force Canadian and Russian log producers to move into less accessible areas. This may have an impact on pulpwood prices but not enough evidence is yet available to assess this question with any degree of certainty. Further studies on this subject are planned as an integral part of forestry project development.

33. The primary rationale for monitoring a pulpwood price would be to facilitate appraisals of the benefits flowing from forestry plantation projects. Often pulpwood is generated during pre-commercial thinning, and some plantation projects are specifically designed to feed pulp and paper operations. For this purpose one would want to know the prevailing price in the relevant region. It

would therefore seem advisable to monitor, on an informal basis, price and export unit value series such as those in Annex VI. Of particular use is the Chilean series, as this best approximates the conditions confronting plantation projects.

34. It does not seem worthwhile, however, to monitor one pulpwood series in a formal and systematic fashion. Due to the noticeable constancy of real pulpwood prices and the fact that pulpwood is not heavily traded internationally, detailed regular attention to pulpwood prices may be a misallocation of resources. Needs of project appraisals can be well serviced by keeping informed on pulpwood price trends on an intermittent basis.

IV. MARKET OUTLOOK FOR SOFTWOOD LUMBER

A. Demand Prospects

35. Of the annual average consumption of sawn softwood in the 1974/76 period of 317.8 million m^3, 182.8 million m^3 (57.5%) was consumed in industrialized countries, 121.0 million m^3 (38.1%) in centrally planned economies, and 14.0 million m^3 (4.4%) in developing countries. In Western Europe and North America, both containing large inventories of coniferous forests, per capita consumption has long been high. Over the period 1961-77 sawn softwood consumption increased at an annual rate of 1.3% in Western Europe and 1.5% in North America. During the same period consumption in Japan grew at 2.3% per annum, thus bringing up the average growth rate for industrialized countries to 1.6%.

36. Similarly the growth of sawn softwood consumption in Eastern Europe and the USSR has been relatively slow, also reflecting a long history of softwood utilization. Consumption grew at an annual rate of 0.7% between 1961-77 in the USSR and 1.0% for all centrally planned economies. Consumption grew much faster in Asian CPEs, particularly in Vietnam and Mongolia, but these growth rates are more indicative of low bases than anything else. In total the Asian CPEs (including China) accounted for only 3.6% of world consumption in 1974/76.

37. In the developing countries, largely devoid of softwood stands, consumption has usually been a matter of consuming whatever local timber that might be available. The exception to this pattern has been Africa, where of the annual average consumption of 2.5 million m^3 in 1974/76, 2.1 million m^3 were imported. Basically, however, the only developing region of any importance for softwood consumption is Latin America, where sawn softwood consumption grew at an annual rate of 4.3% from 4.9 million m^3 in 1961 to 10.2 million m^3 in 1977. Softwood consumption in Latin America is highly concentrated, however, in three countries having mature softwood stands: Brazil, Mexico, and Chile. Consumption in these three countries accounted for 87% of total Latin American consumption in the 1974/76 period and 52% of the consumption in all developing countries.

38. Though the exact percentage varies across regions and through time, between 45-65% of all sawn softwood is used in construction, particularly residential construction. Thus the housing market is the predominant determinant of the demand for softwood lumber. In turn the demand for residential construction is largely a function of demographics, income, and interest rates. Also of major importance is the composition of the new residential construction. Single family dwellings use roughly three times more softwood lumber per unit than multi-family dwellings. Recently in North America there has been a trend toward single family dwellings, though rapidly rising energy costs may cause this to change.

39. The income elasticity of demand for sawn softwood is relatively low at the levels of income common in the major consuming regions. It has been estimated to be around 0.4 to 0.5 in industrialized market economies. The price elasticity of demand is extremely difficult to measure due to the long lags and the short-term instability of sawn softwood prices. The US Forest Service has estimated the following price effects on demand for lumber, plywood, and "miscellaneous products":

Years after price increase	Change in demand resulting from a sustained 1% rise in relative prices
First	-0.1
Fifth	-0.3
Tenth	-0.5

In this context it is well to point out that around 80% of US consumption of sawnwood and plywood is softwood.

40. The effect of interest rates on future demand prospects is, of course, the most difficult factor to foresee. The use of interest rate variation as an instrument of aggregate demand and foreign exchange management causes the housing market to shift rapidly in the short term. There is some indication that the monetary policies being pursued to combat the persistent inflation in industrialized countries will have a dampening effect on the prospects for residential construction.

41. The forecasts presented here for sawn softwood consumption are based on the studies of the FAO and national governments. 1/ They are not devoid of the influence of various interest groups and at best can be said to reflect orders of magnitude only. As the future supply situation, and hence the price prospects, will be determined by as yet unresolved policy issues regarding the use of forest lands, the forecasts do not account for some of the more extreme, but nonetheless possible, scenarios. For example, between 1969 and 1977 overall US softwood lumber prices increased at a real annual rate of 4.4%. Were this rate to be sustained, these demand projections would surely be on the high side. Prolonged high interest rates might have a similar effect on demand.

42. Demand for sawn softwood is projected to grow from 90.9 million m^3 in 1974/76 to 136 million m^3 by 2000 in North America. Growth rates for Canada will be slightly higher than in the US. Consumption will grow faster in 1978-1990 than in 1990-2000. This is due to the entrance of a large portion of the population into the household formation age group during the 1980s. Consumption in Western Europe will grow from 55.4 million m^3 in 1974/76 to around 65 million m^3 by 2000. Growth in consumption will be higher in Southern Europe than in the EEC-9 region. Consumption in Japan will continue to increase though not at as rapid a rate as in the 1961-77 period; consumption is projected to grow from 31.7 million m^3 in 1974/76 to around 46 million m^3 by 2000.

1/ Three studies of particular interest are: FAO, European Timber Trends and Prospects 1950 to 2000, 1976; US Department of Agriculture, The Outlook for Timber in the United States, 1974; and Executive Office of the President's Council on Wage and Price Stability, Lumber Prices and the Lumber Products Industry, 1977.

43. Prospects for consumption in centrally planned economies point to a continuation of past trends. The Soviet Union will expand consumption at around 1.0% per annum from 92.3 million m^3 in 1974/76 to around 120 million m^3 in 2000. Consumption in Eastern Europe should increase from 17.3 million m^3 to 21 million m^3 during the same period. Consumption in the centrally planned economies of Asia is far less certain. During the historical period consumption closely followed production and information on their ability to expand output is scanty. Given their low levels of consumption, however, continued growth in the Asian centrally planned economies should not greatly affect the overall growth rate of 1% per annum for centrally planned economies as a whole.

44. The outlook for sawn softwood consumption in developing countries can be best discussed in three categories: countries with indigenous softwood stands, capital surplus nations, and all others. In softwood producing nations consumption is projected to grow along past lines. Currently Brazil consumes about an equal quantity of sawn hardwood and softwood. Though there are managed pine forests in Southern Brazil, Brazil is expected to look to the vast hardwood stands of Amazonia to supply a substantial portion of its future wood needs. In Chile, consumption should continue to grow as income rises. Chile has no supply problem and is rapidly becoming the only significant exporter of softwood among developing countries. Consumption prospects in Mexico are also good. Currently Mexico imports about one-third of its softwood lumber consumption, primarily from the US. Given the prospects of rising foreign exchange earnings from petroleum exports and a rapidly expanding population, consumption in Mexico can be expected to continue to rise at around the 1961-77 average of 5.1% per annum. A special case among developing countries is that of Republic of Korea, which follows the Japanese pattern of importing softwood logs from the US and processing them into lumber and plywood. While much of this lumber is consumed domestically, consumption grew at a remarkable rate of 6.9% between 1961 and 1977, Korea also acts as a re-exporter. Korea has also been expanding its domestic production of softwood logs, though production potential is limited by the resource base. These trends in Korea are expected to continue, subject to the continued availability of softwood logs. But given the relatively small size of Korea and Chile, the rising consumption in these countries is not expected to have any major impact on the overall world demand for softwood lumber.

45. The capital surplus petroleum exporting nations of North Africa and the Middle East, on the other hand, constitute a major new market for sawn softwood that will compete with Europe and the USSR for supplies. These nations are largely devoid of forests of any kind and have ample foreign exchange to finance lumber imports. As the wealth of these regions is rather newly acquired, it is difficult to assess the magnitude that these imports might take. The relatively low populations of these countries and an architectural tradition based on non-wood materials are factors that militate against these nations becoming major consumers. The growth rates for developing Africa and Asia from 1961-77 are 6.8% and 4.6% respectively, though these regions started from a very low base. It is entirely possible that growth rates of these magnitudes could be maintained, fueled largely by the petroleum-producing nations.

46. Prospects for softwood lumber consumption in other developing nations to the year 2000 are rather poor. Having no softwood of their own, it is unlikely that these nations would spend scarce foreign exchange on basic building materials. All attempts possible will be made to satisfy timber needs out of the indigenous hardwood stands or through substitution of non-wood materials. While many of these nations have the potential for growing softwood on a short-rotation plantation basis, it is unlikely that any appreciable amount of sawtimber will be generated before the year 2000. Hence in these nations consumption will tend to be constant, confined to those small amounts that are locally available. (See Annex VIII, Table 1.)

B. Supply Prospects

47. From the present up to year 2000 the world patterns of softwood sawtimber supply are not expected to change drastically. Adequate timber exists to meet the projected consumption requirements, but all indicators point to the necessity of ever-rising prices to call forth increased supplies. Both Western and Eastern Europe will remain close to self-sufficient in sawn softwood, with the deficit being filled, as now, by North America and the USSR. Much of the better timber stands of European Russia have already been cut over, and the center of Soviet forestry is shifting ever eastward toward Siberia. This places the USSR in a less opportune position to supply the Western European market but more favorably situated to increase supplies to Japan and the growing Middle Eastern market, where the USSR is already the principal supplier. This implies that an increasing proportion of Europe's imports are likely to come from Canada and from the pine forests of the South-eastern US. Japan will continue to rely heavily on North America and Siberia for softwood, though domestic production should begin to increase as the newly regenerated forests begin to reach sawtimber dimensions. Japan may however be forced to take a larger share of its imports in processed form.

48. It is extremely difficult to make accurate projections on the future supplies to be forthcoming from the major producing regions due to a number of still unresolved political questions concerning the proper use of forest lands. To appreciate the importance of these political issues it is instructive to note that public forest lands comprise 57% of coniferous forests in the US, 92% of all forests in Canada, and, of course, all forests in the centrally planned economies. In all these regions there has, of late, been great public concern about the environmental issues surrounding forestry and the non-wood benefits of forests. The actual levels of wood supply from these public forests will depend in large part on the cutting and management policies adopted by the relevant public bodies.

49. The one point that is fairly certain is that increased supplies will be forthcoming only at substantially higher costs than prevail today. Canada and the USSR do have adequate stands of old-growth sawtimber and substantial increases in production could be realized, indeed removals could be pitched above the net annual increment for some years to come, without compromising the principle of

sustained yield forestry. These stands, however, lie in the remote regions of British Columbia and Siberia. In these regions large investments in basic infrastructure would have to be made to facilitate extraction, and the climatic problems and distance from markets present formidable obstacles.

50. In the US and Europe forest land has come under competition from alternative uses, both economic and recreational. Also, the yield per hectare in these regions is declining as an increasing proportion of the sawtimber comes from second-growth stands. The increased management that would be needed to increase production would inevitably add to the cost of production. In the US it is predicted that the bulk of the increase in removals will be in the broadleaved rather than coniferous species.

51. To meet the projected demand of around 450 million m^3 of sawn softwood in 2000, production in industrialized countries is projected to expand at around 1.5% per annum from 179 million m^3 in 1974/76 to around 260 million m^3 in 2000, i.e., slightly more slowly than the 1.6% per annum in the 1961-77 period. Production will expand most slowly in Western Europe, reflecting pressure on the resource base in Scandinavia. Production in the US might expand slightly more rapidly than in the 1961-77 period as higher lumber prices could have two effects: more intensive utilization of the mature softwood stands in Western national forests and greater cutting of the privately held pine stands of the Southeast. The greatest increase in supplies of softwood lumber, however, will come from Canada. Production there should increase at a rate of around 3.1% per annum from 30.8 million m^3 in the base period of 1974/76 to 67 million m^3 in 2000. During the 1961-77 historical period output in Canada increased at an annual rate of 4.0%. As this rate reflects a low base of 18.5 million m^3 in 1961, it is unlikely to be maintained in the long term. Output in centrally planned economies is projected to increase at an annual rate of 1.1% from 128 million m^3 in 1974/76 to around 170 million m^3 in 2000. Most of this increase should come from the USSR with relatively stagnant growth in Eastern Europe being offset by slightly higher growth in the Asian CPEs. Supplies from developing countries will continue to be insignificant from a global standpoint, though they should grow at around 4.0% annually from 11.5 million m^3 in 1974/76 to around 30 million m^3 by 2000. The bulk of this increase is expected to come from the pine plantations of Chile and Brazil. Much of the increase in softwood production in these nations is likely to be marketed as logs, pulpwood, or pulp rather than sawnwood. (See Annex VII, Table 2.)

C. Trade Outlook

52. Trade in softwood lumber is expected to expand at a rate of around 2.5% between the 1974/76 base period and the year 2000. Trade will expand at a slightly faster rate from the present up to 1990 than between 1990 and 2000. Canada's exports should rise at an annual rate of 4.8% per annum from 19 million m^3 in 1974/76 to around 42 million m^3 in 1990 and then stabilize between 1990

and 2000. This rapid expansion of exports will be due primarily to the rising demand for housing in the US as a large segment of the population enters the household-formation age bracket. Exports from the USSR, the second largest exporter, will continue to grow slowly, around 1.6% per annum between 1974/76 and 2000, as domestic demand will expand at about the same rate as production. Exports from developing countries will expand from 1.4 million m^3 in 1974/76 to around 5 million m^3 in 2000. Part of this increase will be attributable to exports from such countries as Chile to developed countries, but much of it will represent trade between developing countries, particularly in Latin America. (See Annex VIII, Table 3.)

53. Patterns of importation by the industrialized countries are not expected to change substantially by 2000. The US will continue to be the largest importer, expanding its imports from 15.9 million m^3 in 1974/76 to around 32 million m^3 in 2000. As mentioned above, imports will increase rapidly in the early part of this period and then tend to stabilize. Europe will continue to be a minor net importer with imports rising from 21.7 million m^3 in 1974/76 to around 30 million m^3 by 2000. Most of these imports will represent intra-European trade, but a slightly increased proportion of total imports will come from Canada. Japan will probably be forced to take a greater proportion of its softwood imports in the form of lumber, with imports of sawn softwood projected to rise from 2.8 million m^3 in 1974/76 to around 6 million m^3 in 2000. Japan's sawnwood imports will continue to come predominantly from North America. Imports by developing countries will grow more rapidly than in other regions, rising from 4 million m^3 in 1974/76 to around 15 million m^3 by 2000, or at an average rate of 5.4% per annum. This increase in demand reflects the rising incomes in petroleum producing nations in North Africa and the Middle East. The major suppliers to this region will continue to be the USSR and Western Europe. (See Annex VIII, Table 4.)

D. Price Outlook

54. Prices of softwood lumber fluctuate widely in the short-term due to the limited ability of producers to adjust supplies in response to rapid swing in demand. (See Annex III for short-term fluctuation indexes.) As alluded to above, sudden shifts in the demand for softwood lumber (and plywood, which has similar price trends) are often caused by changes in the credit market conditions. Various factors restrain the ability of producers to adjust supplies, inter alia: during slack periods a certain level of output must be maintained to retain an adequate amount of skilled labor; under periods of strong demand output is constrained by timber availability and mill capacity; regional imbalances of timber availability and mill capacity often exist in the short-term; and the cost of holding large inventories in periods of depressed demand is often prohibitive. As credit market manipulation is perhaps the major instrument of macro-economic policy, instability in the demand for housing will continue to cause softwood lumber prices to fluctuate widely in the short term.

55. Over the longer term, however, softwood lumber prices have exhibited a continually upward trend. (See Table 10.) Indeed in the US timber prices (the bulk of which is softwood lumber) have increased at an annual rate of 1.7% in real terms between 1800 and the mid-1970s. Between 1970 and 1978 real prices in the US for all softwood lumber rose at an alarming rate of 4.4% per annum. During this same period prices for Southern Pine Dimension lumber rose at a rate of 2.5%, Southern Pine being the "bottom quality" sawnwood on the US market. Given the high degree of integration in the international softwood lumber market, these trends have been paralleled worldwide.

56. One interesting observation is that since the early 1970s the percentage of stumpage cost in the price of sawn softwood has been rising. This suggests that the rise in sawnwood prices has not been due primarily to lack of mill capacity or collusion by suppliers to restrain output but rather to rising costs of the basic raw material, sawtimber. The US Forest Service predicts that in the future 60-65% of the increases in the price of softwood lumber will be attributable to increases in the cost of stumpage.

57. The price elasticity of supply for softwood lumber has been estimated to be around 0.6 on private lands in the US. If this figure were a valid approximation of the overall supply elasticity it would imply that an annual increase of around 2.5% in real prices would be necessary to call forth the projected 1.4% per annum growth in supply. Most of the privately held softwood stands in the US are Southern Pine stands in the Southeast. Recent studies on behalf of the Canadian Department of Industry, Trade and Commerce 1/ indicate that the costs of production of softwood lumber in British Columbia are 25-55% higher than in the Southeastern US, albeit that a higher quality lumber is produced. Cost data for USSR, the other major softwood surplus region, are not available, but all factors indicate that increasing costs will be incurred as the center of gravity of Soviet forestry moves toward Siberia. Hence it is predicted that softwood lumber prices will rise in real terms at an average annual rate of around 2.0-3.0% between the base period of 1974/76 and 2000. Price increases for the indicator price of Southern Pine will tend to be at the lower end of this range, though the differential between the rates of price increases for Southern Pine and the other softwood species can be expected to narrow as pressure on supply increases. As a conservative estimate this would cause the indicator price of Southern Pine Dimension No. 1, wholesale US, to rise from its 1974/76 average of \$77.09/m^3 to \$104/m^3 in 1990 (constant 1975 US\$) and \$126/m^3 (constant 1975 US\$) by the year 2000. Clearly these estimates at best represent orders of magnitude.

1/ For example, Sandwell Management Consultants, Ltd., Analysis of Manufacturing, Cost in the North American Forest Products Industries, April 1977.

ANNEXES

ANNEX I
Table 1

SOFTWOOD LUMBER PRICES

(US$/$m^3$)

	Import Price, c.i.f. /a German North Sea Ports from Scandinavia Pine Battens 50-175mm.	Import Price, c.i.f. /a German North Sea Ports Douglas Fir Planks 2-3" Thick	Import Price, c.i.f./a German North Sea Ports Parana pine boards	Import Price, c.i.f./a United Kingdom Whitewood battens IV 175mm from USSR
1965	66.72	101.65	73.96	52.85
1966	66.30	104.36	74.20	49.72
1967	66.55	94.42	75.71	45.59
1968	68.96	98.15	81.66	44.04
1969	73.12	125.42	97.78	47.56
1970	77.50	134.46	103.58	51.27
1971	79.91	118.80	108.23	52.31
1972	89.87	162.46	121.95	54.79
1973	179.27	289.28	205.35	80.92
1974	208.84	237.08	279.95	145.96
1975	179.80	230.32	248.72	115.97
1976	189.79	277.80	286.33	109.10
1977	198.12	285.29	311.74	n.a.

/a Preise, Löhne, Wirtschaftsrechnungen, Reihe 9, Statistisches Bundesamt, Wiesbaden.

Source: World Bank, Economic Analysis and Projections Department.

SOFTWOOD LUMBER PRICES

(US/m^3)

	Canada, Wholesale /a Price f.o.b. mill Douglas Fir, green, dimension lumber	US Wholesale /b Price, Southern Pine, dimension No. 1	US Wholesale /b Price, Douglas Fir, 25% Standard green	Sweden, Average Export /c Price, f.o.b. for 2 1/2" x 7" Redwood
1965	29.63	37.97	26.10	56.53
1966	30.99	41.14	27.16	56.60
1967	31,46	41.57	28.05	57.86
1968	39.16	46.99	36.69	60.06
1969	40.06	50.93	37.37	62.26
1970	33.28	45.85	29.83	63.11
1971	43.77	54.11	41.36	64.17
1972	54.83	62.20	49.83	74.02
1973	70.49	75.72	64.28	151.86
1974	62.05	73.18	57.03	177.50
1975	61.23	69.49	58.18	147.39
1976	72.19	88.60	71.06	173,78
1977	n.a.	111,06	86,73	180,96

/a Dominion Bureau of Statistics, Ottawa.

/b Wholesale Prices and Price Indexes, BLS-US Department of Labor.

/c Allmän Månadsstatistik, Statistiska Centralbyran, Stockholm.

Source: World Bank, Economic Analysis and Projections Department.

SOFTWOOD LUMBER PRICES

(US/m^3)

	Japan, US$ Index /a of Import Prices for Hemlock Lumber from the US	Composite Index
1965	44.1	43.1
1966	44.7	43.9
1967	47.8	43.9
1968	54.7	49.2
1969	57.6	53.3
1970	55.4	50.9
1971	56.1	56.2
1972	67.7	66.8
1973	101.5	102.2
1974	108.4	110.5
1975	100.0	100.0
1976	106.0	115.0

/a Price Indexes Annual, Statistical Department, Bank of Japan.

Source: As noted and World Bank, Economic Analysis and Projections Department (composite index).

NEW ZEALAND PINE (RADIATA)

30 cm. diameter x 4.8 + n. long

	$/m^3$
1971	33.6
1972	34.6
1973	40.9
1974	77.4
1975	75.8
1976	67.0
1977	70.8
1978	78.9

Source: Forestry Agency of Japan, Mokuzai, Shikyo, Geppo (Timber Market Monthly Review).

CORRELATION COEFFICIENTS FOR SELECTED LUMBER PRICES /a 1965-76

(US$/m^3)

	Scandinavian Pine c.i.f. Germany	Doug. Fir (US) c.i.f. Germany	Parana Pine (Brazil) c.i.f. Germany	Whitewood (USSR) c.i.f. UK	Doug. Fir Canada Wholesale	Southern Pine (US) Wholesale	Doug. Fir (US) Wholesale	Swedish Redwood Export f.o.b.	Hemlock Japan Imp. Price Index	Composite Index
Scandinavian Pine c.i.f. Germany	1.000	.949	.983	.945	.909	.912	.902	.993	.987	.987
Douglas Fir c.i.f. Germany		1.000	.926	.807	.956	.950	.946	.951	.965	.969
Parana Pine (Brazil) c.i.f. Germany			1.000	.951	.904	.932	.910	.987	.973	.986
Whitewood (USSR) c.i.f. UK				1.000	.766	.790	.765	.933	.906	.908
Douglas Fir (Canada) wholesale					1.000	.985	.996	.912	.953	.957
Southern Pine wholesale						1.000	.991	.928	.952	.965
Douglas Fir (US) wholesale							1.000	.911	.948	.956
Swedish Redwood Export Price, f.o.b.								1.000	.982	.989
Hemlock, Japan Imp. Price Index									1.000	.995
Composite Index										1.000

/a See Annex I for a more complete description of the price series.

Source: As noted in Annex I.

ANNEX II
Table 1

ANNEX III
Table 1

SHORT-TERM FLUCTUATION INDEXES /a FOR
SOFTWOOD LUMBER PRICES

	Index
Scandinavian Pine, c.i.f. Germany	5.86
Douglas Fir, c.i.f. Germany	9.59
Panana Pine, c.i.f. Germany	5.36
Russian Whitewood, c.i.f. UK	6.94
Douglas Fir (Canada), wholesale	6.18
Southern Pine (US) wholesale	4.32
Douglas Fir (US) wholesale	7.20
Swedish Redwood, Export price, f.o.b.	6.71
Hemlock, Japan Import Price Index	4.67
Composite Index	5.19

/a The computational formula for the fluctuation index is:

$$\frac{1}{n} \Sigma \left(\left| \frac{P_t - P_t'}{P_t'} \right| \right) \times 100$$

where: P_t = Price in year t

P_t' = 3-year moving average centered on year t

n = number of observations

Source: World Bank, Economic Analysis and Projections Department.

ANNEX IV
Table 1

EXPORT UNIT VALUES OF SOFTWOOD LUMBER
FOR MAJOR LDC EXPORTERS
(US$/$m^3$)

	Honduras	Chile	Brazil
1965	34	30	46
1966	24	36	47
1967	25	37	49
1968	26	33	54
1969	39	39	73
1970	39	35	75
1971	47	33	74
1972	41	45	83
1973	65	59	142
1974	80	89	229
1975	85	88	204
1976	85	56	191

Source: FAO, Yearbook of Forest Products.

SOFTWOOD LOG PRICES

(US$/$m^3$)

	Douglas Fir No. 2 /a Peeler, N.W. of USA Inland and water sales	Douglas Fir No. 2 /a Sawlogs, N.W. of USA Inland and water sales	Douglas Fir No. 2 /a Sawlogs, N.W. of USA Export Sales
1965	24.15	14.70	17.37
1966	25.17	14.92	17.77
1967	25.96	14.97	18.77
1968	27.71	17.46	21.61
1969	33.07	20.95	27.33
1970	31.68	18.15	26.69
1971	32.63	21.28	24.79
1972	36.11	24.81	29.47
1973	46.60	35.12	66.47
1974	55.61	40.68	55.23
1975	59.84	40.95	51.41
1976	66.49	45.85	116.10
1977	80.00	52.67	61.10

/a Ruderman, Florence K., Production, Prices, Employment and Trade in Northwest Forest Industries, USDA.

Source: World Bank, Economic Analysis and Projections Department.

ANNEX V
Table 2

SOFTWOOD LOG PRICES

(US/m^3)

	Southern Pine Sawlogs /a f.o.b. mill Louisiana, USA	Index of Import /b Price of American Hemlock logs, Japan 1965=100	Import Price in /c Japan of Radiata Pine Logs
1965	10.92	100.0	-
1966	12.31	102.4	-
1967	11.27	103.8	-
1968	14.05	116.6	-
1969	15.94	128.6	-
1970	15.11	120.8	27.80
1971	17.85	118.5	33.61
1972	20.55	141.5	31.80
1973	25.44	222.5	39.89
1974	27.51	227.3	60.13
1975	25.88	249.2	54.05
1976	30.47	296.5	50.03
1977	-	-	58.00

/a The Demand and Price Situation for Forest Products 1976-77, USDA, December 1977.

/b Price Indexes Annual, Statistical Department, Bank of Japan.

/c Chilean Forestry News, October 1978.

Source: World Bank, Economic Analysis and Projections Department.

ANNEX VI
Table 1

PULPWOOD PRICES

(US$/metric ton)

	Softwood Chips /a Average Value of Exports Oregon, US	Pulpwood Chips /b,c Export Unit Values Canada
1965	21.76	-
1966	21.69	-
1967	21.77	-
1968	22.32	-
1969	23.26	-
1970	21.29	11.60
1971	23.08	20.02
1972	24.38	18.63
1973	27.39	19.72
1974	29.21	21.58
1975	38.29	28.17
1976	43.98	27.34
1977	47.76	40.32
1978	47.38	50.21

/a Ruderman, Florence K., Production, Prices, Employment and Trade in Northwest Forest Industries, USDA

/b Statistics Canada - Exports by Commodities, Canadian Treasury Board.

/c Virtually all softwood chips and 99% from British Columbia, Canada.

Source: World Bank, Economic Analysis and Projections Department.

ANNEX VI
Table 2

PULPWOOD PRICES

(US$/$m^3$)

	Pine, free at roadside, umbarked Norway /a	Southern Pine F.O.B. car Louisiana, U.S.A. /b	Radiata Pine at roadside Chile /c /d
1965	11.24	6.16	-
1966	10.98	6.47	-
1967	9.79	6.47	-
1968	9.60	6.67	-
1969	10.29	6.96	-
1970	11.47	6.94	2.34
1971	10.08	7.04	2.26
1972	10.78	7.55	3.79
1973	14.48	8.82	7.09
1974	25.45	11.10	2.83
1975	26.98	11.45	2.65
1976	24.19	11.94	3.19

/a FAO, Forest Products Statistics, Vol, XXX Sup. 6, 1978.

/b The Demand and Price Situation for Forest Products, 1976-77, USDA, Dec. 1977.

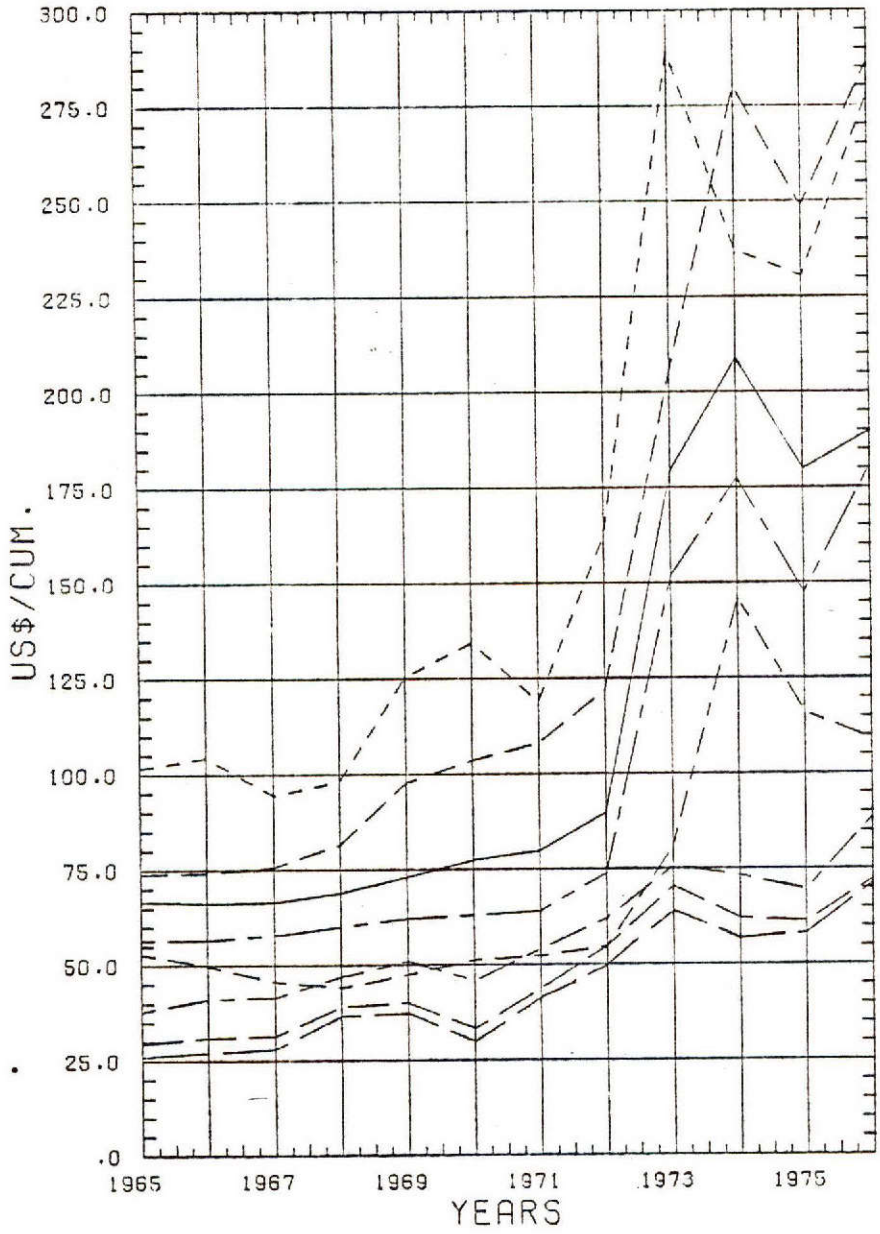
/c Chilean Forestry News, Oct. 1978

/d Due to the dual pricing system of Chile, these prices may not be comparable to those of developing countries.

Source: World Bank, Economic Analysis and Projections Department.

ANNEX VII
Chart 1

PRICE TRENDS OF SOFTWOOD LUMBER 1965-1976



KEY

———— =SCAND. PINE CIF GERMANY
– – – – – =DOUG FIR CIF GERMANY
— — — —=PARANA PINE CIF GERMANY
– – – – =WHITEWOOD FROM USSR CIF UK
—— —— —=CANADIAN DOUG FIR WHOLESALE BC
– —— – —=SOUTHERN PINE WHOLESALE US
———— ————=DOUG FIR WHOLESALE US
– ———— – =REDWOOD EXP PRICE FOB SWEDEN

CONSUMPTION OF CONIFEROUS SAWNWOOD

(Mil. m^3(s))

	Actual					Projected		Growth Rates		
	1961	1965	1970	1974/76	1977	1990	2000	1961-77	1974/76-1990	1974/76-2000
Developed Countries	149.1	171.6	181.5	182.8	199.8	235	255	1.6	1.7	1.4
Western Europe	46.4	55.0	57.6	55.4	56.6	62	65	1.3	0.7	0.6
Germany F.R.	10.1	10.8	11.2	9.7	10.6			0.1		
United Kingdom	7.8	9.4	8.7	7.6	7.1			-0.6		
Italy	3.4	3.1	3.8	4.2	4.4			1.7		
France	5.4	6.2	7.2	7.3	7.1			2.0		
North America	76.1	85.4	84.2	90.9	106.7	128	136	1.5	2.2	1.6
United States	69.1	78.6	75.7	78.3	94.0	105	113	1.1	2.0	1.4
Canada	7.0	6.8	8.5	12.6	12.7	20	23	4.2	3.1	2.4
Japan	23.0	27.0	35.4	31.7	32.0	41	46	2.3	1.8	1.5
Centrally Planned Economies	106.2	111.3	118.4	121.0	116.8	144	155	1.0	1.2	1.0
USSR	83.7	88.9	93.9	92.3	88.9	110	120	0.7	1.2	1.0
Eastern Europe	15.3	14.5	15.0	17.3	16.2					
Asian CPEs	7.2	7.9	9.5	11.4	11.7					
Developing Countries	7.6	9.3	11.8	14.0	18.6	26	40	4.8	4.3	4.3
Africa	1.2	1.3	1.7	2.5	4.4			6.8		
Asia & Oceania	1.5	2.5	2.9	3.2	4.0			4.6		
Latin America	4.9	5.5	7.2	8.3	10.2			4.3		
Brazil	2.0	1.8	3.6	4.7	6.4			7.3		
WORLD	262.9	292.2	311.7	317.8	335.2	405	450	1.4	1.6	1.6

Source: FAO, Yearbook of Forest Products and World Bank, Economic Analysis and Projections Department (actual); World Bank, Economic Analysis and Projections Department (projected).

ANNEX VIII
Table 2

PRODUCTION OF CONIFEROUS SAWNWOOD

(Mil. m^3(s))

	Actual					Projected		Growth Rates		
	1961	1965	1970	1974/76	1977	1990	2000	1961-77	1974/76-1990	1974/76-2000
Developed Countries	145.8	165.8	176.4	179.3	197.8	235	260	1.6	1.8	1.5
Western Europe	40.9	43.0	49.5	49.4	51.0	56	60	1.3	0.7	0.7
Sweden	8.0	10.1	12.0	11.7	10.9			2.7		
Germany F.R.	6.8	7.0	7.5	7.8	8.0			1.1		
Finland	7.9	6.7	7.1	6.1	6.7			-0.4		
North America	79.6	93.1	90.4	96.7	114.0	137	148	1.7	2.2	1.6
United States	61.1	68.8	65.0	65.9	73.3	75	80	0.6	0.7	0.8
Canada	18.5	24.3	25.4	30.8	40.7	62	67	4.0	3.6	3.1
Japan	22.5	26.3	32.8	28.9	28.8	36	40	1.8	1.5	1.5
Centrally Planned Economies	111.3	119.7	126.2	127.7	124.2	150	160	0.9	1.1	1.1
USSR	88.7	97.0	101.9	100.3	97.1	115	120	0.8	1.0	1.2
Eastern Europe	15.4	14.7	14.6	15.9	15.4					
Asian CPEs	7.2	8.0	9.7	11.5	11.7					
Developing Countries	6.1	7.7	9.7	11.5	14.0	20	30	4.6	4.0	4.0
Africa	0.2	0.3	0.4	0.4	0.5			4.9		
Asia & Oceania	0.8	1.6	1.9	2.4	3.1			3.9		
Latin America	5.1	5.8	7.4	8.7	10.4			4.2		
Brazil	3.1	3.0	4.5	5.0	6.6			4.5		
Chile	0.4	0.5	0.7	1.0	0.9			5.9		
WORLD	263.3	293.2	312.2	318.4	336.0	405	450	1.4	1.6	1.6

Source: FAO, Yearbook of Forest Products (actual); World Bank, Economic Analysis and Projections Department (projected).

EXPORTS OF CONIFEROUS SAWNWOOD

(Mil. m^3 (s))

	Actual					Projected		Growth Rates		
	1961	1965	1970	1974/76	1977	1990	2000	1961-77	1974/76-1990	1974/76-2000
Developed Countries	27.7	31.2	36.6	38.5	49.2	70	75	3.1	4.0	2.7
Canada	11.8	15.5	17.3	19.1	28.8	42	44	4.0	4.8	3.8
Sweden	4.6	5.3	6.9	6.4	6.1			2.8		
Finland	5.1	4.1	4.6	3.6	4.3			-0.9		
Austria	3.0	2.8	3.3	3.2	3.7			1.4		
United States	1.4	2.0	2.7	3.6	3.5			6.2		
Centrally Planned Economies	7.2	11.2	11.1	10.5	10.5	13	15	1.2	1.4	1.4
USSR	5.2	8.0	8.0	8.1	8.3	10	12	1.9	1.5	1.6
Developing Countries	1.4	1.6	1.7	1.4	1.5	2	5	1.1	2.4	5.2
Brazil	1.1	1.1	0.9	0.3	0.2					
Honduras	0.2	0.2	0.3	0.5	0.4			7.1		
Chile	-	0.1	0.2	0.2	0.3			15.2		
WORLD	36.3	44.0	49.4	50.4	61.2	85	95	2.6	2.7	2.5

Source: FAO, Yearbook of Forest Products (actual); World Bank, Economic Analysis and Projections Department (projected).

IMPORTS OF CONIFEROUS SAWNWOOD

(million m^3(s))

	Actual					Projected		Growth Rates		
	1961	1965	1970	1974/76	1977	1990	2000	1961-77	1974/76-1990	1974/76-2000
Developed Countries	31.0	37.0	41.7	42.1	51.2	70	73	2.5	3.5	2.3
Western Europe	19.6	23.6	24.4	21.7	22.1	28	30	0.9	1.7	1.3
United Kingdom	7.6	9.0	8.1	7.0	6.3			-1.1		
Germany	3.3	3.9	4.0	2.6	3.2			-1.2		
Italy	2.5	2.4	3.2	3.3	3.5			1.9		
France	0.9	1.4	1.7	2.1	1.8			4.4		
United States	9.5	11.3	13.5	15.9	24.2	30	32	4.7	4.3	2.9
Japan	0.6	0.8	2.7	2.8	3.2	5	6	11.1	3.9	3.2
Centrally Planned Economies	2.2	2.9	3.4	3.8	3.2	5	7	2.8	1.8	1.2
German Dem. Republic	0.9	1.4	1.4	1.5	1.1			1.6		
Hungary	0.6	0.8	1.0	1.0	0.9			2.6		
Developing Countries	2.9	3.1	3.8	4.0	6.1	10	15	3.8	6.2	5.4
Africa	1.0	1.1	1.4	2.1	4.0			7.3		
Asia & Oceania	0.7	0.8	1.1	1.1	1.2			3.3		
Latin America	1.2	1.2	1.3	0.8	0.9			-1.5		
World	36.1	43.0	48.9	49.9	60.5	85	95	2.6	2.7	2.5

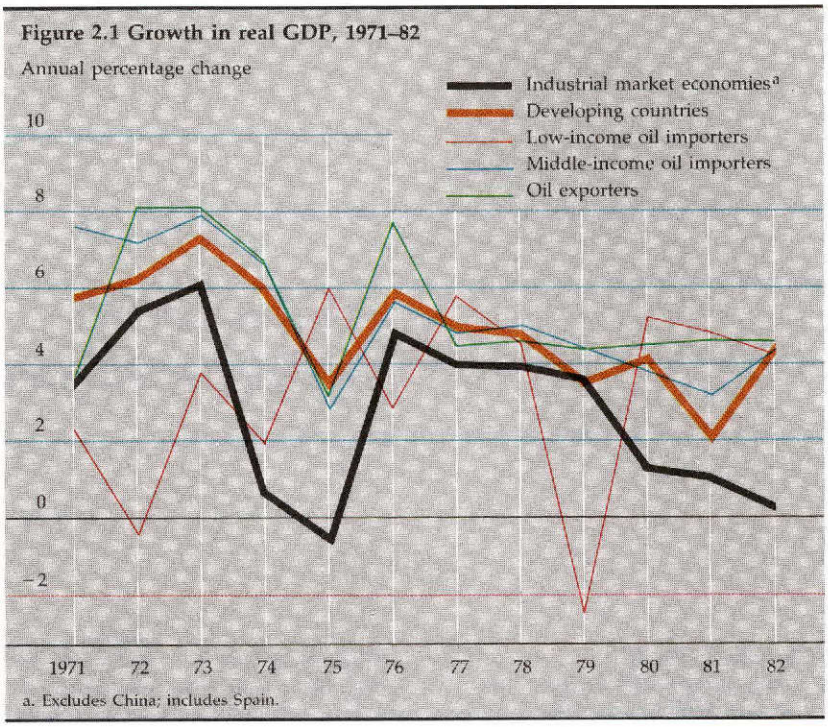
Source: FAO, Yearbook of Forest Products (actual); World Bank, Economic Analysis and Projections Department (projected).

Figures for the World Development Report 1982

Discussion Proof
Scheduled for discussion with
Executive Directors, July 8, 1982

The figures for the World Development Report 1982 are grouped here by chapter, in the approximate order in which they are referred to in the text. A few were not available in color in time to be included here. In the published version of the Report, each figure will of course appear at its appropriate place in the text and will be numbered in correct sequence.

Figure 2.1 Growth in real GDP, 1971–82



a. Excludes China; includes Spain.

Figure 2.2 Share of investment in GDP, 1970–81

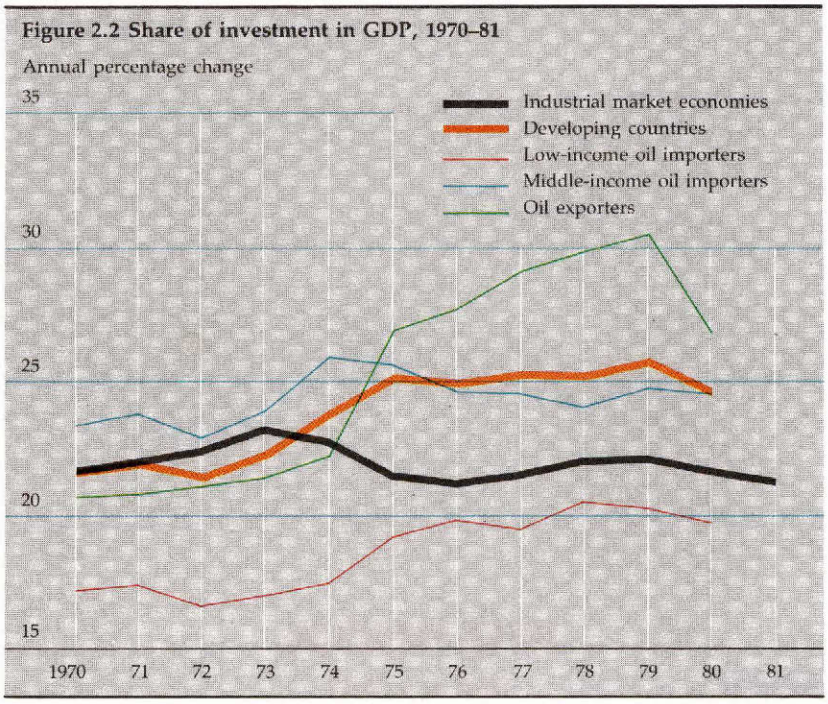


Figure 2.3 Trends in world trade volume, 1971–81

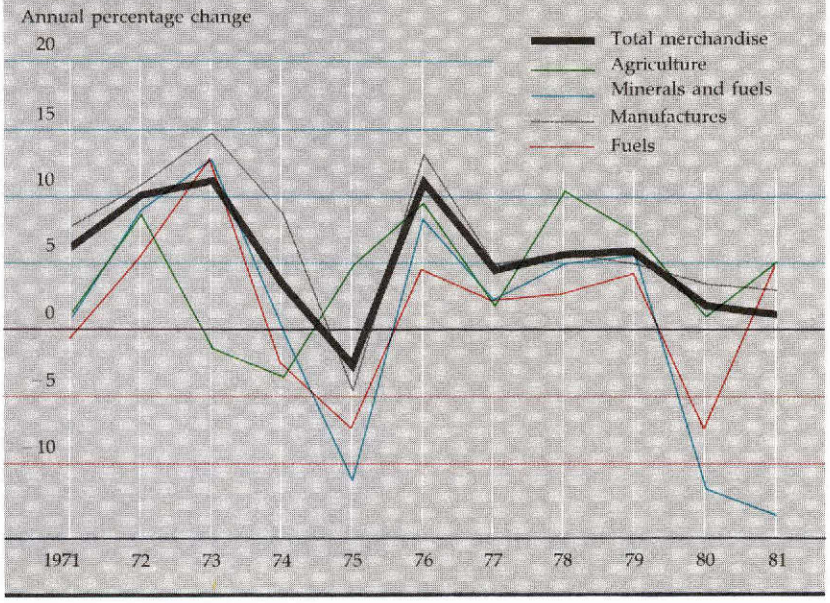
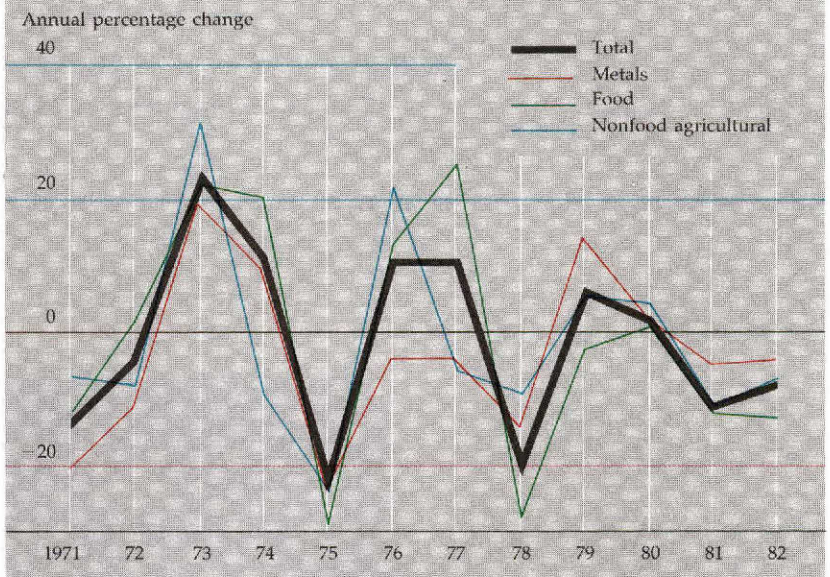


Figure 2.4 Annual fluctuations in developing-country export prices, 1971–82



Note: Based on a sample of 33 commodities, excluding petroleum, weighted by current values of developing-country commodity exports, deflated by the manufacturing unit value index.

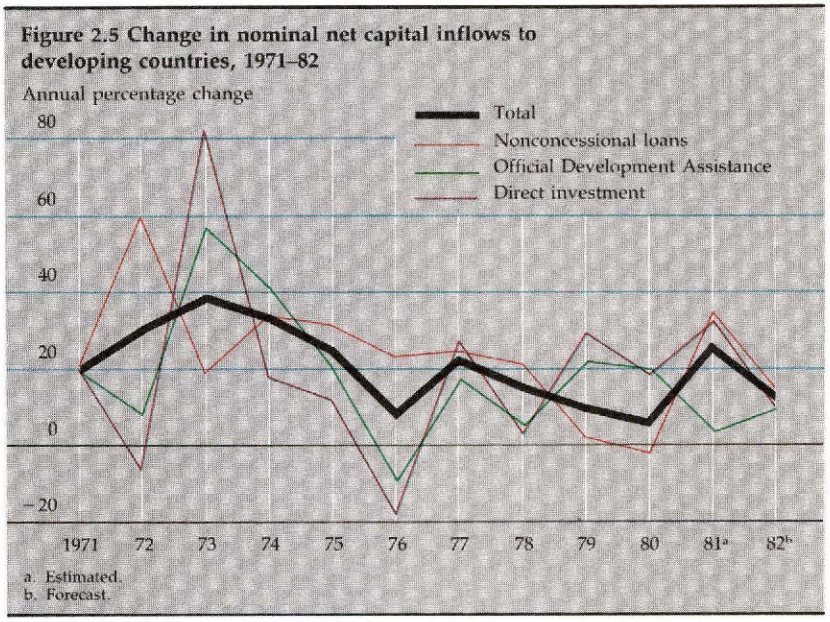


Figure 2.6 Global current account balances, 1973-82

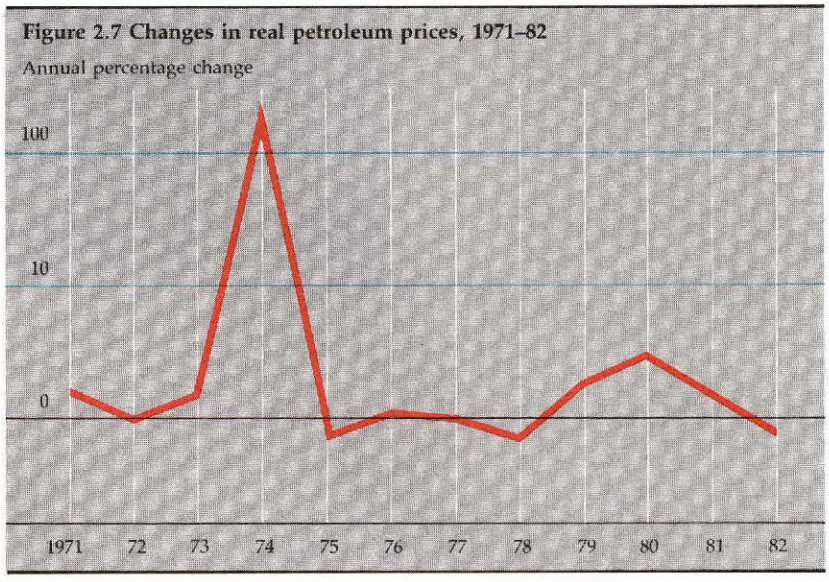
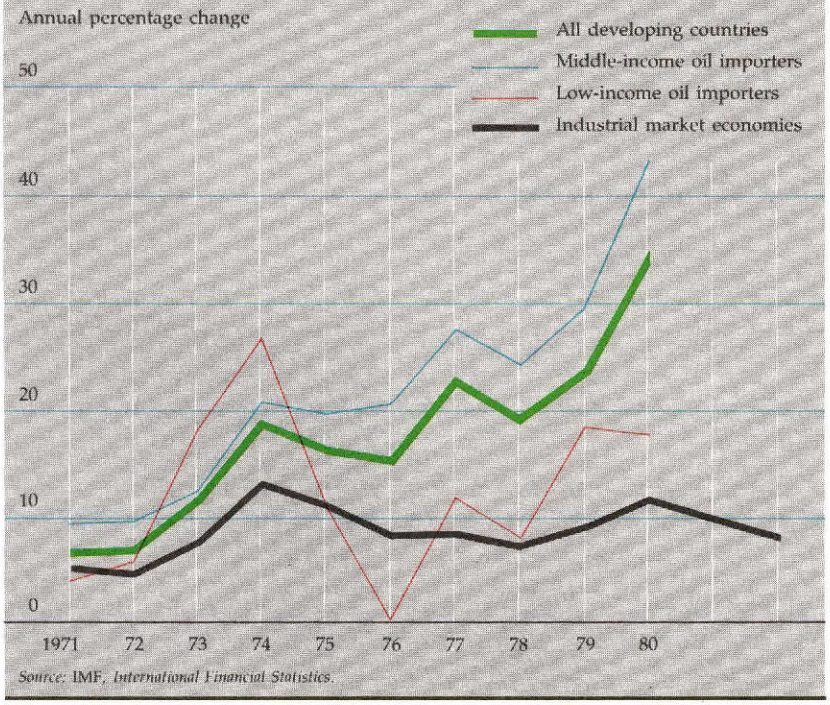
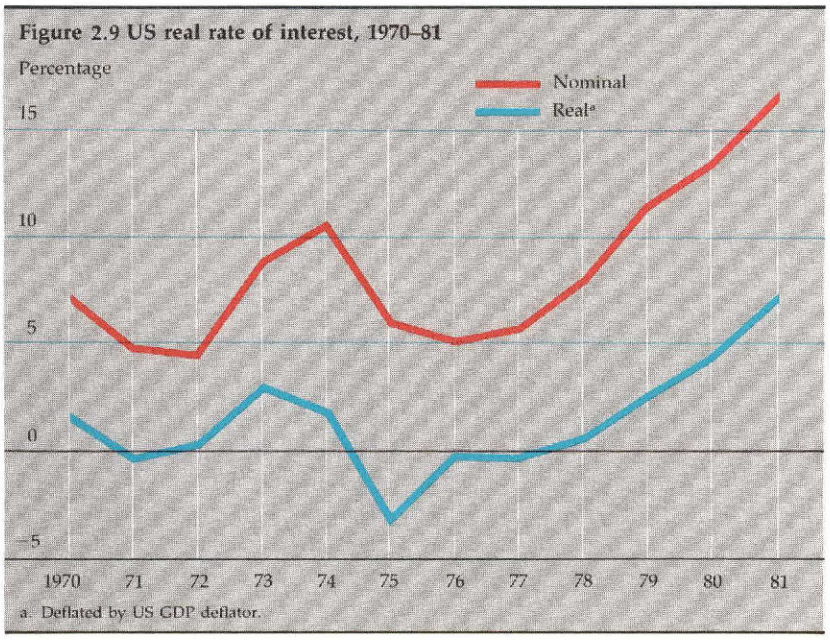


Figure 2.8 Price trends, 1970–81



Source: IMF, *International Financial Statistics*.

Figure 2.9 US real rate of interest, 1970–81

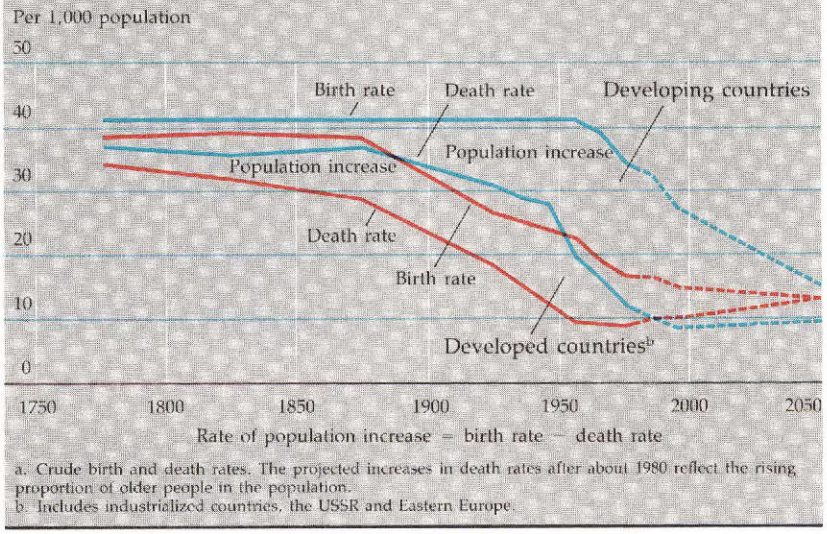


a. Deflated by US GDP deflator.

Figure 3.1 GNP per capita compared, United States and selected countries, 1899–79

Figure 3.2 Per capita GDP, selected countries, 1955–79, using ICP

Figure 3.3 The demographic transition[a]



a. Crude birth and death rates. The projected increases in death rates after about 1980 reflect the rising proportion of older people in the population.
b. Includes industrialized countries, the USSR and Eastern Europe.

Figure 3.4 Long-term patterns of economic growth, 1955–79

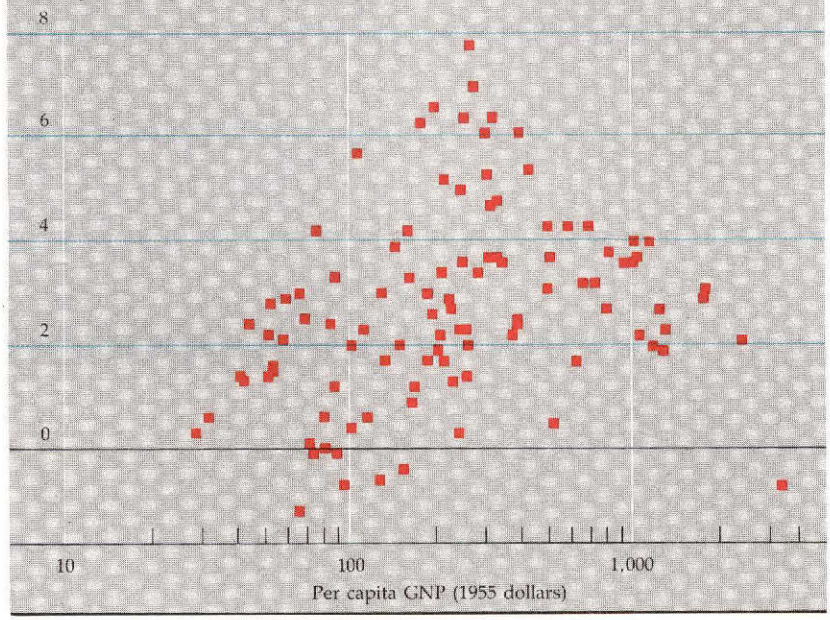
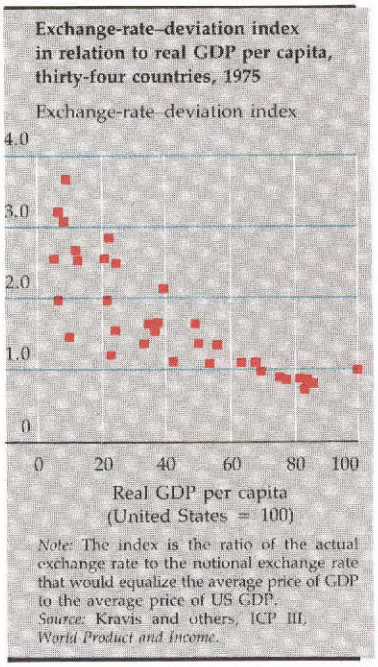


Figure 3.5 Share of imports of manufactures from developing countries as percentage of GNP of developing countries



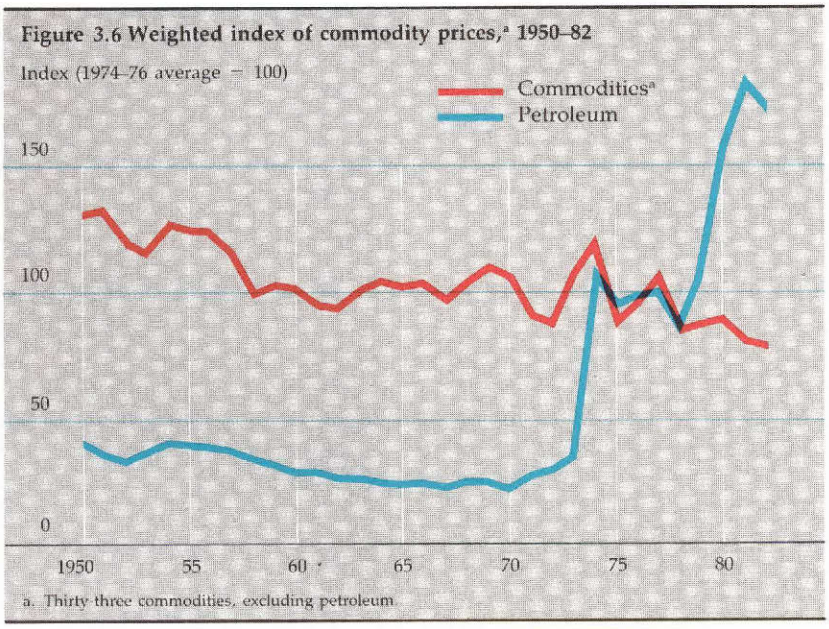
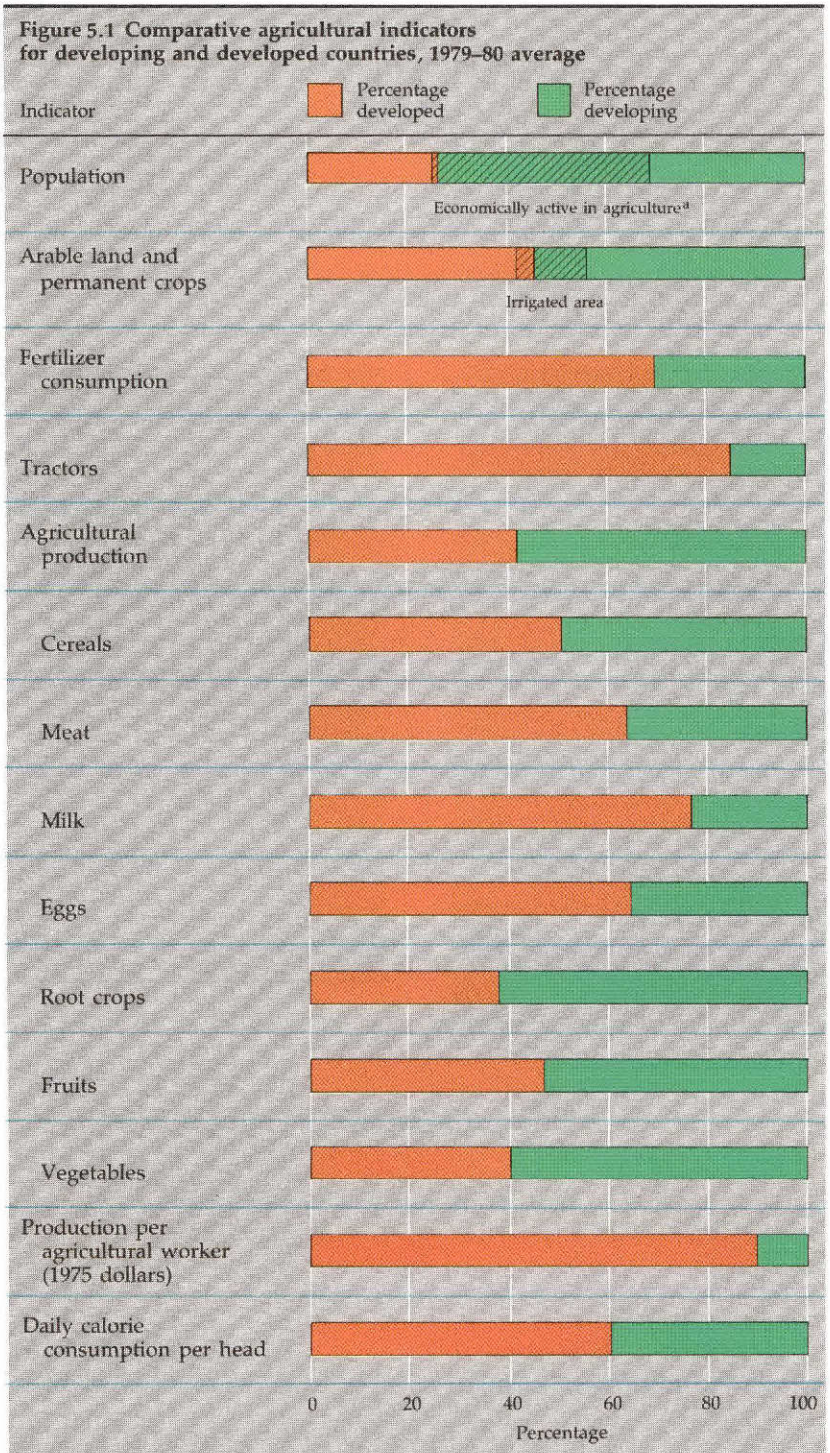


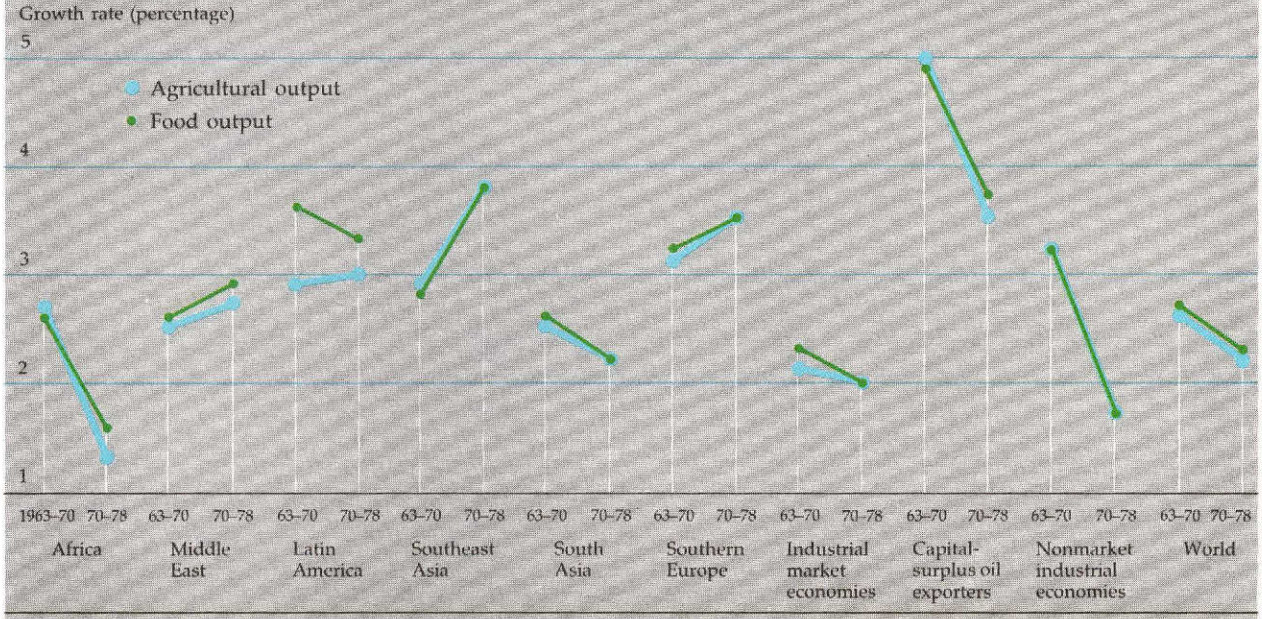
Figure 5.1 Comparative agricultural indicators for developing and developed countries, 1979–80 average



Source: FAO.

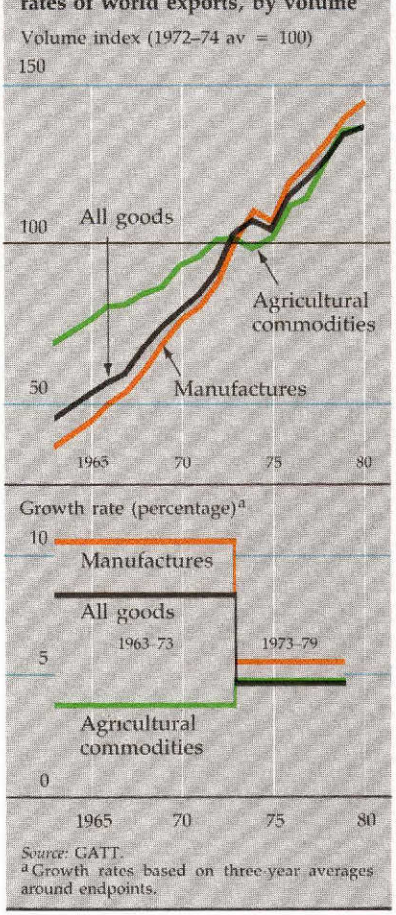
a. World distribution: developing countries, 92 percent; developed countries, 8 percent.

Figure 5.2 Agricultural and food output, by major world region and by income group, 1963–70 and 1970–78



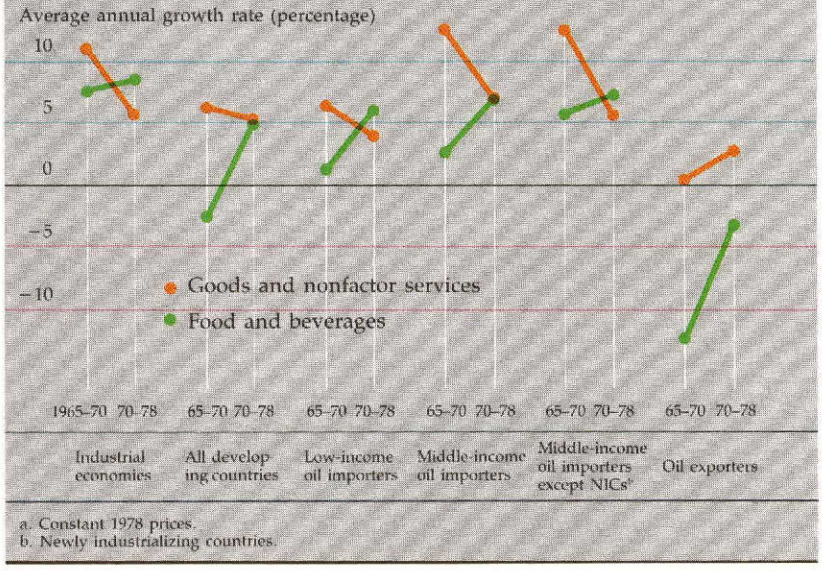
Note: Excludes China. Rates are for mid-points of five-year averages.
Source: FAO.

Figure 5.3 Index and growth rates of world exports, by volume



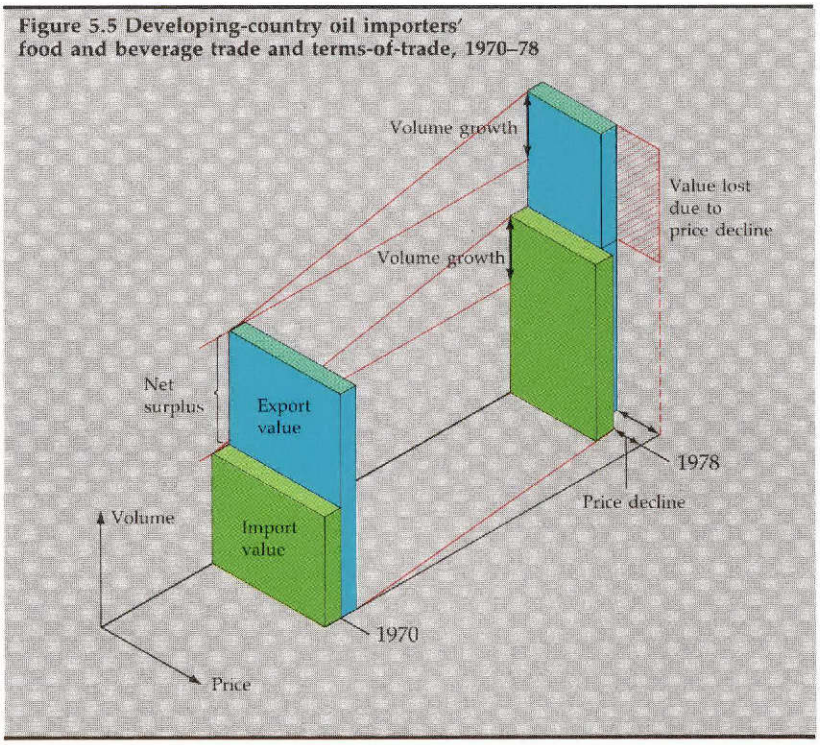
Source: GATT.
[a] Growth rates based on three-year averages around endpoints.

Figure 5.4 Export growth rates[a], by income group



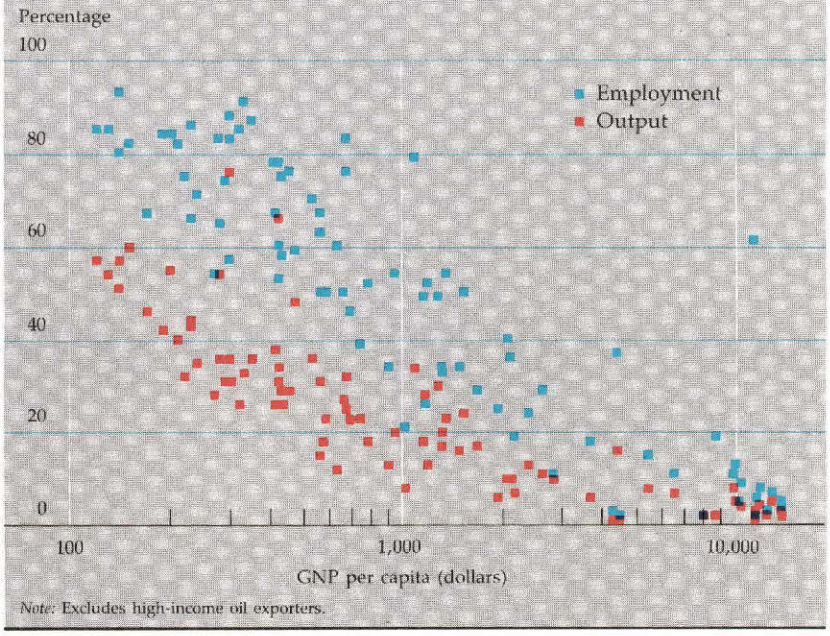
a. Constant 1978 prices.
b. Newly industrializing countries.

Figure 5.5 Developing-country oil importers' food and beverage trade and terms-of-trade, 1970–78



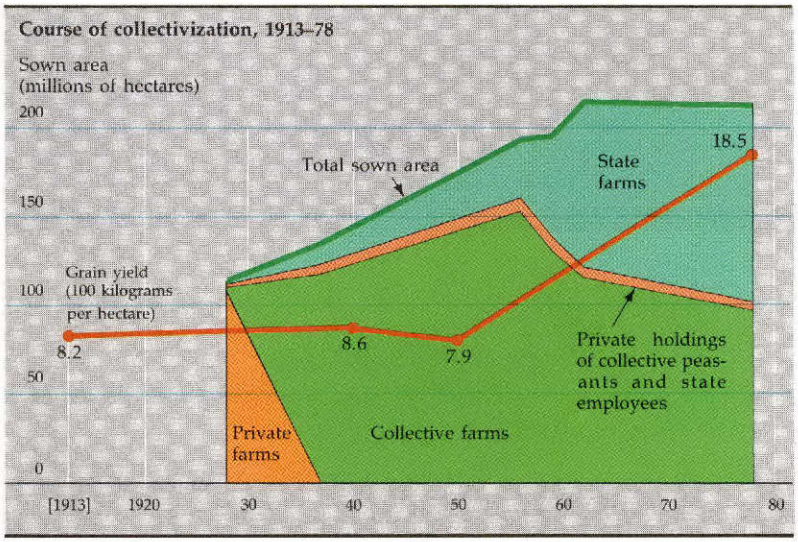
Food and beverages (billion 1978 dollars)	Low-income oil importers			Middle-income oil importers		
	Exports	Imports	Net	Exports	Imports	Net
Value, 1978	5.98	3.04	2.94	38.79	20.90	17.89
Value, 1970	5.03	2.91	2.12	30.38	16.65	13.73
Difference	0.95	0.13	0.82	8.41	4.25	4.16
Value change due to:						
Volume growth	2.22	0.24	1.98	16.19	6.36	9.83
Price decline	−1.27	−0.11	−1.16	−7.78	−2.11	−5.67

Figure 5.6 Cross-country share of employment and output in agriculture, 1980

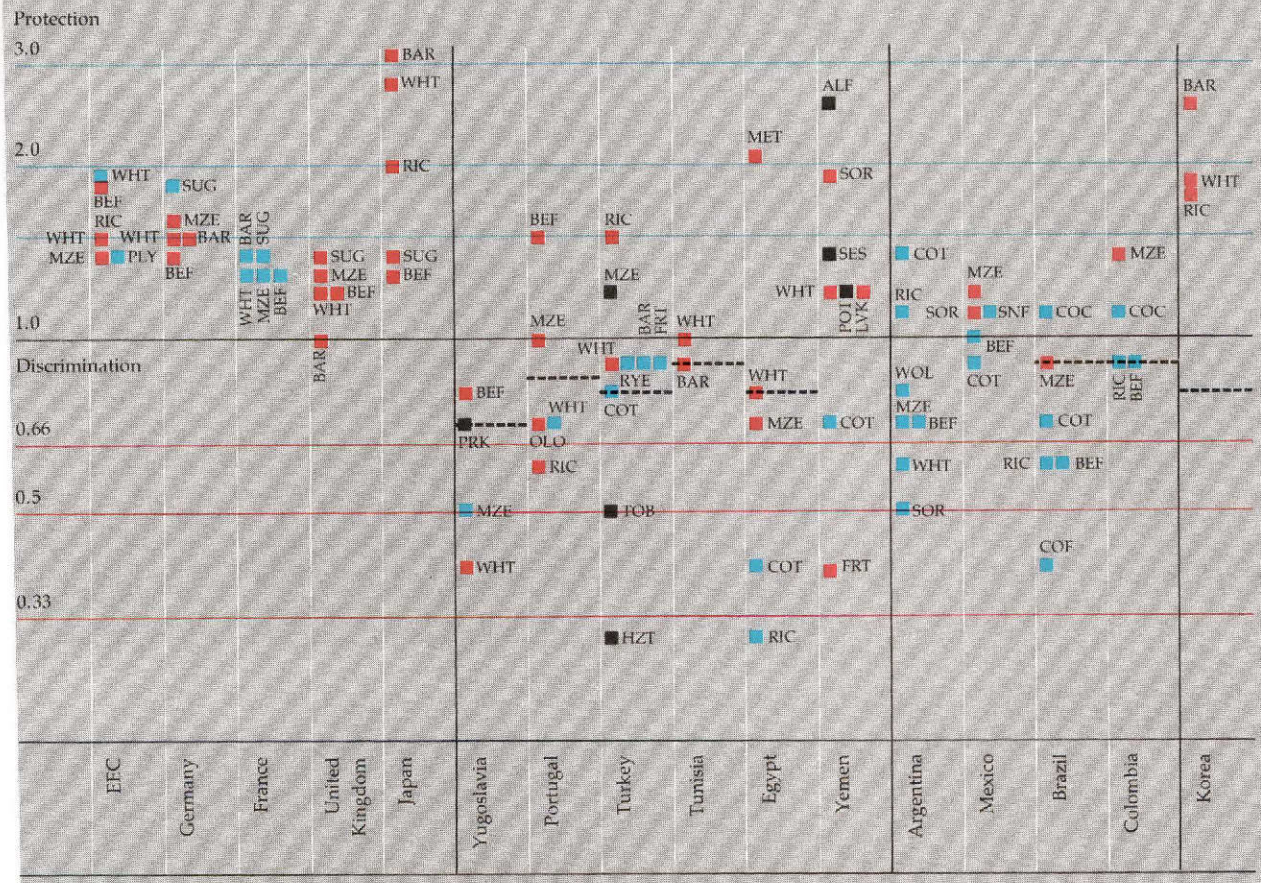


Note: Excludes high-income oil exporters.

Course of collectivization, 1913–78



Adjusted nominal agricultural protection coefficients, by country, late 1970's



Note: ALF is alfalfa; BAR, barley; BEF, beef; BEN, beans; COC, cocoa; COF, coffee; COP, copra; COT, cotton; FRT, fruits; GRT, groundnuts; GUA, gum arabic; HZT, hazelnuts; LVK, livestock; MET, meat; MLT, millet; MZE, maize; OLO, olive oil; OLS, oilseeds; PLY, poultry; POT, potatoes; PPR, palm products; PRK, pork; RIC, rice; RUB, rubber; RYE, rye; SES, sesame; SNF, sunflower; SOR, sorghum; SUC, sugarcane; SUG, sugar; TOB, tobacco; WHT, wheat; WOL, wool.

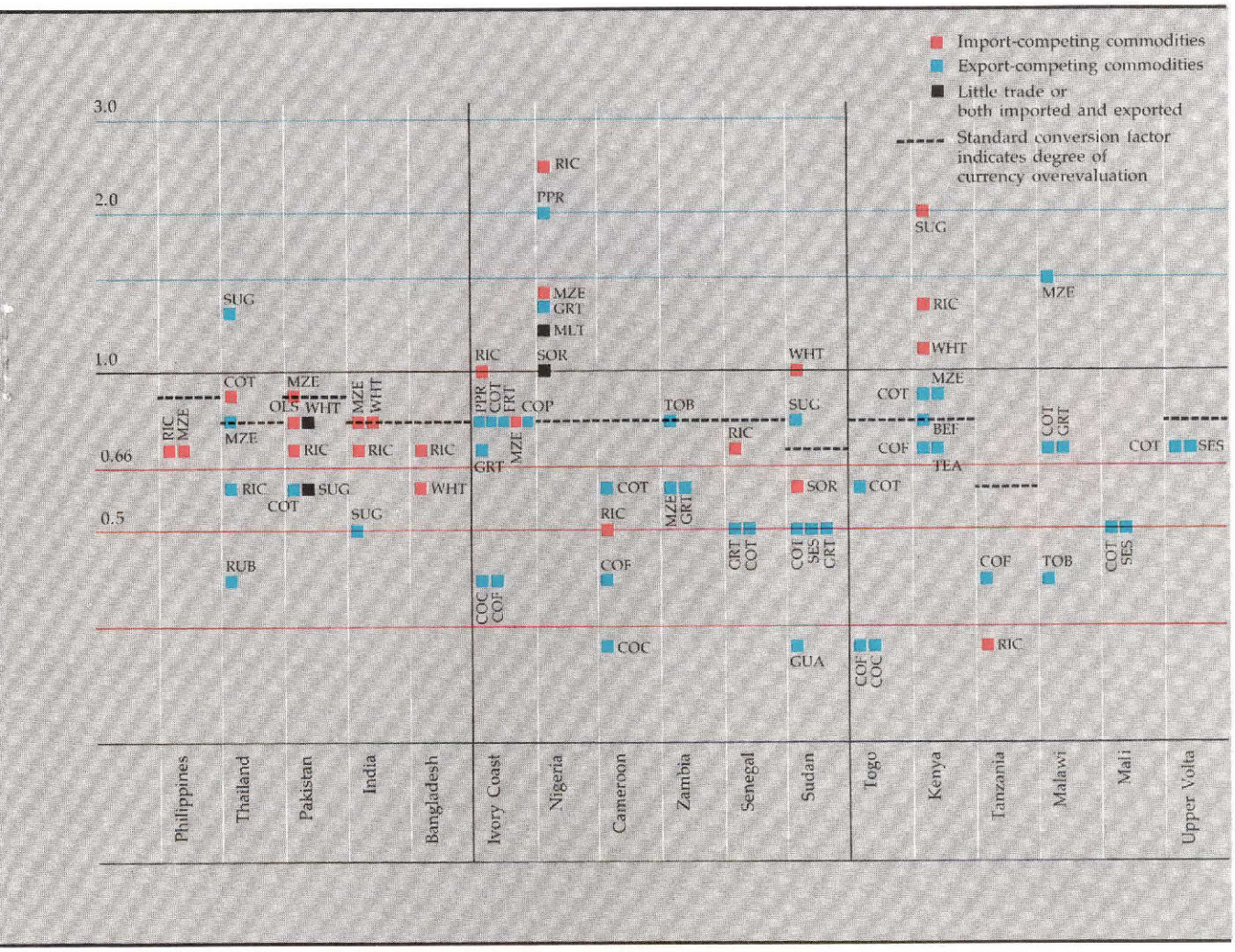
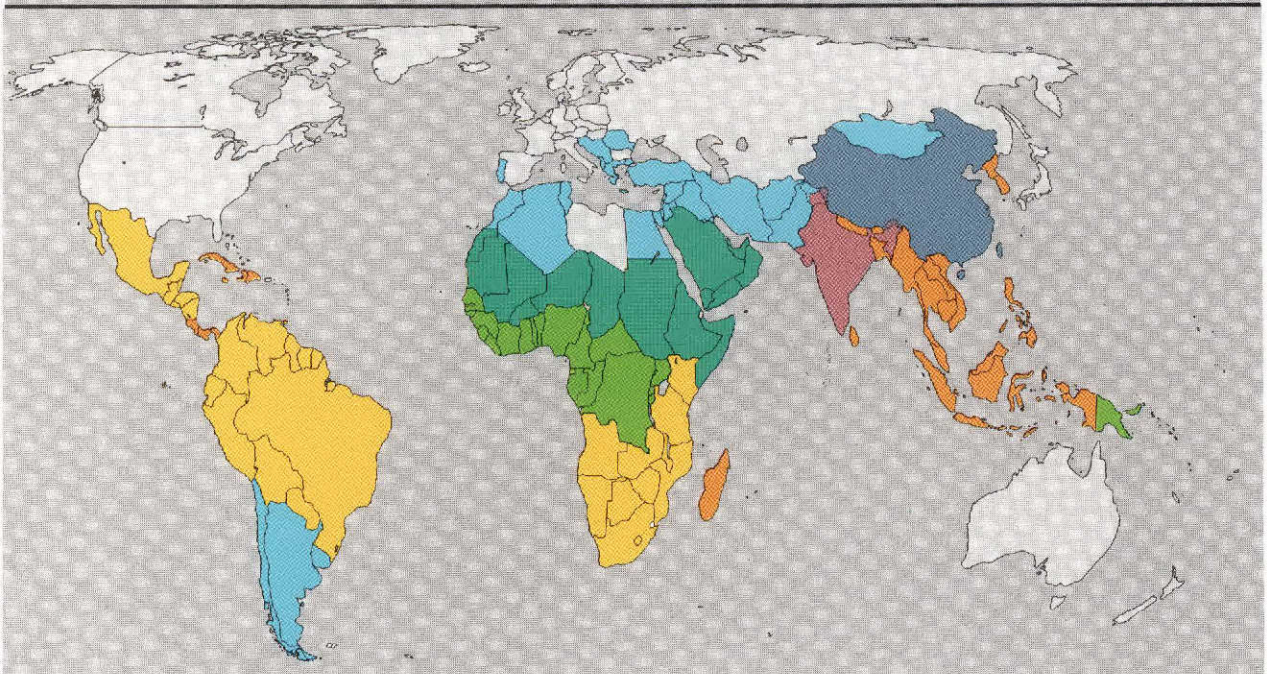

Import-competing commodities
Export-competing commodities
Little trade or both imported and exported
Standard conversion factor indicates degree of currency overevaluation
3.0
2.0
1.0
0.66
0.5
Philippines
Thailand
Pakistan
India
Bangladesh
Ivory Coast
Nigeria
Cameroon
Zambia
Senegal
Sudan
Togo
Kenya
Tanzania
Malawi
Mali
Upper Volta
RIC MZE
SUG COT MZE RUB
OES WHT MZE RIC COT SUG
MZE WHT RIC SUG
RIC WHT
PPR COT FRT MZE GRT COC COF
RIC PPR MZE GRT MLT SOR COP
COT RIC COF COC
MZE GRT TOB
RIC CRT COT
WHT SUG SOR COT SES CRT GUA
COT MZE COF BEF TEA COF COC
SUG RIC WHT
MZE COT GRT
COF TOB RIC
MZE COT GRT
COT SES

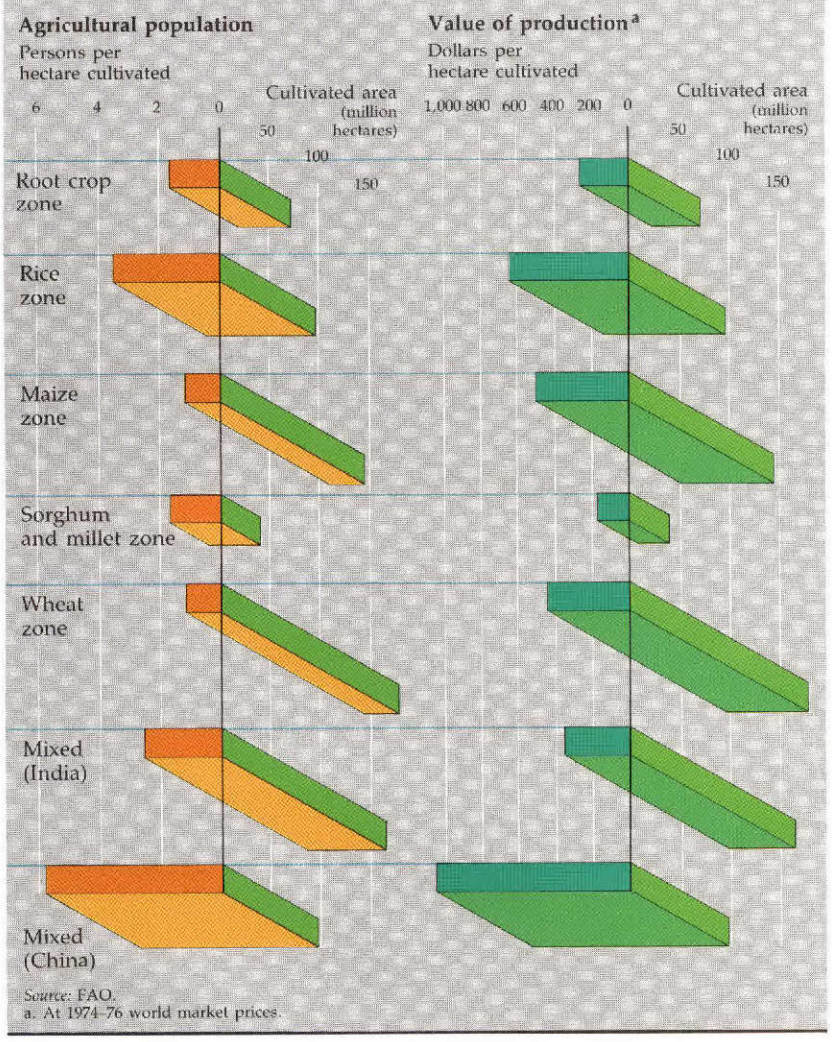
Figure 6.1 Major crop zones in developing countries



Key Crop zone	Predominant agroclimatic condition	Total population (millions)	Agricultural population persons/ha.	Agricultural population density kg/ha.	Average yield of primary cereals	Arable land reserves
Root crop zone	Humid tropical	193	120	1.6	753	Abundant
Rice zone	Humid tropical and humid temperate	574	358	3.5	2047	Moderately abundant
Maize zone	Subhumid tropical	353	161	1.1	1445	Abundant
Sorghum and millet zone	Semi arid tropical	86	70	1.6	666	Moderately abundant
Wheat zone	Temperate/mediterranean	395	182	1.0	1845	Scarce
Mixed (India)	Warm temperate and arid to humid tropical	673	439	2.5	1307	Very scarce
Mixed (China)	Cold temperate to subhumid tropical	977	572	5.8	2696	Very scarce

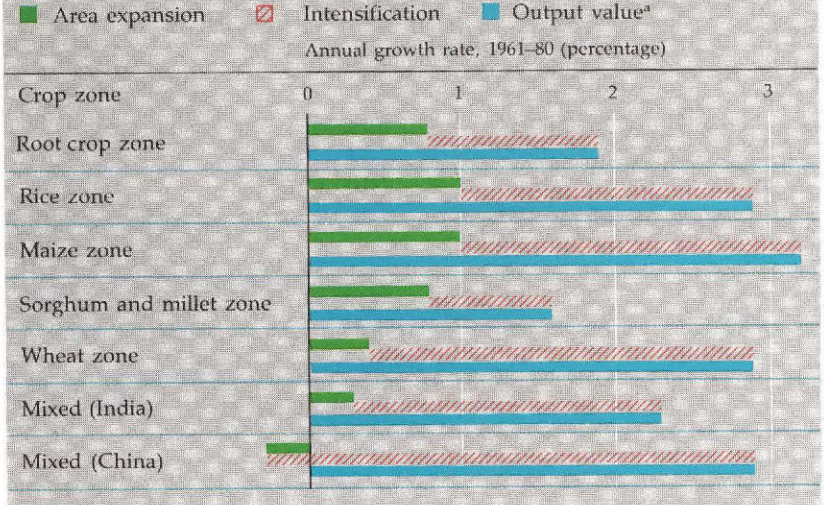
Sources: IFPRI; FAO.

Figure 6.2 Features of major crop zones, 1978



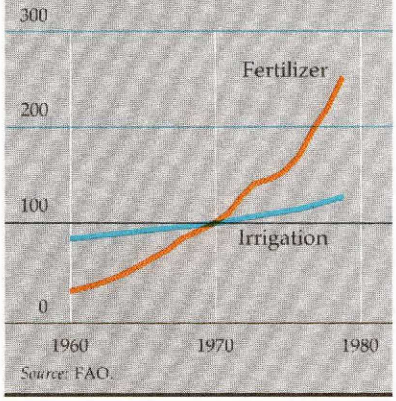
Source: FAO.
a. At 1974–76 world market prices.

Figure 6.3 Area expansion and intensification, by crop zone



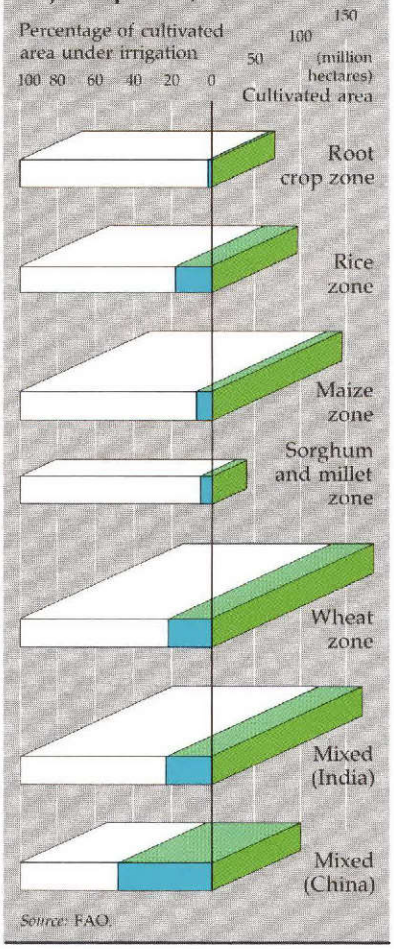
Source: FAO.
a. Constant 1974–76 world market prices.

Figure 6.4 Agricultural inputs in developing countries, 1960–79



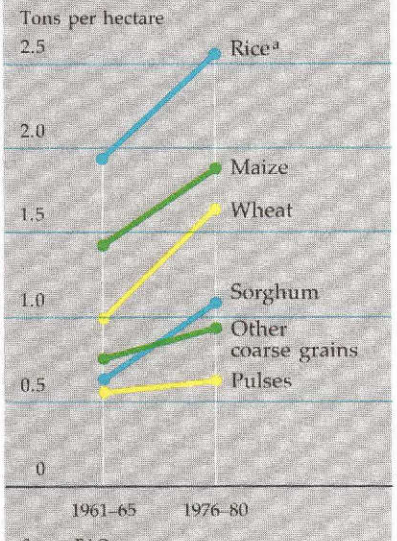
Source: FAO.

Figure 6.5 Irrigation in major crop zones, 1978



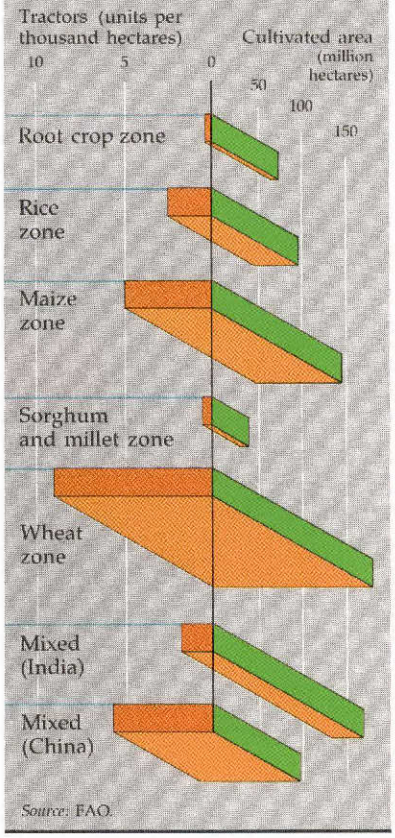
Source: FAO.

Figure 6.6 Foodgrain yields in developing countries, 1961–65 and 1976–80



Source: FAO
a. Paddy (unhulled rice).

Figure 6.8 Tractors in major crop zones, 1978



Source: FAO.

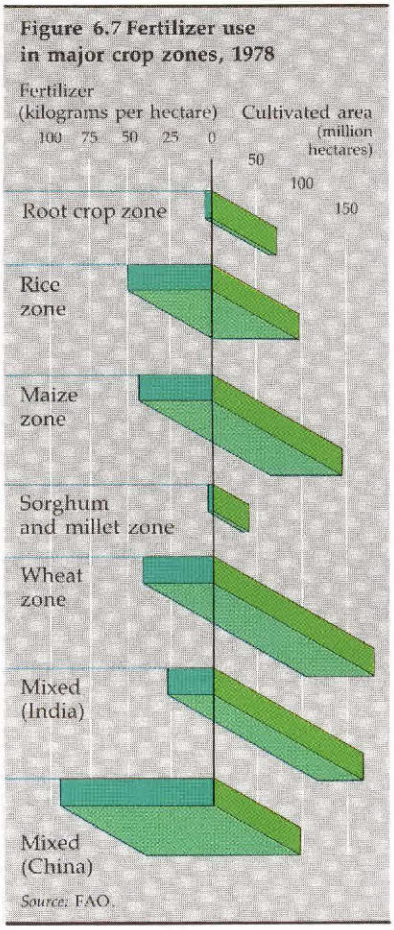
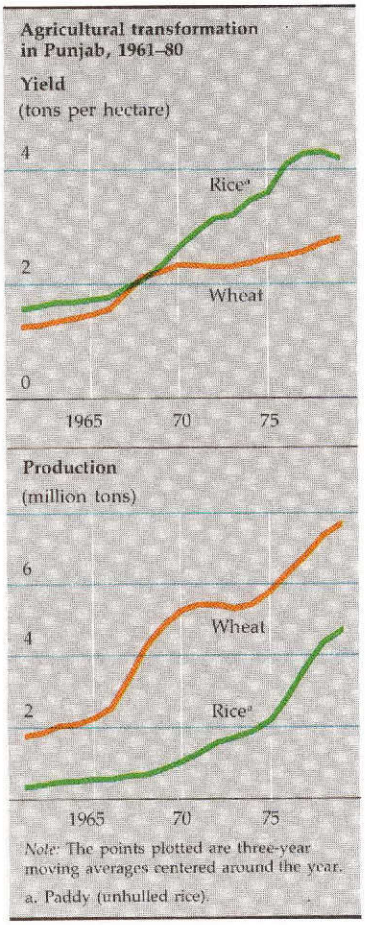


Figure 6.7 Fertilizer use in major crop zones, 1978
Fertilizer (kilograms per hectare)
100 75 50 25 0
Cultivated area (million hectares)
50 100 150
Root crop zone
Rice zone
Maize zone
Sorghum and millet zone
Wheat zone
Mixed (India)
Mixed (China)
Source: FAO.


Agricultural transformation in Punjab, 1961–80
Yield
(tons per hectare)
4
2
0
Rice[a]
Wheat
1965 70 75
Production
(million tons)
6
4
2
Wheat
Rice[a]
1965 70 75
Note: The points plotted are three-year moving averages centered around the year.
a. Paddy (unhulled rice).

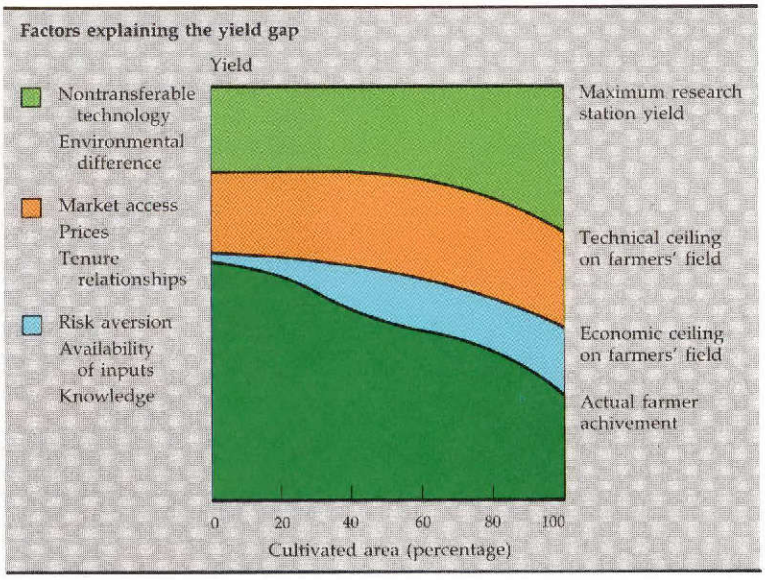
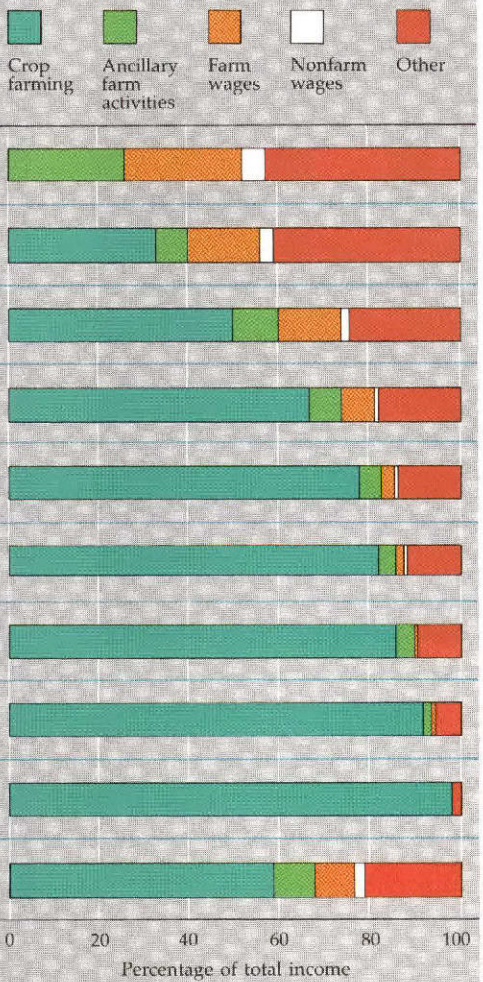

Factors explaining the yield gap
Yield
Nontransferable technology
Environmental difference
Market access
Prices
Tenure relationships
Risk aversion
Availability of inputs
Knowledge
Maximum research station yield
Technical ceiling on farmers' field
Economic ceiling on farmers' field
Actual farmer achivement
0 20 40 60 80 100
Cultivated area (percentage)

Figure 7.1 Indian rural household income, by source and by farm size, 1970–71

Cultivated area (hectares)	Percentage of all households	Income per person (rupees)
0	28	540
0–0.4	9	540
0.4–1	10	460
1–2	15	570
2–3	9	670
3–4	8	820
4–6	8	910
6–10	8	1,040
10+	4	1,410
Average		680



Source: National Council of Applied Economic Research.

Mexican wheat: variety and area, producer price, production cost

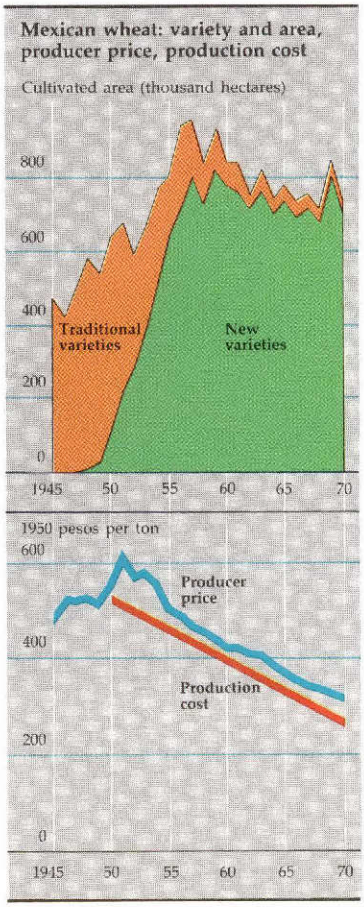
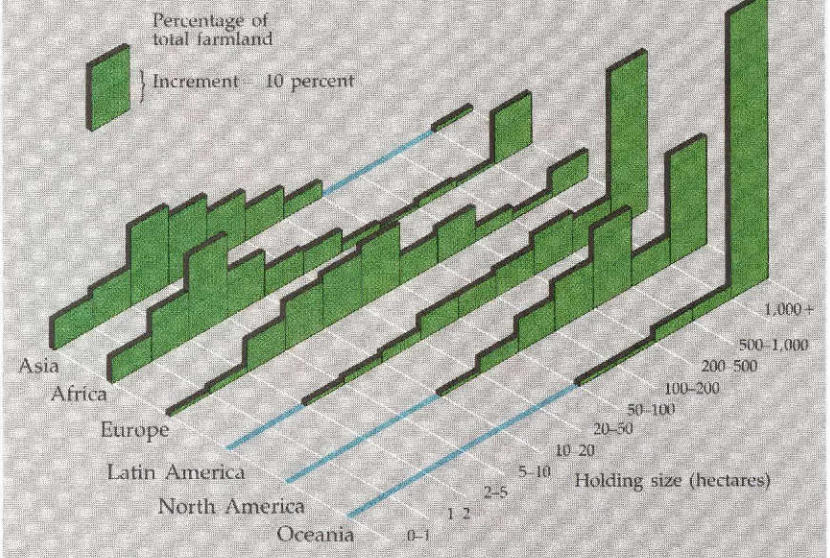
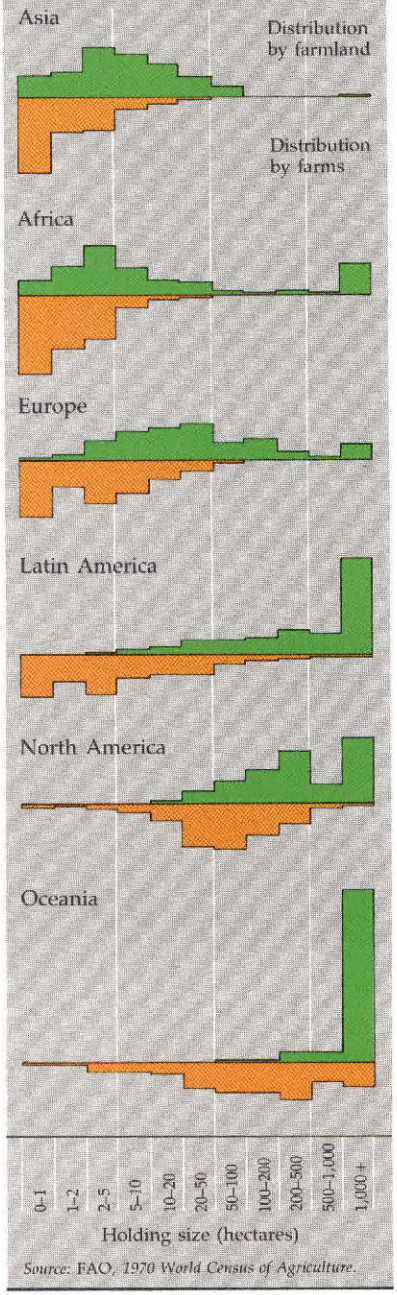


Figure 7.2 Farmland distribution, by farm size selected countries, 1970



Source: FAO, *1970 World Census of Agriculture.*

Figure 7.3 Farms vs farmland: comparative distribution, by region and by farm size, selected countries, 1970



Source: FAO, *1970 World Census of Agriculture.*

World Development Report, 1979

Background Paper

The Managerial and Entrepreneurial Cadres and their Role in Industrialization in LCDs

Prepared by

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Consultant
WDR Core Group

THE MANAGERIAL AND ENTREPRENEURIAL CADRES AND THEIR ROLE IN INDUSTRIALIZATION IN LCDs

Summary

The policy implications of the foregoing report for the Less Economically Developed Nations are clear.

(1) The LDC should determine what sort of entrepreneurial or managerial gap it has.

(a) By seeing if there are difficulties in generating new projects and why.

(b) By seeing if consultants can measurably increase productivity, by seeing how much excess capital capacity it has, and by comparing its actual production from its productive plant with the ideal.

(c) By seeing if small scale enterprises find it easy to expand.

(d) By surveying the social origins of entrepreneurs and managers and deciding if their distribution is acceptable.

(2) The LDC should decide what sort of management or entrepreneurship it wants -- to what extent it is interested in a market system and individualism, in small and large scale industry, and so forth.

(a) If it is concerned with productivity it should:

Train managers and potential managers in proven management systems in marketing, finance, and labor relations as well as production management.

Develop new management systems by experiment and coordination with a program to

Provide Consultancy to Laggard enterprises.

And it should adjust its other governmental policies -- pricing, trade, tariffs, manpower, incentives to provide an environment for maximum productivity.

(b) If it is concerned with a shortfall of entrepreneurs or their social origins it should provide a program to train, counsel, and finance entrepreneurs and help them over their marketing, production, and financial difficulties. This can be done by training -- mostly for the larger scale entrepreneurs - but is better handled by ongoing extension efforts for small scale enterpreneurs.

It is essential in each case that the effort be designed to address the specific shortcomings of the entrepreneurial group that is to be addressed. It is equally essential that the extenders have incentives -- possibly financial ones -- to make their clients succeed. There now exists a considerable body of experience on the appropriate content for extension to entrepreneurs -- simple bookkeeping, costing and planning. There exists much less in experience about the appropriate ways to motivate extension workers.

The McClelland type of "n-achievement" training with small scale entrepreneurs has shown enough promise so that further experimentation with it is desirable.

(3) In all cases we need a more careful monitoring to tell us what program inputs increase productivity and entrepreneurial success. On the productivity side, we need systematic, independent evaluations of consultancy programs showing their contributions to productivity. We need post-evaluation of training showing the subjective and objective effects on management performance. We need manpower projections showing the need for trained manpower. We need to compare cohorts of firms using different management systems to determine their relative effectiveness — specifically to determine the appropriateness of modern management techniques. We need to develop a science of comparative management -- that will enable us to compare and assess management performance.

For more and better entrepreneurship, we need specific country by country studies specifying the specific obstacles to different sorts of entrepreneurship and proposing plans to generate those sorts of entrepreneurship.

I. DEFINITION OF THE PROBLEM

MANAGERS AND ENTREPRENEURS WHO ARE THEY?

The role of managerial and entrepreneurial cadres in industrial development is a catalytic one. They combine available capital, technology and labor forces to meet existing and potential demands. Entrepreneurs make new combinations of factors of production to meet consumer needs; managers oversee and marginally adjust ongoing combinations of factors. Though each role requires the other they are conceptually separate -- and often performed by separate cadres. The entrepreneurial and managerial roles have to be performed both in public and private sectors and the difference lies solely in the parameters to which public and private sector managers and entrepreneurs may have to respond. The performance of these functions in the public sector is of particular importance in the LDCs where according to one recent estimate 20% of manufacturing production and 39% of Gross Capital Formation may be in the public sector. 1/

The difference between the entrepreneurial and managerial role is based on their place in the idealized history of the enterprise. The entrepreneur perceives a need or opportunity that is not being exploited and which a new enterprise or a new combination of productive factors could meet. This new enterprise is an innovation, albeit not one of the cosmic variety. In secondary, follower industrializers - like the LDCs - one expects the prime task of the entrepreneur not to be technological innovation per se, but the creative adaptation of technological innovations from the primary industrializers - the DCs - to local market and resource conditions. As Peter Marris says in his survey of Kenyan entrepreneurs --

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1/ Work in Progress, supervised by Mr. Pierre Biraben of IFC.

> In the African countryside, the innovation may not seem at the outset, very remarkable -- a wholesale business, a restaurant at a cross road, a bus service, a saw mill. But to achieve it, the owner must have seen what others had missed -- an unsatisfied demand, a way of raising money, a source of skilled labor -- and put them together. 1/

The level of innovation in LDCs is not as high as that which Schumpeter posits in his visions of the entrepreneur as the activator of technological improvements. 2/ Nonetheless, it is of the substance of economic development. It creates new enterprises where none were found before.

Entrepreneurs are a catalyst. Their effectiveness is dependent on the quality of materials with which they work. In the absence of effective demand, sufficient capital, appropriate technology, and suitably trained labor forces the absence of managers or entrepreneurs is not the effective block to development.

Thus the lack of industrial development in the pre-1945 period in much of the then colonial world needs to be attributed more to the operations of government policy which did not permit industrial development than to any absence of entrepreneurial drive on the part of colonial subjects -- in fact in areas like Korea, India and Pakistan waves of entrepreneurship followed immediately on the end of colonialism. A. K. Bagchi records in some detail how refusal by the British Indian government and railways to order supplies in India foreclosed the development of the engineering industry there. 3/

1/ P. Marris, The Social Barriers to Entrepreneurship. Mimeo Series No. 22 Inst. of Development Studies, University of Sussex, Stanmer, Brighton, Sussex, p.8.

2/ J. Schumpeter, The Theory of Economic Development. Harvard University Press, Cambridge, Massachusetts, 1949.

3/ A. K. Bagchi, Private Investment in India. Cambridge University Press, Cambridge, England, 1972.

Today, too, private entrepreneurship is constrained to a considerable extent by anti-private sector government policies in a range of LDCs. Similarly, lack of access to capital, technology, markets and labor may foreclose new enterprises, even in the presence of sufficient entrepreneurial and managerial cadre.

DO WE NEED MANAGERS?

Nonetheless, sometimes deficiencies in the quality of entrepreneurial and managerial cadres by themselves are a critical limitation to industrialization. To cite last year's WDR --

> The types of difficulties in raising development levels differ among individual low income countries, but they essentially reflect the shortage of entrepreneurial and managerial talent and the difficulties of increasing savings at low levels of income. In some countries which are still at an early stage of development, especially those in Sub Saharan Africa, there have been serious difficulties in identifying profitable investment opportunities. Efficient investment requires a dynamic entrepreneurial class and public institutions sufficiently well manned and established to identify and implement a broad range of productive projects. Many countries are meeting these conditions only gradually: indeed the creation of an entrepreneurial class and of appropriate public institutions was precisely their first task of development. (WDR 1978, p.6).

Development writers have characterized entrepreneurial and managerial deficiencies as the key block to development in certain countries -- such as the Sub-Saharan ones mentioned in the WDR. J.K. Galbraith, in fact develops one model for an LDC -- the "Sub-Saharan" defined by its shortage of effective government institutions, and managerial and entrepreneurial cadres. This shortage is made manifest in the inability to generate and promote new projects, in the dependence on expatriate managers and entrepreneurs, as well as in a low level of productivity. The problem is not limited, however, to Sub-Saharan

Africa. A. J. Meyers has a seminal article entitled, "Entrepreneurship: the Missing Link in the Arab States," and Albert Hirschman basing himself largely on his Latin American experience bemoans the "insufficient number and speed of development decisions" i.e. entrepreneurial and managerial decisions.

ENTREPRENEURSHIP IN ECONOMIC LITERATURE

To produce entrepreneurs one must see what differentiates entrepreneurs and is responsible for their success; and how that difference can be simulated where it is lacking. Precisely what it is that differentiates successful entrepreneurs from their fellow citizens is the crux of one of the oldest and longest debates in the literature studying entrepreneurship. It seems clear that certain ethnic and occupational groups, certain religious persuasions and social strata produce far more than their fair share of entrepreneurs. The question that we must decide is whether the greater propensity toward entrepreneurship is an incidental result of their social situation, or stems from some intellectual predisposition arising out of their traditions.

Often these successful entrepreneurial groups turn out to be foreigners or migrants from distant parts of the country -- Indians and Chinese in Southeast Asia, Indians and Arabs in Africa, North Indians in Eastern India, and so forth. But sometimes they are sectarians -- dissenters from religious orthodoxy. In either case, there are four standard explanations for their success.

I. -- These successful entrepreneurs may be such because they are "Pariah entrepreneurs", not fully enfranchised in their host societies, barred other avenues of advancement. They may choose entrepreneurship as

the most open path to social mobility. As Max Weber formulates it, "Pariahs" are a "distinctive hereditary social group, having distinctiveness in economic function," but "disprivileged." 1/ The classic case of the pariah entrepreneur in Weber's system was the Jews, especially in the European Middle Ages — but the explanation was soon used to explain the role of migrants to Southeast Asia and Africa, as well as in Weber's own case to partially explain the success of the trading castes in India. 2/ Richard Fox in an article on one such trading caste in Eastern India writes:

> Throughout much of the world, social, religious, or ethnic distinctions often separate the merchant community from the surrounding society. In predominantly pre-industrial economies, the taking of profit is considered socially illegal. Profit signifies the introduction of economic rationality into a system which is based on the rationale of kinship and family. Whatever group undertakes business and the making of profit also accepts social ostracism and develops over time social traits which allow it to withstand the slings and arrows of its non-commercial neighbors and victims, as well as traits which maximize the production of profit which is so socially disreputable. 3/

II. -- There is a thesis that the religious beliefs of the entrepreneurial groups may lead them to have a more rational world view than their neighbors -- and, in fact, volumes have been filled on the relative appropriateness of Calvinism and Catholicism (Weber, Tawney, Sombart, Samuelsson), Old Belief and Orthodoxy (Gerschenkron), Shinto and Confucianism (Bellah), Hinduism, Jainism, Buddhism, Vaishnavism, Confucianism, Judaism and Islam (Weber and Geertz) and Zoroastrianism (Kennedy) to entrepreneurial roles. 4/

1. Max Weber, The Sociology of Religion (Boston, 1962), pp. 108-109; Max Weber, The Religion of India translated by Hans Gerth and Don Martindale (N.Y., 1958), pp. 13-14, 86, 91, 112; Max Weber, Ancient Judaism translated and edited by Hans H. Gerth and Don Martindale, Free Press (Glencoe, Ill., 1952).

2. Weber, op. cit.

3. Richard Fox, "Family, Caste, and Commerce in a North Indian Market Town," Economic Development and Cultural Change XV (April, 1967), pp. 313-314.

4. Weber, The Protestant Ethic and the Spirit of Capitalism translated by Talcott Parsons, G. Allen and Unwin Ltd., London, 1930; R. H. Tawney, Religion and the Rise of Capitalism (N.Y., 1926): Kurt Samuelsson, translated by E. Geoffrey French, Religion and Economic Action: A Critique of Max Weber (N.Y. 1961); S.N. Eisenstaedt ed., The Protestant Ethic and Modernization: A Comparative View, (N.Y., 1958): Herbert Luethy, "Once Again; Capitalism and Calvinism," Encounter XXII (January (1964), pp. 26-83; Alexander Gerschenkron, Europe in the Russian Mirror (Cambridge, Mass., 1970), pp. 1-47; Robert Bellah, Tokugawa Religion, The Free Press, N.Y., 1957; Weber -- Ancient Judaism, The Religion of India, The Religion of China translated by Hans Gerth, Free Press, Glenco, Ill., 1951; Robert Kennedy, "The Protestant Ethic and the Parsees," American Journal of Sociology LXVIII (July 1960), pp. 11-20.

The most serious problem with all these approaches as Milton Singer in his classic "Text and Context" article puts it is that they assume that sacred texts can be assumed to represent the actual day to day values of communicants of the great religions -- an assumption that a comparison of the statements of the Sermon on the Mount with daily behavior on Wall Street or Capital Hill will certainly falsify. 1/ While these above listed and several other sets of beliefs were indeed held by successful entrepreneurial groups there are two counter hypotheses that seem equally well or better to account for these groups differential success. First, as Gerschenkron asserts of his Old Believers and Weber of his Vaishnavites -- their systems of deviant belief to some extent constituted their members a group apart (if not "pariahs") and provided a "free-mason" like network of associates on whom they could draw. 2/ In fact it was this characteristic that made these sects -- like their secular equivalent Rotary and Masonic lodges today -- attractive to businessmen. According to Gerschenkron, the Old Believers (dissenters from Russian Orthodoxy on some arcane theological and ritual points, most notably whether one should cross oneself with three or two fingers), were successful by "utilizing their connections with other Old Believers' communities in the Southern part of the country." Weber reports that Indian traders found the hedonistic Vaishnavite cults with their networks of associations and members, particularly convenient.

> "...the plutocracy -- the richest hinduistic trader castes, above all the Baniya -- was able in such terms to find a taste for the service of God. An extraordinarily large number of them belonged to this somewhat socially exclusive sect." 3/

1/ "Text and Context in the Study of Contemporary Hinduism," Adyar Library Bulletin XXV (1961), pp. 274-303 and When a Great Tradition Modernizes: An Anthropological Approach to Indian Civilization (N.Y., 1972).

2/ See Religion of India, p. 215.

3/ Weber, Religion of India, p. 315.

The supposedly "pariah" migrant communities, often relied as well on their "free-masonry" and their wide flung trading networks. The first Jewish migrants from Baghdad eastward, the Armenians, the Indians going to East Africa and to Burma, the North Indian Marwaris in Calcutta in Eastern India all based themselves firmly on lines of credit and trade reaching into their homelands.

Second, a whole group of commentators follows Tawney and Sombart to demonstrate that entrepreneurial attitudes dominate these successful entrepreneurial groups because they were constituted by people who were already entrepreneurs. 1/ In fact, they demonstrate that the original tenets of Jainism and Old Belief, Calvinism and Rabbinic Judaism are just as anti-rational and anti-commercial as Hinduism and Russian Orthodoxy and Roman Catholicism.

To the extent that differences in attitudes in fact produce entrepreneurship it is possible to seek to inculcate the appropriate attitudes — and one of the most ambitious contemporary schools of entrepreneurial development -- "N-achievement motivation" and its promoters — try to inculcate what they feel are the appropriate attitudes. We shall see, further on, both that the results are still inconclusive and promising enough to justify further use and experimentation.

III. — Everett Hagen of MIT suggests a particular syndrome, involving the loss of high status and a desire to regain it leading people to play entrepreneurial roles. 2/ Here the proposition is, as Alexander

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1/ See Tawney, op. cit.

2/ E.E. Hagen, A Theory of Social Change, Homewood, Illinois, 1962. A. Gersechenkron, "The Modernization of Entrepreneurship," in ed. Myron Weiner, Modernization (N.Y., 1966), pp. 246-257.

Gerschenkron demonstrated, neither testable nor of relevance to the policy maker who can hardly be expected to simulate this particular syndrome, any more than he can purposefully make of some people pariahs, the better to play entrepreneurial roles.

IV. -- Fourth, it is suggested that certain roles, as traders and administrators in earlier periods prepare people well to perform entrepreneurial, and especially industrial entrepreneurial roles -- and it is the policy relevance of this explanation which we must treat next.

INDUSTRIAL ENTREPRENEURSHIP AND DEVELOPMENT

In addition to general problems with entrepreneurship and management there are specific problems of industrial entrepreneurship and management which may constitute a block to industrial development, even where commercial entrepreneurship is highly developed. The industrial entrepreneur and manager must have longer time horizons, and must manage more complex technology, and larger fixed plant, than the commercial entrepreneur. For example, a certain amount of speculative activity is not inconsistent with industrial management -- but a speculator's orientation, toward quick profits, and not toward continuity of operations, has ruined a fair number of industrial enterprises in LDCs. Whether and to what extent those from speculative and commercial backgrounds can be effective industrial entrepreneurs is one of the most controversial points in the whole literature on entrepreneurship. For industrial development policy makers, the question at issue in this controversy is whether they should adjust their selection of entrepreneurs and managers, or differentiate their training and assistance to take account of

the differential effects of different occupational backgrounds -- as traders, artisans or whatever.

In almost every LDC, former traders who already have access to capital and markets do enter industry in larger numbers. But Max Weber and Clifford Geertz in their studies of Indian and Indonesian societies respectively argue that traditional trading groups make poor industrial entrepreneurs. 1/ The same point is made in a number of studies of ongoing industrial concerns, i.e., that traders' orientations cause them to be sub-optimal managers of industrial concerns. 2/ On the other hand, a welter of recent entrepreneurial studies makes precisely the reverse point to Weber and Geertz. 3/ The crucial entrepreneurial roles in LDC's according to these studies are commercial rather than technological so that traders typically lead the march into industry. Empirically, successful industrial entrepreneurs in the LDCs have come from a variety of backgrounds -- as skilled craftsmen,

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1/ Max Weber, The Religion of India. Free Press, N.Y., 1967 (pb.) Clifford Geertz, Princes and Peddlars. University of Chicago Press, Chicago, 1963.

2/ See most recently S. K. Sen, The House of Tata's, Progressive Publishers, Calcutta, 1975 and J. H. van der Veen, "Commercial Orientation of Industrial Entrepreneurs in India," EPW XI, August 28, 1976, Rev. of Mgt., pp. M-91-94.

3/ This writer's book on the Marwaris (Vikas, New Delhi, 1978) is one such study, as is G. Papanek's work on Pakistan and A. Alexander's on Greece. G. Papanek, "Industrial Entrepreneurs -- Education, Occupational Background and Finance," in ed. G. Papanek and W. Falcon, Development Policy: The Pakistan Experience. Harvard University Press, Cambridge, Mass., 1971 and Alec Alexander, Greek Industrialists: An Economic and Social Analysis. Center for Planning and Economic Research, Athens, 1964. The same point is made from a Soviet Marxist point of view in a series of studies based on the work of Shirokov and Reisner, Sovremennaya Indiiskaya Burshuaziya, Moscow, 1966.

as peasants, as noblemen, as civil servants and professionals, as well as traders. 1/

Whatever the case, the different sorts of entrepreneurs have to overcome different sorts of obstacles. The problems are nicely outlined in the appraisal report for a Small and Medium Scale Enterprise Project in Cameroon to be funded by the IBRD (Report 718a-CM). The report addresses three common categories of entrepreneurs -- artisans, merchants, and technicians (better, educated professionals).

For craftsmen -- the overwhelming number of small entrepreneurs in most developing countries - "Their main problem is in their enterprise that often implies some transformation of their methods... They need basic training in management." They may need some short term capital -- but their equipment needs are limited -- and thus they need hardly any fixed capital. 2/

> "The experience of the Indigenous Business Advisory Service [in Gambia] and the pilot project team [In Senegal] suggests that new investments may be part of the solution but usually not as the first step in a program of assistance. Rather

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1/ For studies of craftsmen entrepreneurs, see Kenneth King, The African Artisan: Education and the Informal Sector in Kenya, Teachers' College Press, N.Y., 1978 and Shanti Tangri's unpublished work on the bicycle manufacturers of Ludhiana in India, or Ray Owen's and Ashish Nandy's work on machine shop owners in Calcutta. Liedholm and Chuta's study of small scale industries in Sierra Leone is largely concerned with these artisan entrepreneurs as well. The only studies of gentry entrepreneurship I am familiar with are set in European or Chinese context, but these entrepreneurs certainly exist as well in India and Pakistan. Civil servant and professional entrepreneurship has particularly emerged in the era of institutionalized credit and government assistance to small scale industry -- the social as well as the technical skills of these educated professionals turn out to be of particular use in business. C. Liedholm and E. Chuta, The Economics of Rural and Urban Small Scale Industries in Sierra Leone, African Rural Economy Paper No. 14, Dept of Agricultural Economics, Michigan State University, East Lansing, Michigan, 1976.

2/ Cameroon Rept. Cited.

> what is needed at the initial stage is a better system of reorganization and bookeeping a more efficient utilization of existing inputs, and a realistic assessment of market potential and channels of commercialization." 1/

The limitations of these artisan entrepreneurs makes them unable to make the leap to larger scale enterprise and that expansion of their operation which is essential to increasing overall production.

More advanced artisans who have several employees and want to move into the medium sized sector

> "face formidable problems of organization, financial and personnel management, adoption of appropriate technology and acquisition of both short and long term capital. Past experience shows that because of the complexities involved only a rather limited number of Cameroonian entrepreneurs have succeeded in making the transition to medium sized enterprise."

The successful merchant, now industrialist, faces two problems. First, he has to adjust to the increasing competition to which the modern economy subjects him. Then, he has to adjust to the peculiar demands of industry. "These [merchants] enterprises can utilize relatively large amounts of technical assistance for production, procurement and elementary bookkeeping."

Finally, educated professionals are typically better able to conduct liaison with the government and the outside world than artisans and traders -- but may need assistance both on the technical and commercial side of their enterprise.

1/ Susanna Badgley, "Assistance for Artisans in Senegal: An Evaluation of the Present Approach and Some Building Concepts for the Development of a More Efficient Program Design". Unpublished draft for Industrial Development and Finance Division, West Africa Projects Department, IBRD, September 5, 1978.

Different approaches are clearly called for in each case. For the artisans -- assistance in meeting the needs of transition must come in the way of access to finance, markets, and raw materials -- as well as machinery suitable to their own technical sophistication and the environment in which they will work. Very basic business management techniques can be taught by a foot army of business consultants -- as is now being done in parts of Africa and Latin America.

Examples pour from the pages of the Partnership for Productivity manuals. A small shopkeeper or workshop owner, may use a pro forma they provide to reduce his inventories to the level appropriate to his level of business and save capital. A simple profit and loss statement permits the shopkeeper to isolate unprofitable lines of business and drop them.

This is the approach of the Partnership for Productivity in Africa projects, of the IBRD funded SSE project in Upper Volta, as well as UNO in North Eastern Brazil and other Latin American efforts based on its prototype.

INDICATORS OF ENTREPRENEURIAL AND MANAGERIAL GAPS

In the section that follows I will rapidly review some quantitative indicators that entrepreneurial and managerial deficiencies are present, in certain LDCs and in fact limit industrial development. It must be recognized that these quantitative indicators may be poor indicators even if accurately recorded - and they are often not accurately recorded. Nonetheless, they give some indications of the presence of difficulty.

Lack of bankable investment proposals may show entrepreneurial failure (as is implied in last year's WDR) -- or an economy where investment

opportunities are otherwise limited. The difficulties small scale enterprises face in expansion may be due to external economic as well as internal entrepreneurial and managerial failings. Productivity gaps revealed by consultants may be misreported. Managerial manpower surveys may be inaccurate. In all cases, one has limited comparative data to show how much worse off LDCs are in management and entrepreneurship than DCs. In any case, it is worth seeing what quantitative indicators can tell us.

The absence of entrepreneurial cadres is especially noted in those countries where capital is available with the banks of other lending institutions -- but sufficient bankable propositions are not forthcoming.

Sayre Schatz reports that eighty six percent of the funds requested from the Nigerian Federal Loans Board were for projects that the Board found non-viable. 1/ Lest one think that the high percentage of projects refused were the result of excessively high funding standards, Schatz reports that only 38% of the projects that were funded were eventually successful. Schatz notes a cigar manufacturer who wanted to produce more cigars in a day than he had hitherto sold in a year and had no idea how he would market them; an "inventor" of a plant to dry fish and process rubber; a tailor "who proposed a fanciful project for setting up simultaneous operations for fish-canning, bolt and nut manufacturing, glass making, and ink manufacturing..."; someone who withdrew his application when he found out what interest and amortization would

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1/ Sayre Schatz, Nigerian Capitalism (University of California Press, Berkeley, California, 1977) and Development Bank Lending in Nigeria: The Federal Loans Board (Nigerian Institute of Social and Economic Research, Oxford University Press, Ibadan, 1964).

amount to and so forth. These figures of Schatz, I should point out, refer to Nigeria, which has one of the most sophisticated entrepreneurial groups in Africa -- in 1960 there were already 1.25 million enterprises (1977 population 77 million) -- of a whole range of sizes and complexity. To quote Schatz:

> The lack of commercially viable projects turns out to be the fundamental problem in country after country in Africa which has tried to promote development by providing capital to indigenous businessmen.

Schatz cites a rather impressive list of studies covering Ghana, Uganda, the Sudan, Sierra Leone, Rhodesia and Ethiopia as well as Alfred Hirschman's comments on the Bank of North Eastern Brazil in his Journeys Toward Progress to demonstrate the widespread nature of entrepreneurship deficiencies as a block to development.

Schatz admits that this lack of project proposals is due both to the deficiencies in entrepreneurship and to defects in the economy which objectively limit the number of investment opportunities. The problem on the entrepreneurial level as Schatz sees it is the leap involved from the kind of small scale artisan and trading enterprises that exist, to larger more modern activities -- a leap that requires extending the technological, organizational and marketing skills and horizons of the entrepreneurs as the Cameroons Appraisal Report noted. The key uncompleted entrepreneurial task according to Schatz is the transformation of small informal artisan enterprises into large scale more modern ones. The degree to which this transformation does not occur is a measure of the failure of entrepreneurship in the informal small scale sector, just as the lack of bankable projects measures or shows the entrepreneurial failure in the organized small and medium scale industrial sector.

Schatz noted, "...The limited opportunities for Nigerians to acquire business experience...the limited opportunities for most would be entrepreneurs to participate in the modern society that provides the social as well as the economic setting for business of any size," ...limited the ability of Nigerian entrepreneurs to make the leap to larger scale enterprise. As Peter Marris notes elsewhere, the African businessman

> have to succeed in an economy which is continuous from the peasant farmers to Covent Garden, from textile mills in India through the wholesaler in Mombasa to the tailor in a country market, where they bank their money in the branches of European companies, and compete with products manufactured a hundred or a thousand miles away. But they are socially isolated from the wider economy by profound mutual ignorance. (Peter Marris, The Social Barriers to African Entrepreneurship. p. 11)

IBRD country and project reports are dotted with references to the lack of entrepreneurship and resulting problems with bankable projects as a constraint on development. A recent report on Bangladesh notes, after allowing for the disincentive effects of uncertainty by entrepreneurs about future government policy --

> "Bangladesh entrepreneurs are also still unfamiliar with the techniques of preparing projects for appraisal and bank financing -- which necessitates a strengthening of institutions and advisory services which assist private investment." (Report 1931-BD, Bangladesh - Current Economic Trends Vol. I, p. 14.)

In Tunisia, we find reference (pp. 42-43) to the problem of insufficient project identification capacity. In Portugal, in the public sector, more than 60% of parastatal enterprises could not present projects -- did not have the capacity to generate and present projects for expansion.

While the deficiencies in the number of entrepreneurs in the organized sector can be readily seen in the deficiency of projects submitted

to funding institutions -- and the deficiencies in the unorganized informal sector in the difficulty units experience in making the transition to larger scale enterprise -- deficiencies in management are more difficult to measure.

Entrepreneurship is the making of new combinations of productive factors -- management the oversight of ongoing combinations. Management's effectiveness is measured by the extent to which it maximizes the total productivity, in some sense, of the resources its uses. Deficiencies in management, the management gap, are best noted in deviations from optimum productivity shown by each enterprise -- either in the short or long term. One indicator of these deviations are the reports of productivity consultants that show dramatic increase in production as a result of their suggestions, since in the ideal case managment would already have implemented all possible improvements consultants could suggest. Peter Kilby has, in fact, accumulated a group of the reports of ILO Productivity Missions which give us some idea of what the gap might be (see Table 1). In addition, he cites some other sources -- which indicate the size of the gap in specific countries -- the report of a group of UN experts who found Brazilian textile productivity half that possible, and an article by Swadesh Bose, in which he points to the high tariff subsidies provided and the large-scale idle capital capacity in Pakistan as an indicator of inefficient management there. 1/ The National Productivity Council in India, which does extensive consultancy, reports in 1976/77 that two of its programs alone saved the consulted enterprises over 10 million dollars a year. The problem with this data, as I noted earlier, is the extent

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1/ Peter Kilby, "Hunting the Heffalump," pp. 33-35 in ed. Peter Kilby, Entrepreneurship and Economic Development, Free Press, N.Y., 1971 refers to his, "Organization and Productivity in Backward Economies," Quarterly Journal of Economics (May 1962), and S. R. Bose, in the Pakistan Development Review (Summer 1968), p. 289.

TABLE 1-1
ILO Productivity Mission Results

Factory or Operation	Method[a]	Increase in Labor Productivity %	Impact on the Firm (Unit Cost Reduction) Labor Savings %	Capital Savings[b] %
India				
Seven textile mills	n.a.	5-to-250	5–71	5–71
Engineering firms				
All operations	F, B	102	60	60
One operation	F	385	79	79
All operations	F, B	117	64	64
All operations	F, B	34	26	26
All operations	F, B	44	31	31
One operation	F, B	21	17	17
One operation	F	44	31	31
One operation	F	120	55	55
One operation	F	116	54	54
One operation	F	500	83	83
Vehicle maintenance	A, F	161	62	62
Burma				
Molding railroad brake shoes	A, F, B	100	50	50
Smithy	A	40	29	29
Chair assembly	A, B	100	50	50
Almirah assembly	A, B	65	39	39
Biscuit wrapping	F	45	31	–
Cutting hosiery	F	40	28	–
Packing towels	A, F	20	17	–
Match manufacture	A, F	24	19	–
Indonesia				
Knitting	A, B	15	13	–
Radio assembly	A, F	40	29	29
Printing	A, F	30	23	–
Cement block	A, B	50	33	33
Enamel ware	F	30	23	–
Singapore				
Vegetable oils	A, E, D, F	63	38	–
Malaya				
Furniture	A, D	10	9	9
Engineering workshop	A, D	10	9	9
Pottery	A, B	20	17	17
Thailand				
Locomotive maintenance	A, F	44	31	31
Saucepan polishing	E, D	60	33	–
Saucepan assembly	B, F	42	30	–
Cigarettes	A, B	5	5	–

TABLE 1-1 (continued)

Factory or Operation	Method[a]	Increase in Labor Productivity %	Impact on the Firm (Unit Cost Reduction) Labor Savings %	Capital Savings[b] %
Pakistan				
Textile plants	C, H, G			
Weaving		50	33	33
Weaving		10	9	9
Spinning and weaving		30	23	23
Bleaching		58	37	37
Over-all operations		400	80	80
Spinning waste		36	26	26
Weaving		5	5	5
Weaving		141	59	59
Israel				
Locomotive repair	F, B, G	30	23	23
Diamond cutting and polishing	C, B, G	46	31	–
Refrigerator assembly	F, B, G	75	43	43
Wire insulation	n.a.	44	31	31
Wire insulation	n.a.	50	33	–
Cleaning clothes	n.a.	30	23	23
Ironing trousers	n.a.	50	33	33
Packing textiles	n.a.	40	29	–
Processing textiles	n.a.	140	58	–
Flush tank assembly	n.a.	100	50	–
Orange picking	F	91	47	–

[a] A – plant layout reorganized
B – machine utilization and flow
C – simple technical alterations
D – materials handling
E – waste control
F – work method
G – payment by results
H – worker training and supervision

[b] Limited to plant and equipment, excluding increased depreciation costs.

SECTION FIVE

Summarizing the foregoing review of available empirical evidence from underdeveloped countries, it was found that with a few exceptions entrepreneurial performance in those roles involving exchange relationships and "political administration" is vigorous and effective. On the other hand, entrepreneurs typically do not apply themselves with equal intensity or skill to their tasks in the realms of management control and technology. Deficiencies in these latter areas represent in many instances the operational bottleneck to indigenous industrial development.

This essay will have achieved its major goal if section IV has succeeded in establishing a reasonable case for the existence of differential entrepreneurial role performance. Hopefully, this will entice future investigators in developing

16a-1 Table I

to which the consultancy organizations and the consulted enterprises (who need to justify their participation in the exercise) may both tend to exaggerate their achievement. In addition, these consultancy efforts are almost all focussed on production management and say nothing about such critical management functions as finance, labor relations, marketing, procurement, and general management leadership.

An alternative approach is to rely on the collective judgement of observers and no rehearsal of that opinion is required to conclude that this judgement is usually that there is a large management gap in the LDCs. Barry Richman and Melvyn Copen, and Arun Gandhi and Benjamin Prasad, present detailed and extensive judgements in management specialty after management specialty -- demonstrating the superiority, in general, of Industrialized Country large-scale management to that in LDCs, and for that matter of Industrial Country based Multinational subsidiaries in LDCs to indigenously owned firms. 1/ Finally, and most dramatically, a management manpower shortage is indicated when managerial manpower surveys report that a large number of senior management positions are occupied either by expatriates or unqualified nationals. I will cover some of this manpower data when I look at the situation in different geographic areas in Part II of this survey.

1/ Barry Richman and Melvyn Copen, International Management and Economic Development, McGraw-Hill, N.Y., 1972; Anant R. Negandhi and S. Benjamin Prasad, The Frightening Angels: A Study of U.S. Multinationals in Developing Nations, Kent State University Press, 1975; Anant R. Negandhi, Organization Theory in an Open Society, Dunellen, N.Y., 1975. Anant R. Negandhi, Management and Economic Development: The Case of Taiwan. Martinus Nijhoff, the Hague, 1973-even compares the Japanese subsidiaries unfavorably with their American counterparts.

By any of these measures, many LDCs have serious management gaps -- which public policy tries to remedy to a greater or lesser extent.

Further, it should be useful to assess the particular elements in which LDC management may be lacking. Perhaps we can disaggregate management tasks into financing, marketing, production and operations management, personnel and labor relations, and strategic general management. I would like to add a special category for high level personnel management.

Financial management (the efficient use of financial resources) is perhaps a field in which the greatest variation can be observed in the LDCs -- between the bookless, planless artisans and the former merchants who may have at their disposal sophisticated cash management programs. Even among large scale enterprises there are clear differences between sophisticated larger private firms -- and some of the parastatal firms that labor under antiquated systems of financial management which take no account of the cost of money, lying idle or standing due. Some guidance on financial management in the organized sector is typically provided by the lending institutions and accountants -- but their professional shibboleths may lead as well to wasteful financial practices.

Marketing management (efficient servicing of customer needs) also displays an enormous variety of levels in the LDCs -- but it is handicapped by the lack of data and sophisticated studies that underlie the DC marketing efforts. Inefficient physical distribution systems, and retail and wholesale structures may detract from the efficiency of the enterprise. On the other hand, while I know of no study on distribution of industrial goods that tries to assess the relative efficiency with which they are distributed -- a series

of studies on the distribution of agricultural goods, especially in India, have reported a high degree of efficiency relative to the DCs. 1/

Production and operations management has already been covered in dealing with the ILO productivity data -- which would seem to indicate a management gap -- and a larger one than in the DC's.

Personnel and labor relations is perhaps the field where it is even in principle most difficult to assess success. In the three previous cases the task of management is generally allowed to be the achievement of the maximum production from given resources -- and both product and resources can be described in value terms. In the case of wages, it is not clearly the purpose of the enterprise to pay no more than the minimum necessary to secure the optimum effort from the workers. More precisely while the techniques for getting the maximum out of materials, machinery and capital funds are relatively well understood, those for getting maximum effort out of labor are not, nor is it clear that the enterprise wants to extract that maximum. Finally, while environmental factors limit managerial possibilities in finance, production management and especially marketing -- nowhere is the outside environment more dominant than in labor relations. It is not thus accidental that personnel and labor relations are often the last area to which professional managers and their standards turn their attention.

1/ Leon Hirsch. Marketing in an Underdeveloped Economy. Edgewood, N.J., 1961. Ralph W. Cummings Jr. Pricing Efficiency in the Indian Wheat Market. Impex, New Delhi, 1967. Uma J. Lele. Food Grain Marketing in India. Cornell U.P., Ithaca, N.Y. 1971. J. K. Galbraith, Marketing Efficiency in Puerto Rico. Harvard University Press, Camb., Mass., 1955. I have not been able to consult, ed. Dov. Izraeli, International Conference on Marketing Systems for Developing Countries. John Wiley, N.Y., 1976.

I would venture that personnel management is the weakest point of many LDC enterprises and coping with their work force the hardest task for entrepreneurs in their transition to industrial management and entrepreneurship. Except for the smallest scale artisan entrepreneurs -- again and again anxieties about personnel relations turn out to be a major subjective restraint on small manufacturers expansion.

High level personnel management is a critical problem for large enterprises -- and involves directly the managment gap problem we have been discussing.

Strategic general management -- really needs to be considered along with entrepreneurship of which it is a variant.

In all of these fields Richman and Copen found that American Multinational subsidiaries did considerably better than locally owned firms in India. Negandhi says in China (Taiwan), American MNC subsidiaries were superior to Japanese MNC subsidiaries, which were superior in turn to Chinese (Taiwanese) owned firms. Marketing was the U.S. MNC's forte, but they were rated as better than the local firms in financial management and in production. Indian firms did far more research and development and social welfare expenditure than MNC branches. Neither the MNC's nor the Indian firms were seen as progressive in procurement -- and the picture was mixed in the labor relations and personnel area. 1/

In addition to shortfalls in the number and quality of entrepreneurs and managers, there are also concerns, some of them legitimate, about the social origins of entrepreneurs and managers. In many societies,

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1/ Richman and Copen, op. cit.; Negandhi, Taiwan, op. cit.

entrepreneurs and managers come from a narrow social base -- ethnically or socially. There is a natural desire to take advantage of the talents of all social strata in the tasks of industrialization and to insure a wide dispersion as well as the rewards of entrepreneurship. This concern is particularly voiced in the policies of nations in South East Asia and East Africa -- where business has largely remained in the hands of foreigners or of immigrants from China and India.

The Government of Malaysia has an elaborate system of encouraging "bumiputra" (ethnic Malay as distinguished from ethnic Chinese) entrepreneurs and managers. The MARA Institute of Technology runs a wide variety of sub-professional and professional courses limited to "bumiputras." MARA runs as well a chain of vocational training institutions and junior science colleges for "bumiputras." In addition, government agencies give concessional finance and technical assistance to "bumiputra" owned small scale enterprises and government rules force commercial banks to do so as well. The products of these"bumiputra"enterprises are purchased up to a price differential of 10-15% in preference to others by government organizations, while other government organizations give "bumiputra" entrepreneurs preferential access to imported raw materials. Larger scale enterprises are pressured to hire "bumiputra" managers, and there has indeed been a major increase in their presence in managerial ranks.

But lest one think that concern is limited to special cases like Malaysia we might note that the rather extensive entrepreneurial development programs in India are intended not to remedy an overall shortfall of entrepreneurs, but rather to involve new groups such as technicians in

entrepreneurial roles. In the United States -- the major focus has been to help minorities under represented as business owners such as American Blacks enter small business.

In particular, the technical entrepreneurs it is felt will have a "productive" rather than a "commercial" orientation to industrial entrepreneurship -- and thus are less efficient production managers and managers of technology. 1/

A more common distributional concern is one subsumed under the various indigenization programs. These attempt to indigenize in various proportions the management and equity of foreign controlled firms. This indigenization thrust is of particular concern in Africa, where the majority of large scale private enterprise ownership and organized sector management is often still expatriate. In these indigenization programs -- the desire to tap wider entrepreneurial and managerial bases and distribute rewards is added to a concern for national sovereignty, which may be endangered when such a large proportion of leading social roles are played by foreigners.

WHAT IS TO BE DONE

To the extent that there are shortfalls in the quality and quantity of entrepreneurs or managers there are several paths which public agencies, nation states and private agencies can take. They can:

1. Open access to entrepreneurial and managerial roles -- by providing additional finance, technical assistance and training. Subsidies can be given, guidance provided,

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1/ J. H. van der Veen, op. cit.

protections afforded. Most LDCs do some of these things for small scale enterprises; a fair number do them for larger scale enterprises as well.

2. Restructure incentives to encourage more or more appropriate entrepreneurship and management. Some of this has been covered in the first point -- but company and tax laws, economic planning, and education can all be manipulated. For example, tax benefits for inservice training can encourage enterprises to improve their management skills. Public sector managers can be rewarded for effective management.

3. Provide modern management education -- either through degree programs on the Harvard Business School, MIT or Staff Training College Model or by giving shorter term courses. These courses can and are given both at home and abroad.

4. Provide technical and managerial consultancy and assistance to meet specific management shortcomings. More significantly technical and managerial consultancy capability can be built up in the different countries and themselves. This consultancy and assistance can be provided privately through multinational investment, collaboration, and straight multination consultancy. It can be provided publicly by the nation state itself, private agencies, and international organizations like the ILO. The "consultancy" can be provided "invisibly" through publications, face to face contact etc.

II. DISTRIBUTION OF THE PROBLEM

J. K. Galbraith suggests that different factors are typically short in different geographical regions of the less developed world. In particular he suggests that capital is critically short in Southern Asia and Latin America and entrepreneurial and technical cadres in Africa, Latin America and the Middle East. The last years' WDR states:

> "The Low Income countries in Asia and in Sub-Saharan Africa face very different problems in implementing a strategy to raise agricultural productivity (because of differences)...[in] the numbers of people with industrial and managerial skills" (p. 1).

As we shall see this generalization is somewhat belied by two of these countries, India and Pakistan, who form a special case. The generalization will be belied as well because so many non-low income countries in other regions have problems with managerial and entrepreneurial cadres. It is perhaps indicative that of 80 odd current Country reports on file in the IBRD's report room, managerial and entrepreneurial problems are mentioned in Barbados, Algeria, Malaysia, Swaziland, Burma, Indonesia and Bangladesh -- as well as Cameroons and Upper Volta -- suggesting a rather mixed bag.

It goes without saying, however, that the cadres constraint is most severe in Africa where severely limited supplies of trained manpower mean that often more than half of entrepreneurial and top level management roles are played by expatriates.

In Harbison and Myers classic study (1964) of High Level Educated Manpower the Sub-Saharan African states constitute all but three of the 17 countries at the lowest level. (The exceptions were Haiti, Saudi Arabia and Afghanistan). Only Ghana among the African states was found among the highest

group of next 21 countries listed. Despite dramatic, 5-10 fold increases in university enrollments, recomputation of Harbison and Myers figures using 1975 data hardly shows any relative change. Only Ghana, the Ivory Coast, and the People's Republic of the Congo show enrollments comparable to the poorer Asian countries.

J. K. Galbraith spoke in his Massey lectures on CBC of three models of development. (The Underdeveloped Country, CBC, Toronto, 1965, pp. 18-34).

I. The Sub-Saharan model where the problem is the absence of "a minimum cultural base." -- [a shortage of skilled and educated manpower.] Even today these type I countries -- some of which are in the middle income category (mostly as a result of mineral production) have an average of less than 1% of the eligible population in institutions of higher education -- as compared to 7% for Middle Income Countries as a whole and 22% for the industrialized Countries. As late as 1958 -- these were only 8000 high school graduates in all of Africa South of the Sahara. Concretely, these type I countries are those where shortages of entrepreneurial and managerial cadres are a major independent obstacle to development -- and it is not coincidental that industrial development plans in Sub-Saharan Africa (Low Income Africa in WDR terms) have critical entrepreneurial and managerial training programs in them;

II. The Latin American Model. Here Galbraith argues that the problem is not that of a limited supply of cadres but of social structures that constrain development.

III. In the South Asian Model (Indian and Pakistan and to some extent Egypt and Indonesia) -- "The barrier ... is bad proportioning of the factors of production. Vast populations, shortage of capital and arable land - but not shortages of cadres per se."

Clearly it is the type I countries where the constraints of limited managerial and entrepreneurial cadres are most critical. Even in type II and III countries -- there may be room for improvement in management within the constraints of the system, and for a sort of management and entrepreneurship that economizes on scarce capital and land. This economizing can occur

either through more efficient implementation of the present management systems or through innovations with new technologies and forms of enterprise. In addition, it is precisely in model II and III countries that programs concerned with recruiting enterpreneurs from previously non-entrepreneurial groups have been tried, to change the social distribution of entrepreneurship.

Another adjustment to the differing entrepreneurial environments portrayed by Galbraithis suggested by Alexander Gerschenkron in his theory of relative economic backwardness -- where he suggests that where entrepreneurial cadres are deficient -- the banks or eventually the state may substitute themselves as creators of new enterprises. In fact, the deficiency of entrepreneurs in the African case is partially made up by the relatively extensive parastatal sector. Whereas in Costa Rica, only 1/4 of the GCF is done by the state, it does 87% in Algeria, 41% in Kenya, and 51% in Tunisia. Other factors besides entrepreneurial deficiencies, of course, determine these proportions.

COUNTRY BY COUNTRY SITUATION

In general, the low income and mineral producing countries have critical shortages of entrepreneurs manifested in the difficulties public lending and extension institutions have in locating entrepreneurs as we have seen earlier. Their smaller scale artisan and mercantile entrepreneurs have significant difficulties transcending their role and expanding into large scale enterprise.

Their levels of industrial management and supply of trained managers is also low -- as certified by ILO and other productivity expert surveys and what individual manpower data we have. What follows is some suggestive manpower data from a few countries for which it is available.

COUNTRY	NO. OF MGRS.	EXPATRIATES	UNTRAINED (if available)
Sub-Saharan Africa			
Zambia (1977)	21,415	7,316 (37.6%)	5,386 (38%)
Benin (recent) (superior cadres needed 1977-80)	1,223	537	
People's Republic of the Congo (recent)	420	256 (61%)	
Ivory Coast (1971)	2,573	1976 (plus 234 non-Ivorian Africans) (roughly 80%)	
Zaire (1973)	5,400	3,100	
Tanzania (1974)	1,466	242 (non-citizens)	225 vacancies
South and Southeast Asia			
Bangladesh (recent)	9,000	low	80%
Malaysia (1970)	5,515	17%	

Sources: Final Report of the Zambia Managerial Manpower and Training Needs Survey of the Private and Parastatal Sectors, Prepared by the Management Development and Advisory Service of the Management Development Unit, Office of the Prime Minister, April 1977; ILO internal documents IBRD reports on Ivory Coast and Malaysia; Republique du Zaire: Etude Sectorielle de l'education, Vol. II Annexe 102. UNESCO (confidential); Kitabu Cha Tatu, Jamhuri Ya Mungma Wa Tazania, n.d.

The managerial cadres in the oil producing countries of the Middle East are overwhelmingly expatriate -- many coming from other Muslim nations like Egypt and Pakistan. The Saudi Arabian Critical Skills Survey, 1976 would appear to show the overwhelming number of industrial managers as non-Saudis. Even the most industrialized of the LDCs have a shortage of trained managers. A survey of management education in Korea shows that of 50,000 industrial managers only one third were graduates of a first cycle university course in any field. On the other hand, now more than one thousand students finish first degrees in business management each year -- half probably go into industry. Overtime this would make 40% of all business managers business management graduates. 1/

The pattern of a shortage of entrepreneurs and managers in Low Income and Mineral Producing countries is also confirmed in a range of recent IBRD internal documents. As the 1978 WDR says "A major handicap faced by African industry is the scarcity and high cost of suitable skilled labor and management." (p. 49). In Indonesia, "Management and marketing techniques are often poor, as is knowledge of new techniques and products in industry." ("Problems and Prospects for Industrial Development in Indonesia" Vol. I - Current Situation and Policy Issues p. 72). The IBRD memorandum on Upper Volta reports (p. 12) limited management capacities and lack of entrepreneurial knowhow. In Swaziland, "The main constraint to the balanced development of manufacturing is the shortage of Swazi entrepreneurs and managers." (Report No. 1422-SW -- "Appraisal of the National Industrial Corporation of Swaziland (NIDCS) and its Subsidiary the Small Enterprises Development Company" (SEDCO) April 1,

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1/ "Expanding and Improving Programs of Education in Management in Korea", IBRD financed study by the Academy for Educational Development, Inc., March 1975.

1977, p. 3). In Algeria, "Among the major constraints on economic efficiency the shortage of skilled labor, technicians and managers remains paramount ("Memorandum on the Economic Situation in Algeria", Report No. 1816-AL, p. 32) and in Barbados, "A serious obstacle to industrial development in Barbados at this point in time is the dearth of management expertise".

The exceptions to the pattern of the Low Income Countries -- are the major South Asian countries of India, Pakistan and Sri Lanka which have surplus managers and entrepreneurs for export. The Harbison and Myers report on High Level Manpower in 1964 already showed them far ahead of the African Low Income Countries and despite relatively slow increases in their educational level since then, they have maintained their lead. As the 1978 WDR said, these South Asian countries have "extensive managerial and industrial skills." (p. 41).

Multinational corporations, Indian and foreign, use India and Pakistan as important recruiting grounds for managerial talent. While it is true that managerial inefficiency as measured by improvements consultants have been able to make is large -- and there are many other indications of inefficiency as well -- the best units maintain a very high level of productivity.

Barry Richman, a leading American business school professor did a study for AID in 1969 in which he reviewed the situation in India -- from a comparative viewpoint -- which emphasizes the management gap there, but even he grants the efficiency of the best locally owned firms in the market. 1/

To quote the 1978 WDR again as it refers to these South Asian Countries. "Although...average production costs tend to be high in relation to international prices, in most industries there are many firms, both public

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1/ Barry Richman, A Firsthand Study of Industrial Management and Economic Development in India. AID Research Paper, December 1969, and op. cit.

and private which have achieved high standards of efficiency." In fact, the summary data prepared by Peter Kilby from ILO Productivity Mission Reports would show that productivity hardly varies systematical among such various countries as Burma, Indonesia and Israel. On the entrepreneurial level, too, except when economic conditions forbid, there has never been an overall shortage of entrepreneurs in India and Pakistan. On the other hand, a feeling that the entrepreneurship that has occurred is neither of prime efficiency nor widely enough spread has meant that India has been the focus of a series of ambitious programs for entrepreneurial development among previous non-entrepreneurial groups.

For the purpose of cadre problems -- as for several others -- India and Pakistan, belong with the semi-industrialized countries -- many of whom have large exportable cadres of entrepreneurs and managers -- e.g. Israel, Egypt, Korea, the Repubulic of China, and Mexico.

INDUSTRIAL TYPE BY INDUSTRIAL TYPE

The entrepreneurial and managerial picture differs not only from country to country but from productive sector to productive sector.

There has been a tendency to slight public sector entrepreneurship -- despite indications that one of the key correlates of project success in the public sector is the ability of the first managing director "to put things together." Sophistication in the training and providing of incentives to public sector managers which has accelerated so rapidly over the last decade will lead as well to public sector managers being better able to play entrepreneurial roles. In addition, those countries planning a significant amount of new public sector enterprise might well select and train entrepreneurial cadres to get the new enterprises going.

Several of these countries have, in fact faced a managerial crisis because of the low level of management in their parastatal enterprises and have given management improvement a high priority -- Algeria and Burma are prime examples. The ILO has been a prime mover in providing managerial training and consultancy to overcome public sector gaps -- and has just finished, a major management education scheme for Rumania. A center for public sector training has been developed by the LDCs themselves in Ljubljana -- but is still too new for us to assess its effects. The critical problem in public sector management, however, is not the training and "encadrement" of managers -- it lies more in developing management information and evaluation systems appropriate to the tasks of the public sector enterprise.

In the multinational sector the quality of management and entrepreneurship is generally high. 1/ This serves both to raise management standards throughout the economy as well as to foreclose possibilities for indigenous entrepreneurship and management. The fact that many of the graduates of the new style management schools go into the multinationals on the one hand deprives the indigenous sector of their services and on the other secures the indigenization of management in the multinational sector. At another level, former artisans with the multinationals and parastatal enterprises often constitute a prime reservoir of small scale sector artisan entrepreneurs. The judgement about the dynamic effect of multinational activities needs to be made in each case by concrete evaluation of all the benefits and costs of multinational involvement -- including the effects of such involvement on domestic managerial and entrepreneurial cadres.

1/ See Richman, op. cit.

Deficiencies of entrepreneurship are so great in some countries that no indigenously owned large scale sector exists. On the other hand, the largest enterprises in Korea, the Republic of China, India, Singapore, and Pakistan are now themselves multinationals performing entrepreneurial tasks at home and abroad. The managerial efficiency of these enterprises varies -- and is sometimes complicated by the conflicts between the rationality espoused by professional managers and the rationality of an ongoing family enterprise. It is still not clear whether the familistic or professional values produce the more efficient and durable enterprise. On the one side, we have a series of critics of "patrimonial management" who cite ways in which the enterprise is mismanaged by incompetent family connections, on the other hand, a group of writers who emphasize the adaptability of family concerns in areas as diverse as Japan, India, and Brazil. 1/ Nathaniel Leff outlines the merits of a variety of family firm extended - that characterizes the very largest business houses in the LDCs. Allan Cohen did a series of case studies in connection with the IIM (Ahmedabad) showing how concrete family firms adjusted to reconcile the claims of both family and productive rationality. 2/ Writers like Edward Banfield argue that lack of strong extended family structure can be a major obstacle to development. 3/

1/ K.A. Hammeed, Enterprise: Entrepreneurship in Development. Sage Publications, London, 1974. p. 40; Timberg op. cit. pp. 15-17, Richman, op. cit.

2/ Allan R. Cohen, Tradition, Change and Conflict in Indian Family Business. Mouton, the Hague, 1974; Nathaniel Leff, "Industrial Organization and Entrepreneurship in the Developing Countries: The Economic Groups," EDCC, 1978.

3/ The Moral Basis of a Backward Society. University of Chicago Press, Chicago, 1958.

The indigenous large scale sector is thus a mixed bag -- but one with management problems which are akin to those of the public and multinational sectors -- and that often tries the same solutions -- modern professional management and management systems.

The lack of large scale private entrepreneurship where it is found, has however, unique causes. The key variable is likely to be the attitude of the government toward the development of a large scale private sector. In India, where the government has encouraged the creation of large scale private enterprises, the IDBI (The Industrial Development Bank of India - the government's chosen instrument) ran several successful programs for potential large scale entrepreneurs. It is especially in this large scale sector -- that promotional agencies often accelerate entrepreneurship by providing free feasibility studies and doing other entrepreneurial groundwork.

Finally there is the field of small and medium scale enterprise and the informal sector -- critical because of its potential for employment creation and its economic use of capital. The SSE sector also serves a political purpose -- to decentralize control of the economy and distribute the rewards of industry.

In this sector the problems of entrepreneurship and management coincide -- and there are rarely managers other than the entrepreneur himself. Very rapid growth has occurred in the numbers of these small scale units over the last few years in quite a number of countries. The average annual growth rate in the numbers of enterprises employing 5-99 people was 16% in Kenya in the years 1969-73 (Bureau of Statistics, Ministry of Finance and Planning, Government of Kenya). In Malaysia, small scale enterprises increased from

5,000 to 9,000 units between 1959 and 1974. In Thailand there were 150-160,000 small enterprises at the end of 1976 as contracted to 45,000 recorded in the 1968 census. All figures in this area are hazy since many of the units (often as high as 90%) are unrecorded and unregistered -- nonetheless they account for a large proportion of employment and production in most LDCs.

These small enterprises fall into four rather disparate categories requiring different types of entrepreneurship, management, and assistance.

1. Ancillary units, connected to the large scale sector -- which require a limited amount of entrepreneurial skill most of it provided by the large sector units to which they are attached.

2. Traditional enterprises which require entrepreneurship and management of a traditional type, usually readily available -- but need to adjust to cope with new economic technology and market forces, and to transcend the limits of tradition.

3. Transitional technology enterprises which require entrepreneurial and innovational capacities, along with technical virtuosity -- and are clearly the desideratum sought in many small scale industrial programs.

4. Modern enterprises, which as Lydall and Dhar (P.N. and H.F. Lydall. The Role of Small Enterprises in Indian Economic Development. Asia Publ., N.Y., 1961) point out in their famous study, may not have the advantage of being economical either in their use of capital or labor and thus lack some of the merits of the other kinds of SSE.

Almost every LDC has some apparati (uses) -- often several for finance and several for technical extension -- to assist in overcoming the financial and technical obstacles faced by the small scale sector -- and the World Bank has become a major underwriter of these apparatuses over the years.

Not a few of these programs have addressed themselves to the question of management either through the provision of training or more usually consultancy services. In several cases these have been provided together with

finance through Banks (as in the proposed SMSIE in Kenya, Sri Lanka, and Thailand) or through coordinated efforts by various agencies as in the Gujarat IDC's program in India, and the World Bank financed SSE programs in the Ivory Coast, and Upper Volta, or UNO in North Eastern Brazil.

Fewer of these programs have undertaken entrepreneurial training in a more general sense -- though several efforts have been made to use variations of the "McClelland" approach in areas as diverse as India, Uganda and Ireland.

The programs have had varying success -- though they have rarely assisted effectively the very smallest and artisan enterprises and those that use traditional and transitional technologies. On the average they have not even produced vigorous independent small units. Over the last quinquennium there has been a halting attempt to re-orient these programs toward the small informal sector's needs and transitional technologies -- with a few scattered successes to be reported further on (UNO in North Eastern Brazil, for example).

III. QUANTITATIVE AND QUALITATIVE ENTREPRENEURIAL AND MANAGERIAL CHANGE

While there is clearly a persisting gap between the entrepreneurial and managerial capabilities of the Industrialized and the Less Developed Countries -- the period since World War II has seen a quantitative explosion in managerial and entrepreneurial cadres in many of the more industrialized LDCs.

Economic growth has fuelled the expansion of the small scale and informal sectors. Veterans returning from service in Nigeria and Ghana and craftsmen who had gained experience during the war in South and Eastern Asia started small scale enterprises. Generally rising per capita incomes and consumption standards created demands for the products of tailors, bakers, and furniture makers. The spread of bus and truck transport, agricultural and irrigation machinery, and rising international trade created demands for the products of these small scale enterprises. The previous section shows the dramatic increases in such units recorded in Malaysia, Thailand, and Kenya. On the push side as well, urban immigrants despairing of finding jobs in the organized sector found themselves entering the small scale artisan sector in large numbers in search of employment. Surveys of urban labor forces in LDCs show again and again that it is the most marginal urbanites who populate this small scale sector.

Rapid expansion of higher education and displacement of expatriates has moved a new indigenous generation into managerial positions in the large scale sector. Whereas in 1945 the large scale sector was almost entirely managed and largely owned by foreigners -- large scale enterprises are now predominantly managed by local residents -- except in parts of Sub-Saharan Africa.

Protectionist and promotional policies undertaken by the newly independent and conscious LDCs have fuelled the creation of new enterprises in a whole range of industrial lines -- small, medium, and large - for import substitution, export, and eventually simply to add to domestic production. Both industrial production and exports have expanded dramatically in the LDCs.

A qualitative change was partially pre-requisite to this quantitative one. It is easier to appreciate this change when we look at the new management cadres who have assimilated Western management techniques and applied them successfully in their own economies. It can be noted in the rising level of productivity in the LDCs due in no small part to improved management.

The process of increasing and improving cadres is still far from complete in the countries of Sub-Saharan Africa and the Middle East -- and its incompleteness is certified by the large remaining expatriate cadres, as well as in the migration of high level cadres from other LDCs to those areas. But everywhere the change has been dramatic -- the half of Sub-Saharan managerial cadres which is local itself represents a hundred fold increase in numbers since 1945.

IV. REMEDIES

The question that remains is whether public programs can remedy entrepreneurial and managerial shortcomings, and if so how. There are no easy formulas but several approaches have been tried with a modicum of success.

Typically these approaches are subordinate parts of more general industrialization efforts -- involving programs of subsidy and guidance, and provision of finance, markets and materials. For their success they require as well a political and economic structure that gives managers and entrepreneurs some room to move in and an assurance that they will be rewarded for their successful efforts.

In the first place, there are the formal training programs. More than 240,000 people have gone through courses run by the ILO alone. The Asian Productivity Organization based in Tokyo has put more than 1000 trainers and consultants through its courses. The International Teachers Program -- originally associated with Harvard Business School presided over the creation of a chain of modern management colleges -- while others sprang up by themselves inside established universities. It is estimated today that in India there are over 6000 graduates of modern style MBA programs all established since 1950. More traditional non-college programs for accountancy and industrial engineering increased their output. Formal education in management in India has spread. One survey showed 14% of large scale managers of the youngest generation with graduate level management education as contrasted to 1% in the oldest. 1/ INCAE (Instituto Centro Americano de Administracion de Empresas)

1/ S. B. Prasad and Anant R. Negandhi, Managerialism for Economic Development: Essays on India. Nijhoff, the Hague, 1968, p. 24.

located in Nicaragua but serving all of Central America has graduated 300 MBA from 1966 to 1975 and had more than 1000 students go through its advance management programs (more than 10,000 managers have attended its shorter seminars). The Iran Center for Management Studies in its short existence has graduated 500 to 550 MBA students. Fifty or so of the hundred pages devoted to listing management training institutions and consultancy services in a recent ILO directory cover LDCs. Some considerable amount of training has been done by multinational corporations for their own personnel — and by institutions that limit themselves to short term courses.

Going the other way, a large range of funders have provided money to enable the pursuit of management studies in the developed world -- either through courses or through training assignments and tours. Setting aside for the moment short term visits and non-academic programs more than 25,000 students from LDCs are pursuing management courses in USA universities alone -- and though the U.S. may account for the largest single number — large groups are found elsewhere throughout the Industrialized Countries. 1/

It should be understood that sending students abroad and setting up management training institutions at home are two alternative ways of filling the same management gap -- to be chosen between on a cost-benefit basis. Often the high overhead cost of establishing management development institutions especially for specialized management functions and the educational value of

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1/ Figures from the Institute for International Education, New York. I was not able to get one key assessment of this flow abroad - "Review Mission on Technical and Management Training for Nationals of Developing Countries in Developed Countries." Consultants Report to the Administrator of UNDP, October 1972.

exposure to an industrialized country may indicate that sending students abroad is preferable. At other times regional arrangements can permit a group of countries to economically fulfill their management manpower needs as in INCAE in Central America. A recent memorandum estimated that training costs in one recent in-country training proposal would reach $150,000 per capita -- as contrasted to a fraction of that for the most expensive training abroad.

Almost every LDC has developed a series of management training institutions -- usually of four different sorts.

1. In-enterprise training is characteristic of only the largest and most sophisticated enterprises -- like the multinationals, the banks, and India's Tata industrial group.

2. Short term courses are usually run on an in-service basis by banks, promotional agencies, and educational institutions.

3. Long term courses are run for those preparing for a managerial career, both inside universities and out. These courses include many non-degree ones such as those that lead to careers as Chartered Accountants and Cost and Works Accountants.

4. Foreign training and fellowship programs, either on a regional basis or in the Industrialized Countries, send managers -- present or potential -- abroad for further study.

In addition one should not forget the important element of management training present in much of the dramatic expansion of commerce, engineering, and vocational training in the LDCs. Thirty five to forty percent of the graduates of East African polytechnical vocational schools set-up businesses for themselves and the curricula are to some extent designed to prepare them for their entrepreneurial roles.

The results of all this formal training have certainly been that an increasing proportion of managers in the developing world large scale private and public sector are graduates of some sort of modern management training exercise. We are left gropping for proof that the training has, in fact, improved the level of management. The effects consultants and multinational subsidiaries are able to produce certainly suggest that managers who learn whatever skills these change agents are applying should be able to show increases in productivity. On the other hand, old line managers often complain about the "new managers" that neither their skills nor their attitudes are appropriate to the roles that they are called upon to play in the enterprise. But employers continue to offer the newly minted graduates of the more extensive pre-training programs princely salaries so that the market seems to show that modern management training has proven itself in LDCs. A cost-benefit analysis of the social value of the new management schools in Ahmedabad and Calcutta in India -- calculated partially in terms of the increased earnings of their graduates -- yields estimates of 2-6 million dollar gains for their first few years of operation. 1/ The new managers meet some resistance (as they do in the Industrialized Countries) from old line managers, but the market validates the value of the credentials.

One would like to see, however, some empirical validation of the new managers' value, perhaps by comparison of firms in which they are and are not present. Richman and Copen and Negandhi and Prasad do this in an indirect way when they compare management practices in different fields (marketing, finance, etc.) -- looking at U.S. MNC branches (which use many management

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1/ Thomas Hill, et. al, Institution Building in India, Harvard University, Boston, 1973.

graduates) and indigenously owned Indian firms (which use somewhat fewer). But neither set of authors tie these "input" practices directly to measures of productivity.

Entrepreneurial training is another matter. A fair number of funding agencies try to run pre-courses for their new entrepreneurs particularly those with limited experience of business and industry. Some of these courses as in V.G. Patel's, "Innovations in Banking: The Gujarat Experiments," (Domestic Finance Studies No. 51, IBRD, August 1978) demonstrate important differential success.

A group of such training exercises are strongly influenced by David McClelland's theories of "n-Achievement". Essentially McClelland demonstrates a testable group of psychological traits called "n-Achievement". These traits are characteristic of entrepreneurs and entrepreneurial societies. McClelland hypothesizes that they are an important causative element in successful entrepreneurship. McClelland further developed training material that he felt would increase the level of "n-Achievement" of those who used the material. McClelland's own applications of the method have achieved some success. 1/ But after several attempts elsewhere he has limited his own activities since 1974 to the United States. A group of institutions and consultants taking their inspiration from him have followed in his footsteps elewhere. The most prominent group is in Ireland, but at least four institutions in India use some variants of his methods. The Small Industries Extension Training Institute in Hyderabad, where McClelland made his first experiments uses

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1/ David Miron and David McClelland, "The Impact of Achievement Motivation Training on Small Business Performance" unpublished; McClelland & David Winters, et. al. Motivating Economic Achievement. Free Press, N.Y., 1969; McClelland, The Achieving Society, D. van Nostrand Co., Princeton, N.J., 1961.

"n-Achievement" tests to select candidates and some other "n-Achievement" instillation techniques in the short courses it runs for the various state industrial development corporations. SIET's course participants are typically young technicians with 3-4 years work experience, but usually no more, and perhaps $3-4,000 of own capital -- as compared to a national per capita GNP of $150. In other words, the program deals with a young middle class clientele. V.C. Patel's study of the Gujarat Industrial Development Corporation describes in detail one of this sort of program albeit without SIET participation. The NIMID (National Institute of Motivational and Institutional Development) based in Poona has a program of giving "n-achievement" training in backward areas, though no conclusive results are yet in on its success. NIMID has operated in 13 districts — in which it has selected from 50-75 people out of 300 applicants (for reasons including high "n-Achievement") to undergo training. After 15 months 50% had begun enterprises of one sort or another. ILO funded one application of "n-achievement" training in Uganda, with inconclusive results. (P.A. Neck, "Report on Achievement Motivation Programmes conducted: Uganda," 1969-70, ILO Report).

In an unpublished article David McClelland himself and an associate, David Miron survey the success of those programs with which he is most familiar — both in the U.S. and in four other countries (India, Curacao, Uganda and Ireland). It concludes that "achievement motivation training significantly improves small business performance" (in terms of profits and sales) — "provided that there is at least some minimum of support from the economic infrastructure in the form of available loans, market opportunities

and a labor force." This effect has only been demonstrated for small firms -- logically enough if the entrepreneurs' personality is so critical to the firms' success. Formal business management training on the other hand, while a useful complement to Achievement Motivation techniques actually over inhibited entrepreneurs when given alone. One is reminded of Keynes "statement."

> If human nature felt no temptation to take a chance, no satisfaction (profit apart) in constructing a factory, a railway, a mine or a farm, there might not be much investment merely as a result of cold calculation.
>
> (p. 150, J.M. Keynes, The General Theory of Employment, Interest and Money. Complete Works, Vol. VII, McMillan, Cambridge, 1973).

Far more extensive entrepreneurial training programs than those mentioned have been conducted in various countries -- often with the assistance of ILO, Partnership for Productivity, bi-national agencies, banks and lending institutions and promotional agencies. These programs have more typically worked with ongoing established enterprises and focussed on managerial rather than purely entrepreneurial skills.

As at the level of the management of large scale enterprise the appropriateness of the management technologies taught in these small scale training programs is more questionable. Chuta and Liedholm in their study of the informal sector in Sierra Leone and Kilby's and Harris' studies of small scale entrepreneurs in Nigeria show no correlation between level of formal education and commercial success measured in terms of profits -- though they did find that there was some relation between profits and the simple keeping of books. Miron and McClelland in their review of the success of various programs in which they were involved found that formal business training was often an obstacle to business success when not combined with

"n-achievement" training. What is probably the case is that simple business skills are required for success -- but that able people with extensive educations choose other fields than small business enterprise to advance their careers. Those with good educations who remain in business are less able, and therefore possibly not as good businessmen as their competitors.

Besides all this training activity there have been a large number of programs providing consultancy or training consultants. Conceptually, while training programs teach systems to apply to future managerial and entrepreneurial problems - consultancy develops such systems on the spot to cope with pressing managerial and entrepreneurial tasks.

The Asian Productivity Organization and ILO have sponsored a great deal of activity -- primarily training consultants and to a lesser extent in providing them to enterprises. As with the management education one could question the applicability of the techniques -- except for the demonstrable increases in productivity recorded earlier.

One particularly successful series of such consultancy programs for small scale enterprises is run by UNO (Uniao Nordestina de Assistencia a Pequenas Organizacoes) a private non-profit group in Recife founded in 1972. This is a program limited to those enterprises with sales of less than $36,000, ten employees, and a total net worth of the proprietor of less than $14,000. The program runs a full technical assistance and training program -- involving 3-6 week courses (two hours a week). The program serves as a broker in getting finance, and has regular follow up sessions by extension workers -- technicians and students. Besides established relations with the banks UNO operates a guarantee fund to satisfy bank collateral requirements. Between

1973 and 1977 the program selected 1350 enterprises of 4224 visited for assistance and actually aided 531 firms -- involving an average loan of $1583. The default rate incidentally on these loans was 2% -- which seems an incredibly low figure for small scale enterprise success unless Brazilian norms are far out of line with those elsewhere. All this was done with a staff of 7 full time extension workers assisted by 22 half-time university students. As a result of the UNO success a group of similar programs have been set-up in Brazil's Northeast by the Government and in other parts of Latin America by UNO's parent group, Accion International. The results of all these are still tentative, but indicate significant levels of accomplishment.

The issues posed by the UNO experience are two in number -- and the data is hard to assess in giving answers to either. The first question is whether the total social cost of the increase in production is worth it. The costs of the capital involved in the program seem to have been roughly 80% per annum though the program is working on reducing its overhead to the point that these fall to 50%. It is likely that the social marginal productivity of small enterprises may be higher than 50 or perhaps 80%. The private profitability of informal sector traditional enterprises surveyed by Chuta and Liedholm in Sierra Leone ranged as high as 175% and in most cases exceeded 75%.

The second question is whether program costs could have been reduced without a dimunition in productivity -- and that verdict will have to await comparisons of different UNO-type projects with greater and lesser extension components.

Extension efforts of similar types are now in place in most countries with extensive informal sectors -- though in some cases, as in Senegal and India the facilities are largely limited to registered units -- those units

who conform to some, often onerous, government restrictions. The IADS in Gambia has been doing similar sort of one on one extension job -- as have several efforts associated with the Partnership for Productivity, Accion International (the original sponsor of UNO), and the University of the Philippines. In Kenya, prototypes of small industrial enterprises using simple tools have been provided at development centers.

Several of these extension efforts have been financed or are associated with projects which are financed by the World Bank. The Bank will be funding 1.93 million dollars of management training outside the education sector in fiscal 1978 and 79 projects altogether mention management or commercial curricula in their project appraisal reports. In specific, a new project for Small Scale Enterprises in Upper Volta has a training and consultancy component on the Partnership for Productivity model -- using high school graduates to train businessmen in simple bookkeeping (even if they are illiterate), and simplified business procedures for costing projects, estimating sales, calculating needs for stocks etc. Partnership for Productivity reports present involvements in Liberia, Kenya, Upper Volta, Botswana, and Malawi with anticipated involvements in Guatemala, Jamaica, and the Middle East -- under a variety of auspices. Unfortunately, extensive independent evaluations are not yet available on these projects. USAID has let a contract jointly to Partnership for Productivity and Accion International, and the IBRD one to The Development Group for Alternative Policies to study the value of different approaches to assisting small scale industry.

The quality of assessment of the consultative services provided for the large scale sector is even lower than that for consultative services for SSE. The 1973 In-Depth Review of the Management Development Programme of the

ILO limits itself to the most general of statements -- and I think bases its satisfaction on the popularity of ILO consultative services with their clients. A larger scale assessment of consultancy efforts in India is now underway (to which the Bank is contributing), under the auspices of the Management Development Institute in Delhi and its results should give us some guidance here.

More so than in the case of management training there is a strong belief that much management consultancy in the LDCs has been inappropriate at best and of low enough quality to be counterproductive at worst. On the other hand, some consultants have performed crucial roles either in substituting for missing manpower or catalyzing the indigenous manpower that is already in place.

Finally there are a multitude of management improvement activities in the private sector. The literature of multinational investment and collaboration is too vast to be summarized here. It seems clear that on the one hand multi-nationals and expatriates provide critical entrepreneurial and managerial skills -- on the other hand, they may foreclose opportunities for indigenous entrepreneurship and management. On the former count, an older study by Geiger and Armstrong (The Development of African Private Enterprise, NPA, Washington, D.C. 1964) shows how the United Africa Company encouraged Ghanians and Nigerians to start factories to supply it with consumer goods and agencies to sell for it up-country. De Wilde shows that former artisan employees of MNC's are a prime source of industrial entrepreneurs. On the other hand, precisely the power of large multinational agencies has kept Africans from moving into a number of industrial and commercial fields.

It may be that newer forms of multinational involvement -- involving use of indigenous management (now more characteristic of large multinationals than smaller expatriate firms) collaborations with individual indigenous entrepreneurs, and consultancy arrangements maximize the multi-nationals' potential for encouraging national development. It is certainly with that end in view that more and more LDCs have enacted legislation requiring that multinationals indigenize their management, take on local collaborators, and transfer technology. There is a good deal of indication -- that indigenous businessmen involved in these collaborative roles in the past as "compradors" in the Leninist sense -- have often become modern managers and entrepreneurs. 1/

As an empirical matter a large number of entrepreneurs acquire their skill and save money working for multinationals, parastatal and large scale enterprises before opening up in business for themselves. This seems almost the mode for a large group of artisan entrepreneurs in the LDCs particularly those involved in ancillary type small scale enterprises.

VALUE ISSUES

We are left with the need to consider the three basic value questions which the whole field of management and entrepreneurship poses. Roughly the three questions are of selection, techniques and incentives.

The question of selection is that of determining who the entrepreneurs and managers are to be, and what should be their preparation? From where should they come? In a competitive market, the answers to these get

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1/ Yen-Ping Hao, The Comprador in Nineteenth Century China, Harvard U.P., Camb. Mass., 1971.

some post hoc market validation but they still have to be answered a priori by banks and funding agencies -- as well as extension agencies.

The question of techniques is one of what sort of tasks entrepreneurs should perform and what management systems they should use. This question is subsumed in the broader one of what goals the economy should set for itself.

The question of incentives is one of how much and how entrepreneurs and managers should be rewarded for doing their job.

The answers to these questions and therefore the kinds of managers and entrepreneurs to be encouraged depends to a considerable extent on what model of development one wants to pursue.

On one extreme, the individualist model requires everyone to secure his interests through the market as much as his initial resource endowment will permit. If the market is competitive it will reward his productive efforts and provide him an optimal collection of goods to consume.

On the other extreme, the collectivist model will determine collectively the goods to be allocated to individuals and managers and entrepreneurs will try to produce them as expeditiously as possible. Managers' economic rewards must not be so excessive as to violate society's decision about the allocation of consumption. The ideal is summed up here in the phrase -- "from each according to his abilities to each according to his needs." By contrast in the pure individualist model the slogan might well be "from each according to his needs to each according to his ability."

Market mechanisms might well be used to allocate intermediate goods in the collectivist model -- or to allocate goods about which society is indifferent -- but these mechanisms must not be permitted to undermine the social order which it is desired to create.

In the individualist model entrepreneurs and managers are selected according to their ability to perform their role in the market mechanism to maximize profit. They use a set of techniques which enable them to maximize profit. And they are rewarded sufficiently to encourage them to put out their optimal effort.

In the collectivist system managers and entrepreneurs are selected because of their responsiveness to social imperatives -- use techniques that maximize the fulfillment of these imperatives, and are rewarded in ways that do not imperil the social order to be created.

In practice, most social systems are located in an intermediate state, where some reward, even if disequalizing, goes to higher productivity, and some goods are allocated on the basis of socially determined need. Where each economy lies along this continuum affects the sort of entrepreneurship that is encouraged.

Obviously, countries with strong reservations about individualism and the market provide little encouragement to private sector entrepreneurs and managers to enter a market economy. It is only in a market economy that the private sector is justified. Those few entrepreneurs and managers who continue to exist in the private sector are at a disadvantage in a collectivist society in securing credit, markets and raw materials as compared to socially owned enterprises which are presumed by the government to be more socially responsive. In addition, uncertainty continues to affect the private sector as to whether it will be permitted to continue to operate in the future. This situation -- in respect to private sector enterprise -- is true not only in the centrally directed economies but is reported as well from countries whose position is ambiguous or even nominally favorable to private

sector enterprise -- Tanzania, Zambia, Bangladesh to say nothing of Guinea, Algeria and Mali. In these cases private sector entrepreneurship and management cannot be expected to flourish. Contrariwise, it is essential that public sector management be of a high level -- since it carries the entire weight of the economy. The kinds of public inefficiencies described by Galbraith's term, "Post Office socialism," are sustainable when like the typical post office department in a market economy one is dealing with a small segment of the economy. These inefficiencies are insupportable if they characterize all areas of the economy. In these non-private sector oriented economies, the residual private sector must be given firm guidelines about its future, and allowed sufficient scope to operate in the areas that remain to it.

Other countries encourage for political or productivity reasons the small scale private sector, in preference especially to the large-scale private sector. As a matter of fact, the encouragement is often limited to that small part of the small scale sector which meets all of the government's criteria. In any case, more general government policy, e.g. to limit imports to protect domestic large scale industry, may in fact handicap small units more than any assistance provided. In these pro-SSE countries, elaborate extension and financing operations exist to service the small scale sector and small scale units may be given preferential access to raw materials, government markets, and even have the production of certain products reserved for them. Large scale enterprise and international trade may be limited to permit these enterprises to grow.

Despite all of these incentives the aided sector of SSE, particularly that not ancillary to large and medium scale industry often lacks dynamism as

compared to the unaided informal sector. And the control mechanisms designed to help the small units often hurt them. For example, licensing requirements, frequently justified as an anti-monopoly measure -- often discriminate against small units.

Other countries encourage the whole range of domestic private sector enterprise -- because of a general commitment to the market economy model -- and provide training and subsidy to it -- and incentives to private sector managers and entrepreneurs. In several of these countries there is an explicit policy - as in Malaysia or East Africa - to force the inclusion of certain ethnic groups at various levels of management and entrepreneurship.

If we subscribe to market and efficiency values -- we permit multinationals, expatriate management and big business to thrive (as in Brazil and the Ivory Coast) to the extent that they do not exploit market imperfections. Otherwise we limit their scope to provide market space for production by public or smaller indigenous firms (as in India), we promote the indigenization of management even at the cost of productive efficiency (everywhere). On the other hand, we may argue on productive efficiency grounds that these large scale enterprises owe their entire position to market imperfections -- and that a pattern of smaller indigenous enterprises using intermediate level technologies is more appropriate. But it seems to be true that the larger enterprises are more efficient than public sector enterprises in many cases -- that have they advantages beyond their monopoly position -- and that intermediate technologies do not emerge may well indicate that they are not viable. Or we may choose to oppose the promotion of bourgeois values and espouse a collectivist model of enterprise (as in Cuba). In each case, there are logical

implications for who shall be permitted to be entrepreneurs and managers, how they should be trained, how they should be rewarded and what kinds of management systems they should use.

V. SOME METAPOLICY

The policy implications of the foregoing report for the Less Economically Developed Nations are clear.

(1) The LDC should determine what sort of entrepreneurial or managerial gap it has.

(a) By seeing if there are difficulties in generating new projects and why.

(b) By seeing if consultants can measurably increase productivity, by seeing how much excess capital capacity it has, and by comparing its actual production from its productive plant with the ideal.

(c) By seeing if small scale enterprises find it easy to expand.

(d) By surveying the social origins of entrepreneurs and managers and deciding if their distribution is acceptable.

(2) The LDC should decide what sort of management or entrepreneurship it wants -- to what extent it is interested in a market system and individualism, in small and large scale industry, and so forth.

(a) If it is concerned with productivity it should:

Train managers and potential managers in proven management systems in marketing, finance, and labor relations as well as production management.

Develop new management systems by experiment and coordination with a program to

Provide Consultancy to laggard enterprises.

And it should adjust its other governmental policies -- pricing, trade, tariffs, manpower, incentives to provide an environment for maximum productivity.

(b) If it is concerned with a shortfall of enterpreneurs or their social origins it should provide a program to train, counsel, and finance entrepreneurs and help them over their marketing, production, and financial difficulties. This can be done by training -- mostly for the larger scale entrepreneurs - but is better handled by ongoing extension efforts for small scale enterpreneurs.

It is essential in each case that the effort be designed to address the specific shortcomings of the entrepreneurial group that is to be addressed. It is equally essential that the extenders have incentives -- possibly financial ones -- to make their clients succeed. There now exists a considerable body of experience on the appropriate content for extension to entrepreneurs -- simple bookkeeping, costing and planning. There exists much less in experience about the appropriate ways to motivate extension workers.

The McClelland type of "n-achievement" training with small scale entrepreneurs has shown enough promise so that further experimentation with it is desirable.

(3) In all cases we need a more careful monitoring to tell us what program inputs increase productivity and entrepreneurial success. On the productivity side, we need systematic, independent evaluations of consultancy programs showing their contributions to productivity. We need post-evaluation of training showing the subjective and objective effects on management performance. We need manpower projections showing the need for trained manpower. We need to compare cohorts of firms using different management systems to determine their relative effectiveness -- specifically to determine the appropriateness of modern management techniques. We need to develop a science of comparative management -- that will enable us to compare and assess management performance.

For more and better entrepreneurship, we need specific country by country studies specifying the specific obstacles to different sorts of entrepreneurship and proposing plans to generate those sorts of entrepreneurship.

LIST OF INSTITUTES

OF

PUBLIC ADMINISTRATION AND MANAGEMENT DEVELOPMENT

AFRICA

Algeria

Ecole Nationale D' Administration (ENA)
Institut National de Productivite et du Developpement

Cameroon

Centre D' Assistance Aux Petites et Moyennes Entreprises
Ecole Nationale D' Administration et de Magistrature

Egypt

Institute of Public Administration
Productivity and Vocational Training Department
National Institute of Management Development (NIMD)

Ghana

Ghana Institute of Management and Public Administration
Management Development and Productivity Institute

Ethiopia

Centre for Entrepreneurship and Management (CEM)
Ethiopian Institute of Public Administration

Ivory Coast

Centre Ivoirien de Gestion des Enterprises (CIGE)
Ecole Nationale D' Administration

Kenya

Kenya Institute of Administration
Kenya Institute of Management
Management Advisory and Training Centre

Morocco

Ecole Nationale D'Administration
Institut Superieur de Commerce et D'Administration

Nigeria

Centre for Management Development
Institute of Administration
Nigerian Council for Management Education and Training
Nigerian Institute of Management

Uganda

Institute of Public Administration
Uganda Institute of Management

Zambia

National Institute of Public Administration
Office of the Prime Minister, Management Development

ASIA

India

Administrative Officers' Training School, Hyderabad
Indian Institute of Management, Ahmedabad, Calcutta, and Bangalore
Indian Institute of Personnel Management, Calcutta
Indian Institute of Public Administration, New Delhi
Institute of Public Enterprise
Lal Bahadur Shastri National Academy of Administration
Management Development Institute, New Delhi

Indonesia

National Institute of Public Administration
Indonesian Management Institute
Institute for Management Development

Iran

Industrial Management Institute
Iran Center for Management Studies
State Management Training Centre

Iraq

National Centre for Consultancy and Management Development
State Organization for Training, Employment and Rehabilitation

Israel

Institute of Public Administration
Israel Institute of Productivity
Israel Management Centre

Malaysia

National Institute of Public Administration
Malaysian Institute of Management (MIM)

Korea

Korea Management Development Institute

Lebanon

Industry Institute
Lebanese Management Association
National Institute of Administration

LATIN AMERICA

Argentina

Centro Interamericano de Capacitacion en Administration
Instituto Nacional de Technologia Industrial (INTI)
Management Center de Argentina

Brazil

Escola Interamericana de Administracao Publica
Management Center do Brazil

Colombia

Instituto Colombiano de Administracion (INCOLDA)

Jamaica

Jamaica Institute of Management
Jamaica Productivity Centre

Chile

Escuela Nacional de Adiestramiento de Funciones Publicas
Instituto Chileno de Administracion Racional de Empresas

Paraguay

Centro de Desarrollo y Productividad
Escuela Paraguaya de Administracion Publica

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A WORLD MARKET OUTLOOK FOR

CHEMICAL WOODPULP

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SUMMARY AND CONCLUSIONS

1. The largest chemical woodpulp consumers in the world are the United States, Western Europe and Japan. Their consumption reached 65 million tons in 1978 and accounted for 80% of world total. The most important chemical woodpulp producers and exporters are Canada, Sweden, the United States and Finland; in these countries woodpulp is traditionally produced from softwood species of Northern Hemisphere, often at large, export-oriented mills.

2. The developing countries account for about 7% of total world chemical woodpulp consumption, with their share of production at only about 6%. Expansion of pulp and paper industry in the developing countries has been accelerated in recent years on the basis of growing domestic demand. Increased possibilities to use fast-growing plantation woods and (to a lesser extent) hardwoods as pulping raw materials have stimulated expansion of pulping capacity in the Southern Hemisphere; some countries even have opted for large-scale, export-oriented pulp production as a part of their development strategy.

3. In the 1980s, as the import requirements of woodpulp in world markets are likely to grow at least at a moderate rate, the role of bleached pulps in general and that of hardwood pulp specifically, are bound to become increasingly significant. Western Europe and Japan are expected to increase their dependence on imported woodpulp. North America will continue to dominate the supply of bleached softwood sulphate pulp. The U.S. pulp producers located in the Southern states, who enjoy a considerable advantage due to their low wood costs, will further enhance their competitive position. Availability of low-priced chips will safeguard British Columbia's competitive position in the future, although limits for capacity expansions based on low-cost wood are in sight.

Due to tightening wood supply, high costs of raw materials and further integration of paper production, market pulp supply from Nordic countries is likely to diminish further and the power of price-setting in international markets will shift farther toward North America.

4. The developing countries are expected to become important suppliers not only of bleached hardwood sulphate pulp, but also of softwood sulphate pulp; Latin America has already begun pulp exports; it is expected to be followed by Africa. So far, pulp exports from the developing countries has had only a limited impact on international pulp prices and trade flows, but as their export volumes expand, their influence on prices and trade flows is likely to increase. If the proposed capacity expansions, especially significant in Latin America, are further delayed, a deficit might develop in the world bleached sulphate markets by 1990, with upward pressures on prices.

5. Despite the apparent advantages, such as the availability of low cost wood and possibilities to benefit from an optimal mill size, the cost-effectiveness of export-oriented pulp production in developing countries depends on several factors which decisively affect the feasibility of such pulp production, and these must be critically evaluated on a project by project basis:

1. ability to penetrate traditional market (marketing "know-how");
2. availability and the development of skilled labor;
3. transportation costs, i.e., proximity of major markets;
4. inadequate local cooperation to make full use of nearby markets;
5. the capital-intensive nature of production;
6. availabilities of subsidies and incentives;
7. other competing uses of planted wood (e.g., increasing need for fuelwood and charcoal);

8. concentration of pulp and paper production in traditional markets in terms of physical and financial integration;

9. ability of lower-quality woodpulp grades to compete with pulp produced from wood species of Northern Hemisphere;

10. the effects of tariff and non-tariff barriers in paper and paperboard trade, if a project for market pulp production is later intended to be integrated with export-oriented paper and paperboard production;

11. the pricing policies of established woodpulp producers; the high costs of new pulp mills have little effect on international pulp prices because they represent a minor percentage of the total capacity of market pulp mills.

12. in many cases production costs in the develop- countries have turned out to be higher than anticipated.

6. In the long run real prices for bleached softwood sulphate woodpulp in international markets are expected to rise at around 0.25-0.50 percent per annum. Thus, an upward trend in real woodpulp prices experienced in the 1970s is likely to continue. Inter alia, tightening wood supply in the traditional wood supply areas is anticipated to have an impact on the woodpulp prices. In 1985, the price of bleached softwood sulphate in international markets is projected to be around US$500 per metric ton (constant 1979 dollar terms). Good-quality hardwood pulps (e.g., eucalyptus and gmelina) coming from developing countries are expected to be competitive both in quality and price with traditional market pulp grades, although price differences tend to widen at the time of slackening demand.

RECOMMENDATIONS

7. From the point of view of the World Bank Group it would be most desirable to follow on a regular basis the price development of bleached softwood sulphate in the Western European markets. Western Europe is the largest importer of woodpulp and is the most competitive market. The West German import price of

bleached softwood sulphate is considered the most suitable for the World Bank's projection purposes. To monitor the changes in Scandinavian list prices, as announced for West European markets, and U.S. domestic list prices for bleached softwood sulphate pulps would be useful for checking purposes. It is also necessary to follow prices of pulps which have quality characteristics similar to those manufactured in the developing countries.

8. In the future work, it would be desirable to construct a model for long-term price projections where key cost variables are included. The present report indicates that woodpulp prices in international markets are determined more by those on "demand side".

9. In updating woodpulp price projections it would be valuable to update the calculations of the woodpulp sales price required for new mills to make reasonable profits. Comparison of the required sales price based on cost calculations with the woodpulp price projections based on past price trends and future supply and demand prospects would give an indication of adequacy of actual and anticipated selling prices to cover the production costs of pulp to be produced by new capacity additions; assuming an acceptable rate of return on new investment.

10. An alternative for producing woodpulp in developing countries is production and exports of chips. In accordance with tightening pulpwood supply in present producer regions, import requirements and prices of chips are expected to increase in the future. From the point of view of the World Bank Group, it might be desirable to pay increasing attention to contributions to promote chip production as an alternative with pulp mill. For example, in the Liberian forestry project, chip production (sawlogs with chips) was found to give an economic internal rate of return only slightly lower than an alternative with pulp mill, although a difference in the scope and economic impact of a long-term industrial plantation program with and without a pulpmill was significant.

I. INTRODUCTION

1. In the 1970s the World Bank Group's lending for forestry and forest industries expanded rapidly. In 1968-80 forestry lending alone amounted to about US$610 million spread over 38 countries and some US$200 million was loaned for the establishment of pulp and paper capacity as part of Industrial Projects Department lending. 1/ In addition, International Finance Corporation's original commitments for establishing pulp and paper capacity were in magnitude of US$140 million. 2/ Total forestry lending in FY80, excluding pulp and paper, amounted to US$218 million representing a ten-fold increase over the average level of forestry lending in the 5-year period prior to 1978 and approximately double the annual rate of lending proposed for the 1979-83 period. In future lending programs for forestry plantations, tree farming, rural development projects with forestry components are likely to expand further.

2. main purpose of this study is to provide a price scenario for chemical woodpulp which might be used as a basis for evaluating Bank Group projects involving woodpulp and pulpwood. 3/ In addition, the study attempts to bring together the most recent data on woodpulp consumption, production, trade and production costs, which would be useful for project appraisals. Future trends in world paper and paperboard markets are briefly commented upon to cast light on

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1/ M. Yudelman and J. Spears, Bank Forestry Sector Activity, FY80, World Bank/ IFC Office Memorandum, June 20, 1980.

2/ International Finance Corporation/Annual Report 1980; total IFC (loan & equity) US$110 million and total syndications US$30 million.

3/ A review of the World Bank Group appraisal reports and President's Reports was carried out to summarize past practices on calculating long-term international woodpulp prices. The results of this evaluation are given in Annex I.

expected developments in these markets because they would significantly influence the feasibility of the woodpulp industry.

3. In this study the main emphasis is given to prices of bleached sulphate market pulp, a dominant woodpulp grade in international trade. In 1978, its share of world chemical woodpulp exports was 70% and its significance is expected to increase further in the long run. Sulphate market pulp has primarily been produced from softwood species of the Northern Hemisphere, but the market picture is changing. Increasing quantities of hardwood pulp will enter world markets in the future when a number of export-oriented pulp mills based on fast-growing hardwood plantations and/or mixed tropical hardwoods will be in operation. For example, in 1979 Brazil exported 600,000 tons of eucalyptus pulp. Because the relationship between prices of softwood and hardwood pulps is of special interest to the World Bank Group's project work, the price differentials among various pulps is reviewed in this paper.

4. Price projections for market pulp are primarily based on expected trends in major supply and demand regions (i.e., North America, Western Europe, Japan) which in the 1980s still are expected to affect the price development of woodpulp most decisively.

II. DEMAND FOR WOODPULP

A. Demand and Supply Prospects for Paper and Paperboard

5. Demand for woodpulp is a derived demand. Basically paper and paper board consumption determines how much fiber furnish (woodpulp, recycled paper, non-wood fiber like bagasse or reed pulp) paper and paperboard mills will use in the production process to satisfy both local demand and import requirements of areas in short supply. 1/

1/ Definitions on different pulp grades and conversion factors are given in Annex IIA.

6. Consumption of paper increased rapidly from 73 million tons in 1960 to 144 million tons in 1973-75 (Annex Table III.I).In 1975, however, consumption was seriously hit by the worldwide recession, declining to 132 million tons. It recovered steadily in 1976-1979, reaching about 171 million tons in 1979.

7. North America, Western European countries (mainly EC countries) and Japan are the three largest paper consuming regions in the world, accounting for 75% of the total. Paper consumption in the developing countries has been increasing rapidly; their share of total world consumption increased from 6% in 1960 to 11% in 1979. However, their per capita consumption is still extremely low as compared to the industrialized countries (Table 1).

Table 1: PER CAPITA CONSUMPTION OF PAPER AND PAPERBOARD
1960 to 1978-79

	Industrialized Countries	Centrally Planned Economies	Developing Countries
	(kg. per capita)		
1960	91	8	4
1965	113	10	5
1970	138	12	6
1973-75	146	14	7
1978-79	160	14	8

Sources: FAO, Forestry Paper 4/1, 1977 and Pulp and Paper International, Annual Review 1980

8. According to FAO, world paper and paperboard demand is forecast to increase from 144 million tons in 1973-75 to a minimum of 281 million tons or a maximum of 350 million tons in 1990. 1/ An alternative forecast prepared by

1/ Source: FAO, Forestry Paper 4/1, 1977

the Industry Working Party (IWP) for FAO predicts that paper and paperboard consumption will amount to 256 million tons in 1990. 1/ In the light of current levels of consumption and the World Bank's outlook for world economic growth, the IWP forecasts appear to be the most relevant ones, except that the IWP forecasts for paper and paperboard demand growth in developing countries appears to be too pessimistic (Table 2). 2/ In any case, the FAO "high" projections are no longer relevant, given the prevailing world economic outlook for the 1980 decade.

Table 2: WORLD DEMAND FOR PAPER AND PAPERBOARD

	1973/75 Average	1979	1980 Low	1980 High	1980 IWP	1990 Low	1990 High	1990 IWP
	(million metric tons)							
Industrialized Countries	112.2	130.9	138.9	147.0	137.7	203.0	240.7	187.2
Centrally Planned Economies	18.1	20.6	25.1	27.2	24.1	43.7	54.9	37.3
Developing Countries	13.3	19.0	18.5	22.1	17.9	33.8	54.7	31.3
WORLD TOTAL	143.6	170.5	182.5	196.3	179.7	280.5	350.3	255.8
	(percents)							
% Developing Countries	9.3	11.1	10.1	11.3	10.0	12.0	15.6	12.2

Sources: FAO Forestry Paper 4/1, 1977 and Pulp and Paper International, Annual Review, 1980

9. The growth rate for paper consumption in industrialized countries is expected to decline in accordance with the performance of overall economic growth

1/ Source: FAO, Forestry Paper 4/1, 1977

2/ Economic growth rates used by FAO and IWP for major paper consuming regions are compared with the latest World Bank assumptions in Annex IIB.

and the declining population growth rate. Furthermore, in some grades such as newsprint, a natural saturation level is likely to be reached in some industrialized countries. Competition from plastics and other new materials has hit the packaging industry, though, the competitive threat from man-made fibers, such as plastics, somewhat diminished in accordance with increasing oil prices. The printing and writing paper sector is just beginning to feel the effects of electronic forms of communication and information storage. Electronic mail, electronic libraries and electronic transfer of funds, are all still in their infancy and are examples of the new techniques which could reduce demand for paper. In the long run, paper and paperboard demand will grow more rapidly in developing countries than in industrialized countries, although increases in absolute quantitative terms, will be larger in the industrialized countries than in developing countries. The share of developing countries in world consumption is expected to increase from about 10% in the late 1970s to as much as 16% by 1990, if the high income assumption-forecast would materialize.

10. A large share of the increased consumption of paper and paperboard in developing countries is still expected to be satisfied by imports from traditional supply areas, like North America and Western Europe. However, several developing countries have extensive plans for increasing their domestic supply in paper products. Their production plans are typically based on the utilization of locally available fiber resources, and the rapidly increasing domestic demand which presents opportunities for import substitution. So far, paper production in developing countries has taken place primarily in unintegrated mills producing woodfree printing and writing paper (i.e., fine paper) from imported pulp and packaging papers and boards from waste paper. Establishment of integrated units has often been hindered by financial difficulties, lack of infrastructure and insufficient domestic consumption to support economies of scale-production.

B. Future Fiber Requirements of the Paper Industry

11. According to FAO, fiber furnish input of the world paper and paperboard industry is likely to change gradually, i.e., from chemical pulp grades primarily to waste fiber. 1/ While white pulp's share of the percent furnish input is forecast to decline from 30% in 1972-74 to 26% in 1990, waste fiber's share would increase from 25% to 29% (Table 3). The share of mechanical pulp is expected to remain unchanged. In mechanical pulping, the thermomechanical process (TMP) is one of the newest developments, and a lot of new equipment has already been installed or is being planned.

12. Unbleached sulphate is seen to gradually lose its importance, while the significance of non-wood fibers and fillers/pigments will increase marginally in percentage terms. Waste paper is foreseen to replace mainly unbleached chemical pulp and mechanical pulp, but also bleached chemical pulp to some extent.

13. In quantitative terms world white pulp consumption is expected to increase from 44 million tons in 1972-74 to 67 million tons in 1990. From 1980 to 1990 demand increase is foreseen to be more than 15 million tons or about 1.5 million tons a year (Table 4 and Annex Table IV.1). In recent years white pulp substitution in paper and paperboard production has been slower than predicted by FAO (Figure 1).

14. The importance of hardwood pulps is increasing. Hardwood sulphate pulp consumption is forecast to reach 25 million tons in 1990. This means an annual growth rate of about 4% in the 1980s compared to 3.5% in softwood sulphate. Hardwood sulphate's share in total white pulp is projected to rise to almost 40% in 1990 from 25-30% in the mid-1970s. Hardwood sulphate's utilization is expected to increase most rapidly in production of printing and writing. In addition it is very suitable for production of household and sanitary tissue and top liner of folding boxboard.

1/ Source: FAO, Forestry Paper 4/2, 1977.

Table 3: FIBER FURNISH REQUIREMENTS OF WORLD PAPER AND PAPERBOARD INDUSTRY

	1972-74	1980 /a	1990 /a
	(% of product produced)		
Mechanical/Semi-Chemical	22.5	22.2	22.6
Unbleached Sulphate	20.6	19.8	18.4
White Chemical Pulp	29.8	28.6	26.2
Waste Fiber	24.7	26.9	28.8
Non-Wood Fibers	4.7	4.5	5.2
Fillers/Pigments	4.7	4.9	5.2
TOTAL FURNISH PERCENT INPUT	107.0 /b	106.9 /b	106.4 /b
	(million metric tons)		
TOTAL WORLD	157.3	192.1	272.1
Industrialized Countries	129.2	152.5	207.2
North America	68.6	78.0	104.6
Western Europe	42.4	50.9	66.0
Japan	16.4	21.2	32.6
Centrally Planned Economies	18.5	25.3	39.3
Developing Countries	9.7	14.3	25.6
	(percents)		
% Developing Countries	6.2	7.4	9.4

Source: FAO Forestry Paper, 4/2, 1977.

a/ Industry Working Party forecast for future paper demand is used as a basis when computing furnish input.

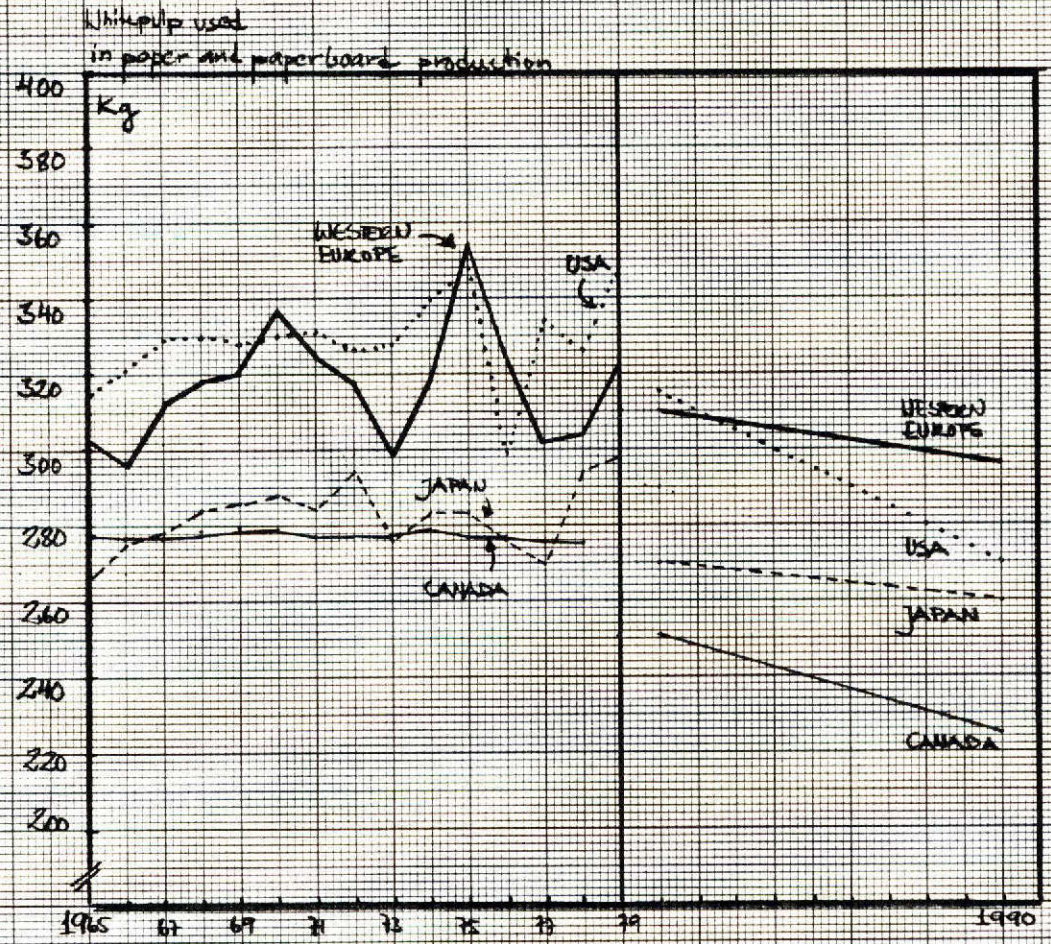
b/ 7-7% wastages in material are allowed for.

Table 4: PROJECTED INCREASES IN WORLD FIBER FURNISH REQUIREMENTS

	1972-74	1980	1990	Increase 1980-90
	(million metric tons)			
Mechanical/Semi-Chemical	33.0	39.9	57.7	+17.8
Unbleached Sulphate	30.3	35.6	47.1	+11.5
White Chemical Pulp	43.8	51.5	67.1	+15.6
Bleached Softwood Sulphate	18.2	22.8	32.0	+ 9.2
Bleached Hardwood Sulphate	12.4	16.8	25.1	+ 8.3
Total Sulphite	13.2	11.9	10.0	- 1.9
Waste Fiber	36.4	48.2	73.6	+25.4
Non-Wood Fibers	6.9	8.1	13.3	+ 5.2
Fillers and Pigments	6.9	8.8	13.4	+ 4.6
TOTAL FURNISH	157.3	192.1	272.1	+80.0

Source: FAO Forestry Paper, 4/2, 1977.

FIGURE 1. WHITE PULP CONSUMPTION IN PAPER AND PAPERBOARD PRODUCTION



SOURCES: OECD, API, FAO

15. In addition to technical considerations, the limited availability of hardwood sulfate supply and the traditional preference of papermakers for softwood sulfate have been working against the substitution process. However, increased experience in using hardwood sulfate, reasonably good quality characteristics as well as somewhat lower price levels compared to softwood pulp are considered to be the major encouraging factors for further substitution.

III. WOODPULP SUPPLY AND TRADE

A. Principal Producers and Grades

16. In 1978 about 80 million tons of woodpulp was produced in the world, most of it in integrated mills. "Market pulp" is a marginal product in the world woodpulp economy; only about 25% of total woodpulp production or about 20 million tons 1/ is traded in open markets (the rest being "captive" within integrated producers). Most of "market pulp" is in bleached grades. In addition to regular market pulp producers, there exists swing capacity in world markets; i.e., during slackening demand for paper some integrated paper producers sell a part of their production as pulp to maintain utilization rates. Swing capacity is most important to the U.S.

17. North American 2/ and Scandinavian countries are the biggest producers and exporters of chemical woodpulp in the world. In 1978 their shares of total chemical woodpulp production and exports were 70% and 80% respectively (Figure 2). EC countries, Japan and the United States are the principal importers (Annex Table V.1).

18. Operating ratios of major chemical woodpulp producers are shown in Figure 3. In the last fifteen years the U.S. pulp industry, which is based

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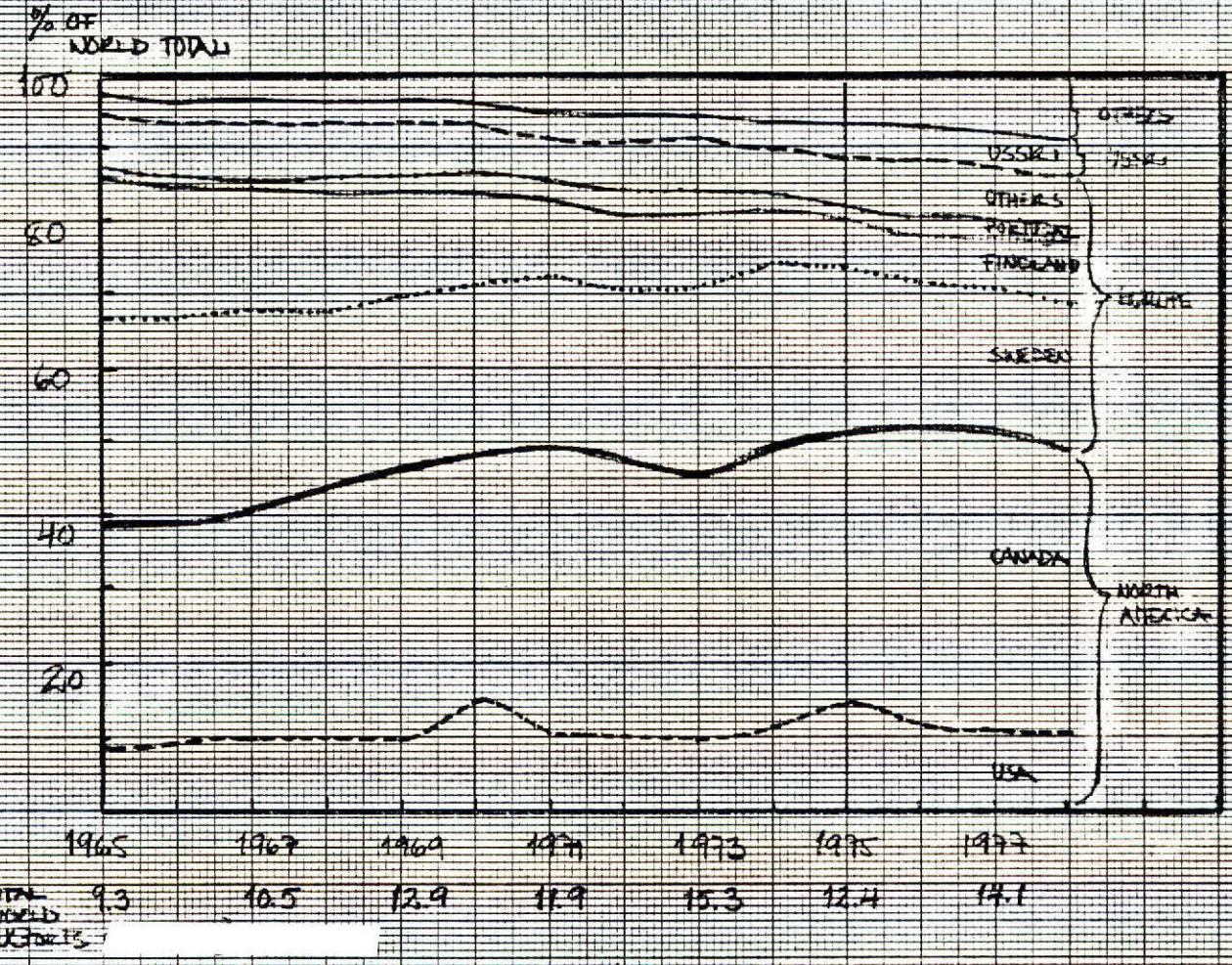
1/ Estimates based on Norscan (North American and Scandinavian market pulp producers) production data and worldwide trade statistics; Paper Trade Journal, June 30, 1980 and FAO Yearbook of Forest Products, 1978.

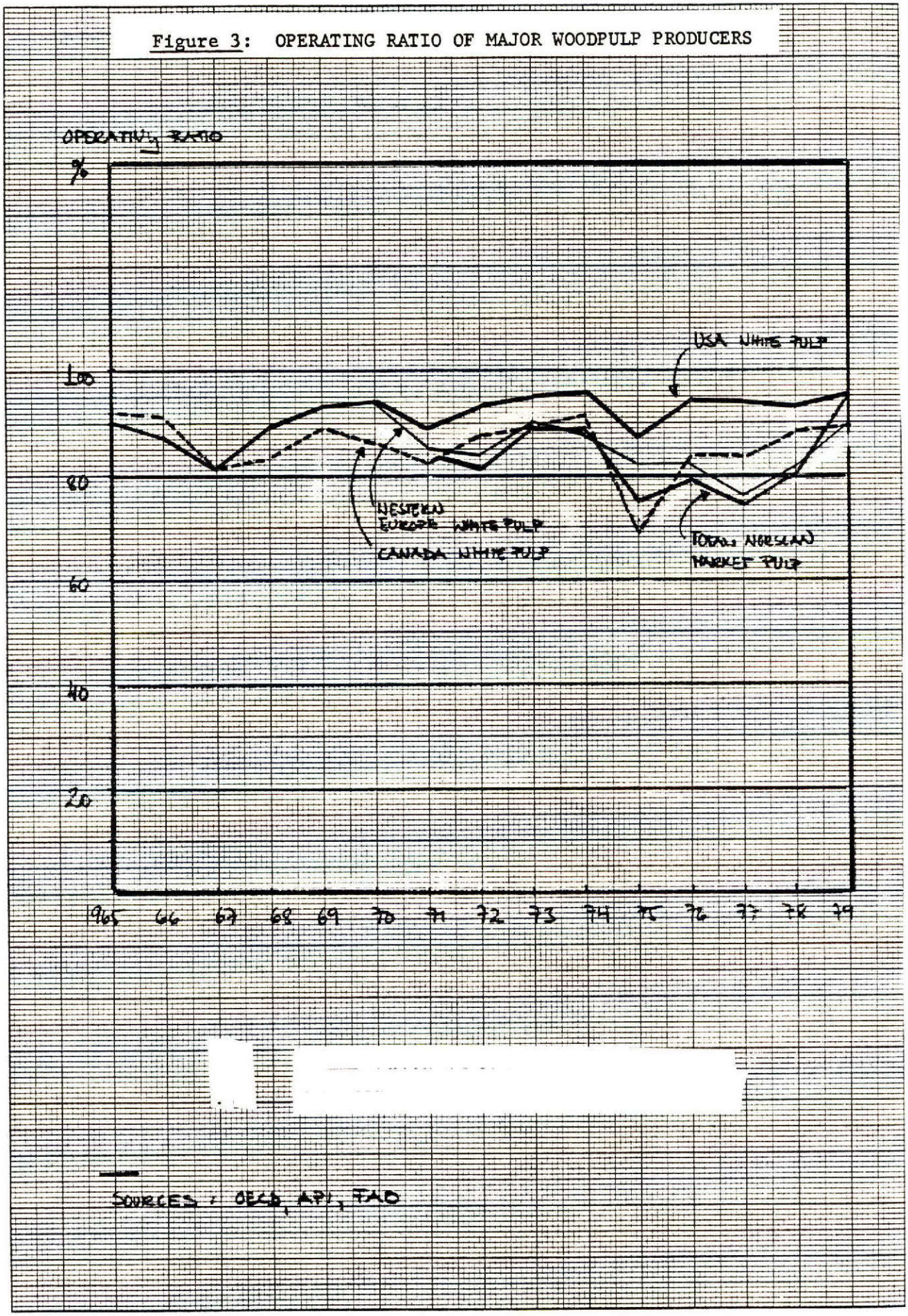
2/ As a whole the U.S. is a net importer of chemical woodpulp; in 1978 U.S. imports of chemical woodpulp were 3.3 million tons (primarily from Canada), while exports amounted to 1.6 million tons.

Figure 2: CHEMICAL WOODPULP EXPORTERS 1965-78



SOURCE: FAO

Figure 3: OPERATING RATIO OF MAJOR WOODPULP PRODUCERS



predominantly on domestic demand, has been performing well. During periods of weak demand in domestic markets U.S. producers have tended to enter international markets with low-priced spot lots in order to keep their mills running at close to full capacity utilization. In areas with strong export-oriented pulp production, like Canada, Sweden, Finland and Chile, capacity utilization is quite sensitive to fluctuations in international markets and year-to-year changes in capacity utilization tend to be violent.

19. In 1978, developing countries accounted for only 6% of world chemical woodpulp production and their share in world import tonnage was 7.5%. In 1978, the net import bill of developing countries due to paper and paperboard and chemical woodpulp imports was in the magnitude of US$2.4 billion. Their export earnings totalled US$470 million.

20. In 1978, the share of chemical woodpulp in world woodpulp exports (excluding dissolving pulp) was 92%. Among chemical woodpulps, bleached sulphate is the most important grade; from 1968 to 1978, the latter's share of total world exports grew from 56% to 70% (Figure 4).

B. Structure of Industry

21. In 1979, 60 companies among the top 100 pulp and paper manufacturers produced almost 14 million tons of market pulp (including dissolving pulp) or 55-65% of the world's total (Annex Table VI.1). 1/ Forty companies had an annual production of 100,000 tons or more. In the U.S., International Paper, Weyerhaueser and ITT Rayonier annually produce about one million tons of market pulp each. In Canada top producers are British Columbian Forest Products, MacMillan Bloedel and Canadian Cellulose (CC not among the top 100). Sodra Skogsagarna, Stora Kopparberg

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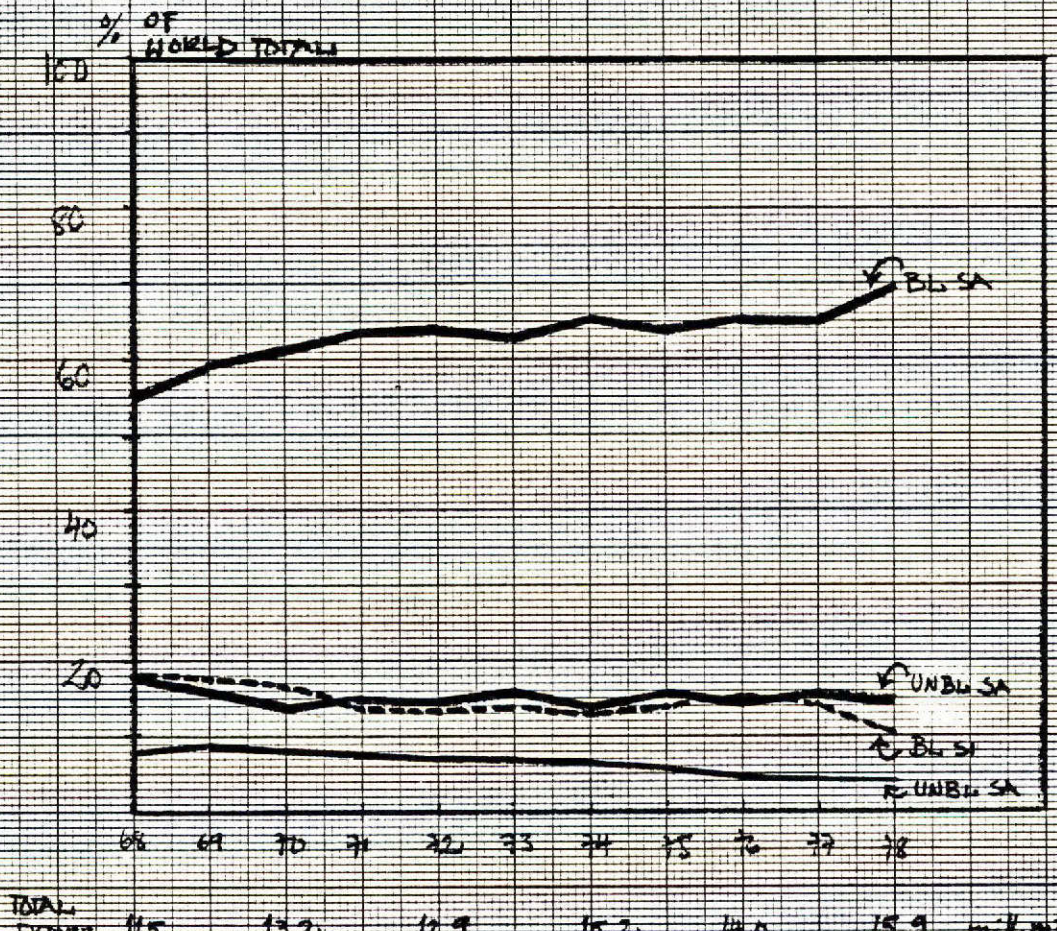
1/ Source: Pulp and Paper International, September 1979.

Figure 4: CHEMICAL MARKET WOODPULP EXPORTS BY GRADE 1968-78



SOURCE : FAO, FORESTRY TAPES

and Mo och Domsjo are the largest Swedish producers. Both North American and Scandinavian producers supply market pulp for national and international markets. In North America, pulp producers are more extensively financially integrated with paper and paperboard production than producers in Scandinavia. 1/

22. Both North American and Scandinavian pulp producers have invested in paper and paperboard production overseas, mainly in Western Europe, to guarantee markets during depression. Because woodfree printing and writing paper and tissue are major end-products of chemical pulp, these products have been of special interest to pulp producers. Tissue products are particularly difficult to transport in a cost-efficient way and are, therefore, produced in close proximity to the market. "Also, since thorough knowledge of consumer preferences for tissue products is an essential ingredient in the marketing and manufacturing of these products for foreign consumption it is by necessity located abroad". 2/ It is estimated that in 1976 North American producers controlled 12% of Central and South European paper and paperboard production; the share of Scandinavians was 5%. 3/

23. North American and Japanese pulp and paper companies are co-financers and know-how partners in some Brazilian and Southeast Asian pulp projects. For example, Cellucam in Cameroon is primarily sponsored by the Government, but an Austrian firm which has been supervising the construction, is a financial partner in the project. In some cases the marketing know-how of traditional producers is

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1/ Pulp and Paper, September 1980 estimated that in North America the share of the top five companies of paper-grade chemical market pulp capacity was (1980) 33.1% and that of the top ten companies was 57.3%.

2/ Source: Pulp and Paper, January 1979.

3/ Source: Paper, Volume 189, No. 10, 1978.

utilized by the producers in developing countries to penetrate the traditional markets; some Brazilian pulp is sold through Finncell (a joint marketing organization of Finnish woodpulp producers) and Svenska Cellulosa Aktiebolaget, a Swedish forest products company, acts as Cellucam's sales department.

C. Importance of Western European Markets

24. Western Europe is the largest importer of woodpulp and is the most competitive market, taking into account that a large part of North American pulp sales are captive 1/ by nature. This applies particularly to pulp produced in Canada and consumed in the United States. In 1978, the OECD-Europe's share in the world chemical woodpulp imports was 50% or 8.3 million tons. The share of OECD-Europe increases to 65% if interregional trade between Canada and the United States is excluded.

25. Since 1965 the export share of North American woodpulp producers in Western European markets has increased rapidly; it rose from 18% in 1965 to 43% in 1978 (Figure 5). At the same time the share of Nordic countries has declined to 57%. The decreasing export share of Scandinavia is partly due to the fact that the limits of physical production potential of forests have been reached. In addition, woodpulp producers are increasingly willing to have an integrated paper production in order to minimize the high level share of wood costs in an end-product.

26. In the recent years pulp exports from the Southern states have started to disrupt the supply and price picture in Western European markets. In spite of long distance transportation costs, U.S. producers (i.e., mainly Southern states) enjoy a competitive advantage over the Scandinavian countries due to

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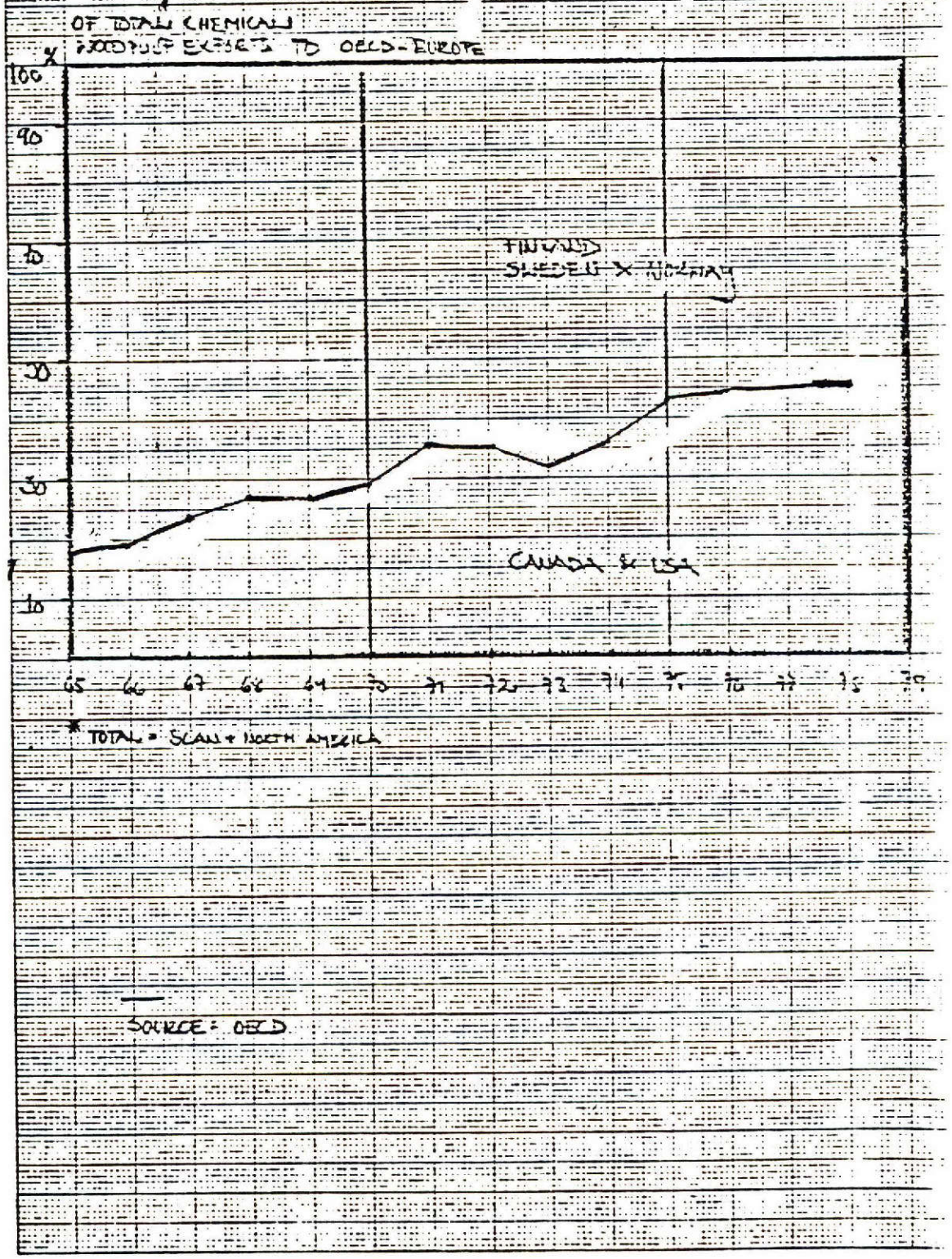
1/ Captive pulp is pulp produced for use in the same mill or in mills owned and controlled by the affiliated consuming mill.

Figure 5: INCREASING NORTH AMERICAN CHEMICAL WOODPULP EXPORTS TO OECD-EUROPE



lower wood costs, cheaper labor, rather ready availability of capital and the huge economies of scale made possible by the size of U.S. markets. 1/ Canadians compete favorably in Western European markets mainly because of availability of low priced softwood chips.

27. The importance of new supply sources in Western European markets has slowly been increasing. In 1978, producers other than North Americans and Scandinavians supplied 20% of woodpulp imports of the EEC countries. Most new and proposed export oriented pulp mills in the developing countries actually export, or are planning to export, their pulp to Western Europe.

D. Future Capacity Expansions

28. An increase of 21 million tons of paper making pulp capacity is expected to take place over 1979-84. Mechanical pulp will account for 5.7 million tons (including 4.6 million tons of TMP), semi-chemical for 1.2 million tons, chemical pulp for 11.2 million tons and 2.4 million tons will be other fiber pulp (Table 5). Other pulp will continue to play an important role in providing domestic raw materials for papermaking in developing countries. For example, in Asia the proportion exceeds 50%.

1/ Source: Financial Times Survey, Tuesday, May 15, 1979.

Table 5: WORLD PULP CAPACITY EXPANSIONS 1969-84 /a

	Total Capacity				Growth Rate		
	1969	1974	1979	1984	1969-74	1974-79	1979-84
	--(million metric tons)-----				-------(% per annum)---------		
Total Woodpulp	101.0	123.8	137.0	155.1	4.3	2.0	2.5
Mechanical	26.4	30.0	33.0	38.7	2.6	2.0	3.2
Semi-chemical	8.2	10.1	10.5	11.7	4.2	0.9	2.2
Chemical	66.4	83.7	93.5	104.7	4.7	2.2	2.3
Other Fiber Pulp	7.3	7.9	11.0	13.4	1.6	6.7	4.0
Dissolving	5.3	5.9	6.0	6.5	2.2	0.3	1.4

/a Currently announced capacity expansions.

Source: FAO, Pulp and Paper Capacities Survey 1979-84, 1980.

29. All but a small proportion of woodpulp capacity is located in the industrialized countries. With the implementation of new pulp mills in developing countries their share of world woodpulp total is expected to be about 8.5% in 1984 compared to 4.9% in 1974.

30. In 1979-84 an increase in capacity of chemical woodpulp will take place predominantly in North America, Latin America, Western Europe and the Soviet Union. Start-ups of new facilities in Cameroon, Gabon and Nigeria will mean that Africa will also become a significant producer of chemical woodpulp (Annex Table VII.1). The estimated plans for 1980-84 indicate that close to 70% of the chemical pulp capacity increase in the world will be in bleached grades and about two thirds of this increase in hardwood pulp.

E. Prospects for Net-Trade

31. Projections for white pulp net trade suggest that Japan and Western Europe will become increasingly dependent on pulp imports, and the developing countries are expected to meet the bulk of their increased needs for bleached hardwood sulphate pulp. North America on the other hand, is foreseen to continue dominating the interregional supply of bleached softwood sulphate pulp (Table 6).

32. In light of actual export figures and capacity expansion plans, it could be anticipated that North American white pulp exports will total at least 4.4 million tons in net terms in 1990, as suggested by FAO. 1/ However, while future expansion potential still exists in British Columbia, pulpwood supplies are considered to be very close to maximum potential in Eastern Canada. In the United States, high capital costs and a trend toward integrated facilities may limit capacity expansion in market pulp despite advantages of the South . 2/

32a. Latin America might be able to export more than 1.5 million tons in net terms to international markets in 1990; much depends on woodpulp demand growth in domestic and regional markets. At present, Brazilian producers are more attracted by export transactions than by sales to the home market; because of price controls, present woodpulp prices in Brazilian markets are about US$150-200 lower than export prices. In Brazil pulp producers are at present facing considerably higher production costs than originally expected.

1/ Source: FAO Forestry Paper, 4/1, 1977.

2/ Source: Pulp and Paper, September, 1980.

Table 6: WORLD WHITE PULP PROSPECTS FOR NET TRADE

	1972-74	1978	FAO Estimates /a 1980	FAO Estimates /a 1990
	(million metric tons)			
North America	+3,066	+4,297	+3,613	+4,354
US	-1,590	-1,563	-1,592	-2,040
Canada	+4,656	+5,860	+5,205	+6,394
Western Europe	-1,836	-2,429	-2,273	-3,444
Japan	- 565	- 945	-1,009	-2,464
Oceania	- 152	- 82	- 171	+ 83
Centrally Planned Economies	- 195	- 386	-	-
Developing Countries	- 587	- 237	- 160	+1,471
Latin America	- 342	+ 225	+ 249	+1,182
Africa, South of Sahara	- 57	(- 56 /b	- 81	+ 489
Near East and North Africa	- 9	(	- 34	- 62
Far East	- 179	- 406 /c	- 294	- 138
WORLD TOTAL	- 269	+ 218	-	- 166

/a Supply estimates for 1980 and 1990 are based on the assumption that in addition to currently decided and planned capacity expansions further expansion plans can be expected, taking into account, in particular, the trend of self-sufficiency ratios and the limiting effect of raw material, (i.e., a growth rationale).

/b Total Africa

/c Total Asia

Sources: FAO Forestry Paper, 4/1, 1977 and 1978 figures from FAO Yearbook of Forest Products, 1978.

33. Japan is expected to import about 2.5 million tons of white pulp in net terms in 1990, i.e., 1.5 million tons over the 1978-79 level. In the long run a key question is, whether the Japanese market pulp industry is competitive enough to increase its own production or whether Japan will have to rely more increasingly on pulp imports. Much is dependent on availability and prices of wood chips and their sea freight rates. Japanese pulp producers base nearly half of their raw material requirements on imported chips, predominantly from the Pacific Northwest.

Chip prices have increased from US$55 per BDU (bone dry unit) in October 1979 to US$130 FOB US West Coast in the second quarter of 1980, not to mention a steep rise in sea freight rates to Japan. 1/ The recent imbalance and rocketing prices on the West Coast chip market was caused by the sharp downturn in U.S. housing, which reduced the amount of residuals from the region's lumber and plywood mills to about 70% of their normal level by May 1980.

34. The Western European paper and paperboard industry is anticipated to rely increasingly on outside sources for white pulp; 3.5 million tons of net imports by 1990 is foreseen by FAO. This seems conservative, because in 1979 net imports already totalled 3 million tons. The Centrally Planned Economies are forecast to become self-sufficient, while the Far East's dependency on outside sources would remain unchanged. Africa is forecast to supply about 0.5 million tons of white pulp in net terms to international markets in 1990. Especially in the case of developing countries, it should be emphasized that selfsufficiency ratios, as indicated by FAO, will be reached only if the capacity expansions take place as planned. If the proposed establishment of new pulping capacity is considerably delayed, as is a case, for example, in Latin America, a deficit might develop in wood white pulp market by 1990.

IV. WOODPULP PRICES

A. Price Series and Price Fluctuations

35. To analyze price behavior in international woodpulp markets and to select a world indicator price for price projection, several bleached softwood and hardwood sulphate pulp price series were evaluated over the period 1960-79 (1980 I-II):

1/ Source: The Swedish Timber and Wood Pulp Journal, May 1980.

NORTH AMERICAN MARKETS (Annex Table VIII.1) 1/

1. US Domestic BL SW SA, d/d
2. US Domestic BL HW SA, d/d
3. CAN to USA BL SW SA, d/d
4. CAN to USA BL HW SA, d/d

WESTERN EUROPEAN MARKETS (Annex Table VIII.2)

1. SCAN to Western Europe BL SW SA (cif North Sea and Atlantic Ports of Europe*)
2. SCAN to Western Europe BL HW SA (cif North Sea and Atlantic Ports of Europe*)
3. Imports to West Germany BL SW SA (cif North Sea Ports**)
4. FIN to West Germany BL & SEMIBL SA (fob Finland)
5. FIN to United Kingdom BL & SEMIBL SA (fob Finland)
6. SWE to West Germany BL & SEMIBL SA (fob Sweden)
7. SWE to United Kingdom BL & SEMIBL SA (fob Sweden)

* As announced by Scandinavian producers.
** As recorded by West German import statistics.

JAPANESE MARKETS

1. JAP Domestic BL HW SA

36. Correlation analysis of nominal chemical woodpulp prices indicates a highly competitive nature of international woodpulp markets (Annex Table VIII.3). Only the correlation coefficients of Japanese bleached hardwood sulphate showed some deviation from price uniformity.

37. Real woodpulp prices have followed changes in the macroeconomic activity level fairly closely, though the amplitudes of downward and upward swings in prices have been more violent than in general business cycles (Figure 6). In the mid-1970s there occurred a considerable mismatch in the direction of changes in Western European markets; from 1973 to 1975 woodpulp prices remained firm though

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1/ BL = bleached pulp, SEMIBL = semibleached pulp
SW = softwood pulp, HW = hardwood pulp
SA = sulphate pulp
d/d = delivered, duty paid - basis
CIF = cost, insurance and freight paid - basis
FOB = free on board - basis
CAN = Canada, SCAN = Scandinavia, FIN = Finland, SWE = Sweden
US = The Untied States, JAP = Japan

economic growth in Western Europe was negative, while from 1975 to 1977, in spite of economic recovery, woodpulp prices collapsed. As will be discussed later, this development was by and large due to pricing policies of the North American and Scandinavian market pulp producers and the enormous inventory buildup in major producing countries.

38. Over the 1960-80 period, sensitivity of different price series to fluctuations was 2-3% per annum. 1/ The long-term fluctuation index reflects, however, only very broad trends; short-term price fluctuations have been much stronger in the 1970s than in the 1960s. In the 1960-70 period price fluctuations were around 2-5% per annum, while in 1970-80 (I-II) the year-by-year changes in prices were around 10-15% (Annex Table IX.1). In practice, pulp prices are not flexible downwards, as production is reduced rather than prices dropped.

B. Growth Rates of Real Prices

39. Least square average annual growth rates for prices of chemical woodpulps over 1960-80 (I-II) indicate that real woodpulp prices have been increasing slightly in the past 20 years (Table 7 and Figure 7). Average annual growth rates in the 1960s were in the range of -1.5 to +1.0% per annum and in the 1970s in the range of -1.0% to +3.5% per annum. North American woodpulp producers are found to have enjoyed substantial annual increases in real prices in the 1970s, if the U.S. Wholesale Price Index is used as a deflator, while in the 1960s prices declined in real terms. Similar results were obtained for Western European markets, when the Swedish and Canadian Wholesale Price Indexes were used as a deflator; in the 1970s these countries were the most important individual woodpulp supply sources in Western European markets.

39a. In addition, all price series were deflated by the International Price Index, but these results were not similar to those discussed above. Later on in this study the International Price Index is, however, considered the best possible deflator of world indicator price (i.e., the woodpulp price in Western European markets) taking into account the increasing number of woodpulp supply sources in Western European markets.

Figure 6 MACROECONOMIC ACTIVITY LEVEL AND WOODPULP PRICES IN WESTERN EUROPEAN MARKET

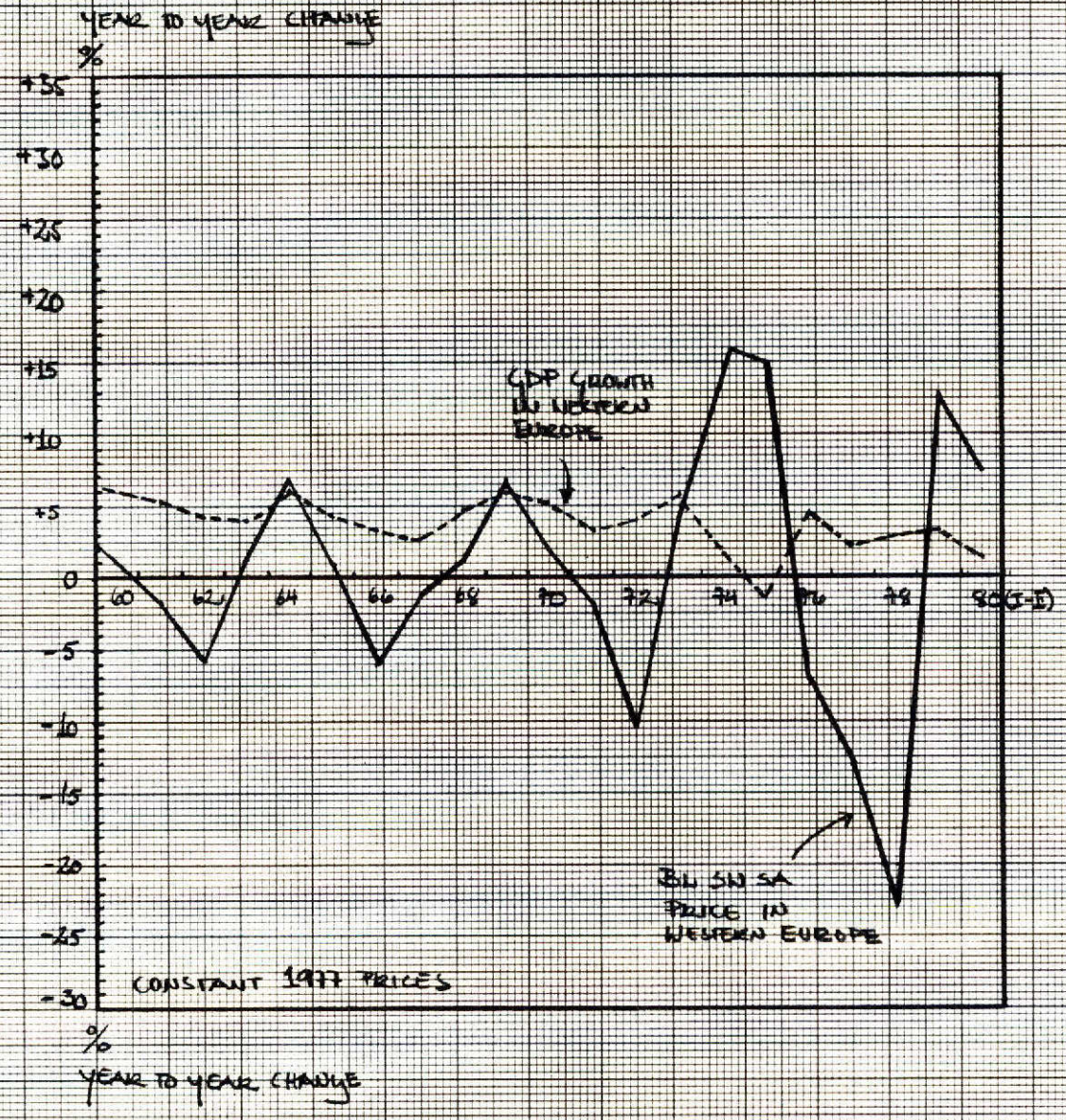

Figure 7: BLEACHED CHEMICAL SOFTWOOD SULPHATE PRICES IN REAL TERMS

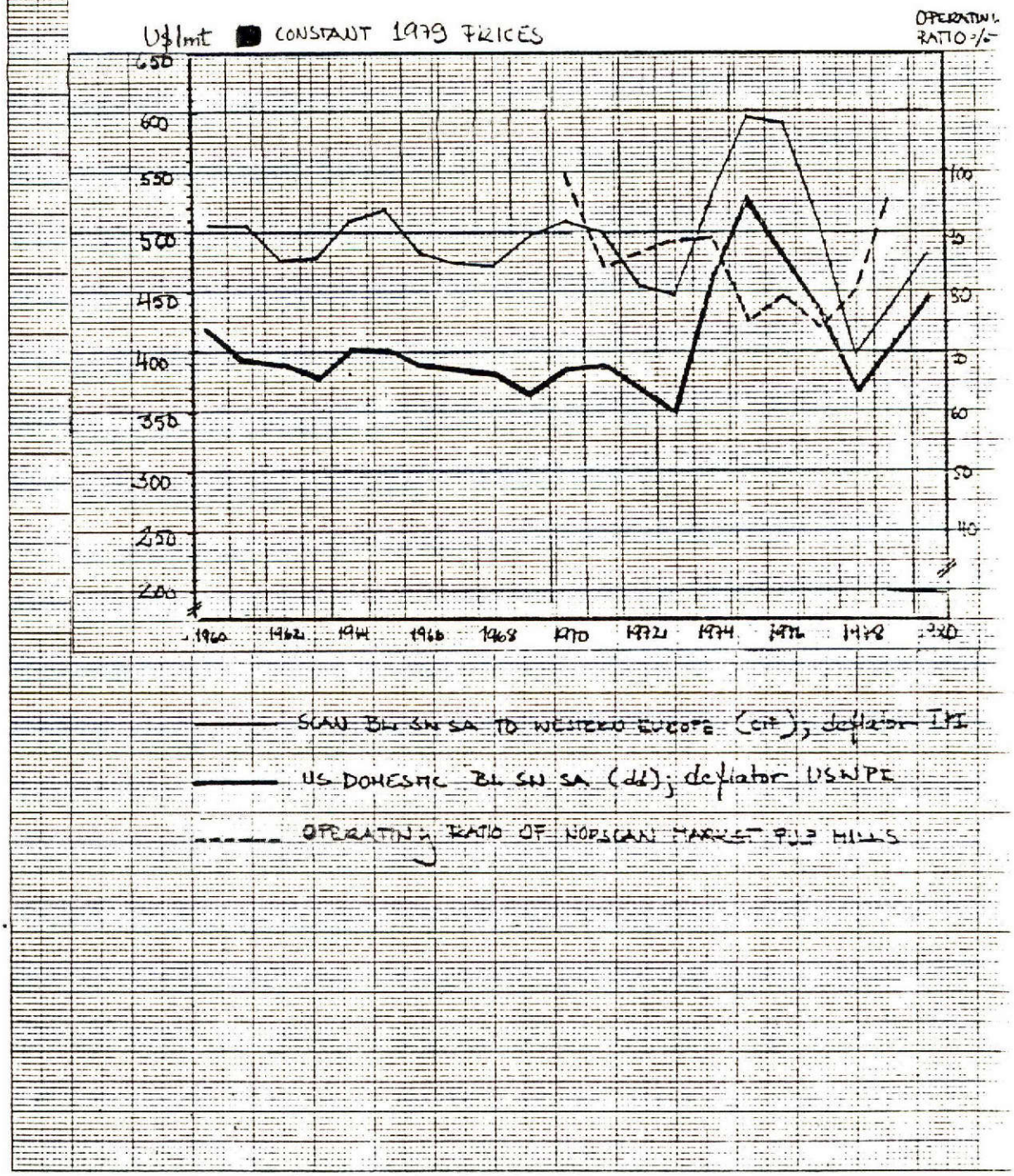

Table 7: GROWTH RATES FOR REAL PRICES IN CHEMICAL WOODPULP

	Least Squares Average Annual 1960-80 (I-II)	Average Annual (year by year) 1960-70	1970-80 (I-II)
	(% per annum)		
NA MARKETS			
US Domestic BL SW SA/dd (USWPI) /a	0.55	-0.72	2.30
US Domestic BL SW SA/dd (IPI) /b	-0.98	-0.31	-0.86
US Domestic BL HW SA/dd (USWPI)	0.48	-1.44	2.95
US Domestic BL HW SA/dd (IPI)	-1.04	-1.00	-0.39
CAN to USA BL SW SA/dd (USWPI)	0.91	-0.73	2.58
CAN to USA BL SW SA/dd (IPI)	-0.61	-0.31	-0.52
CAN to USA BL HW SA/dd (USWPI) /c	2.09	0.00	3.20
CAN to USA BL HW SA/dd (IPI)	-0.58	1.10	6.60
WE MARKETS			
SCAN to WE BL SW SA/CIF Europe (IPI)	-0.16	0.15	0.17
SCAN to WE BL HW SA/CIF Europe (IPI)	0.40	0.97	0.12
West German Imports BL SW SA/CIF (IPI)	0.08	0.45	0.20
FIN to West Germany BL & SEMI BL SA/FOB (IPI) /d	0.37	-0.07	1.07
FIN to UK BL &SEMIBL SA/FOB (IPI)	0.43	0.64	1.06
SWE to WG BL & SEMIBL SA/FOB (IPI)	0.46	0.61	-0.96
SWE to UK BL & SEMIBL SA/FOB (IPI)	0.34	0.68	-1.02
West German Imports BL SW SA/CIF (SWPI) /e	0.65	-1.43	2.62
West German Imports BL SW SA/CIF (CWPI) /f	0.78	-0.51	2.37
JAPANESE MARKETS			
Japan Domestic BL HW SA/dd (IPI) /g	1.94	0.88	3.72

/a Deflator: USWPI = US Wholesale Price Index.
/b Deflator: International Index of Inflation, World Bank.
/c 1966-80.
/d All FOB prices 1960-79.
/e Deflator: SWPI = Swedish Wholesale Price Index.
/f Deflator: CWPI = Canadian Wholesale Price Index.
/g 1960-76.

40. Reasons for declining real prices of woodpulp in the 1960s are considered many: 1/

i. In the 1960s production capacity was seen to be in excess of demand. Especially the British Columbian and Scandinavian woodpulp capacities were expanded marketly.

ii. The 1960s was a decade of favorable cost developments for the pulp and paper industry: a) Wood was readily available for new pulp mills and rising labor costs in wood harvesting were largely compensated for by advancing harvesting technology; b) During the 1950s and 1960s considerable advances were achieved in pulp and paper making technology; the optimum size of machines increased yielding considerable economies of scale and increased automation in mills helped to reduce the impact of rising labor costs; c) Energy prices were stable as new resources were tapped; d) Interest rates on borrowed funds were low and investment funds were rather abundant to encourage new ventures.

41. In the early 1970s the lagging capacity expansions were regarded as a primary reason for the short supply of woodpulp and the upward pressure on prices. Additional factors boosting the price development in 1972-74 were the sharply increased energy, capital and raw material costs.

42. In 1975 the recession in the international economic activity caused a slackening of demand for pulp. Despite the softness of market declines in woodpulp prices were resisted until 1977. North American and Scandinavian producers opted to reduce capacity utilization rates and/or to build up stocks rather than to cut prices. In 1976-77, woodpulp stocks were built up to more than 3 million tons in North America and Scandanavia close to 4 million tons on a worldwide basis. Thus, the world stocks were about 3 million tons above the "normal" level and these "surplus" stocks represented extra costs of US$100 million per annum (Figure 8). In Sweden, inventory build-up was subsidized by the government. In the last half of 1977 Scandinavian producers were forced to reduce their list prices due to increasing disturbances caused by

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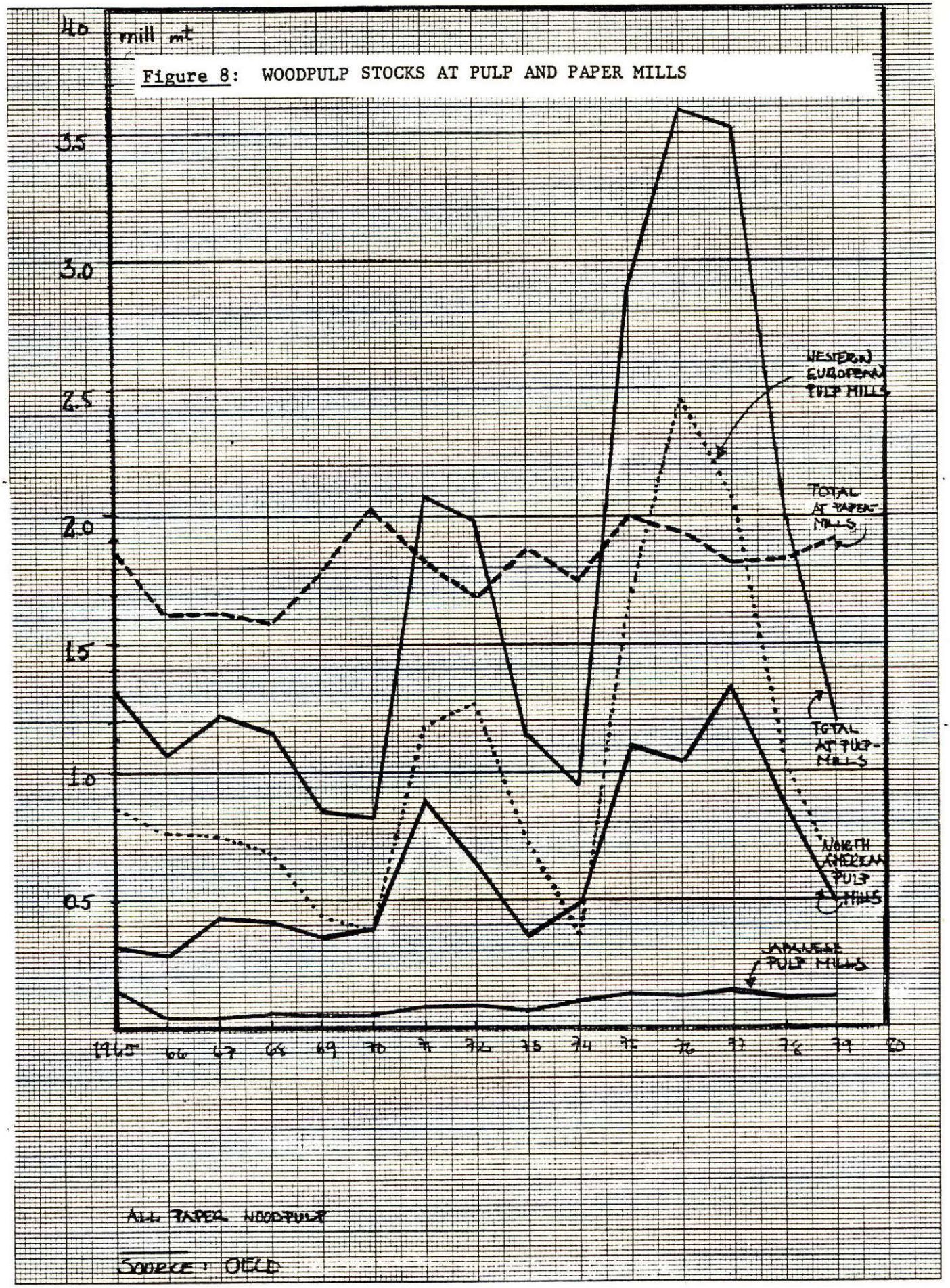
1/ Sources: Pulp and Paper International, January 1980, and EVAF 10th Annual Conference, Copenhagen, 1975.


mill mt
Figure 8: WOODPULP STOCKS AT PULP AND PAPER MILLS
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
WESTERN EUROPEAN PULP MILLS
TOTAL AT PAPER MILLS
TOTAL AT PULP MILLS
NORTH AMERICAN PULP MILLS
JAPANESE PULP MILLS
1965 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80
ALL PAPER WOODPULP
SOURCE: OECD

the low-priced spot sales and increasing supply pressure from North American producers. It was in 1979 that woodpulp prices began to recover from depressed levels.

C. Price Differentials

43. In the past, the prices of bleached, unbleached and semi-bleached pulps and the prices of sulphate and sulphate pulps have moved closely together. In a strong market situation price gaps usually diminish, while slackening demand widens price differentials. In accordance with diminishing supply of sulphite pulp the price difference between bleached sulphite and sulphate pulps has almost disappeared. This is the case especially during strong demand. The most recent price differences between bleached softwood sulphate and other chemical woodpulp grades are shown in Table 8.

Table 8: PRICE DIFFERENTIALS OF CHEMICAL WOODPULP GRADES IN WESTERN EUROPEAN MARKETS a/

		BL SW SA	UNBL SA	SEMI BL SA	BL SI	UNBL SI
		US$/mt	----difference relative to BL SW SA---------- (US$/mt)----------			
1979	I	410	-60	-10	-10	-35
	II	435	-45	-6	-10	-50
	III	435	-45	-6	-10	-50
	IV	475	-55	-6	-10	-55
1980	I	500	-50	-8	none	-55
	II	545-550	-50	-11	none	-50
	III	545-550	-50	-11	none	-50
	IV	545-550	-50	-11	none	-50

a/ CIF North Sea and Atlantic Ports of Europe.

Source: Pulp and Paper International.

44. In 1975-80 high quality Scandinavian and North American softwood pulps were sold approximately at the same price in Western European markets (Figure 9). Occasionally there have been minor differences in price quotations, but they have been short-lived. The price of lower quality North American softwood pulp from the Southern States has been, on the average, about US$25-30 lower than the price of premium softwood sulphate. During 1977-1978, the price differences were as wide as US$30-90 per ton. The price of good quality hardwood pulps is at present US$25-30 lower than that of premium softwood sulphate.

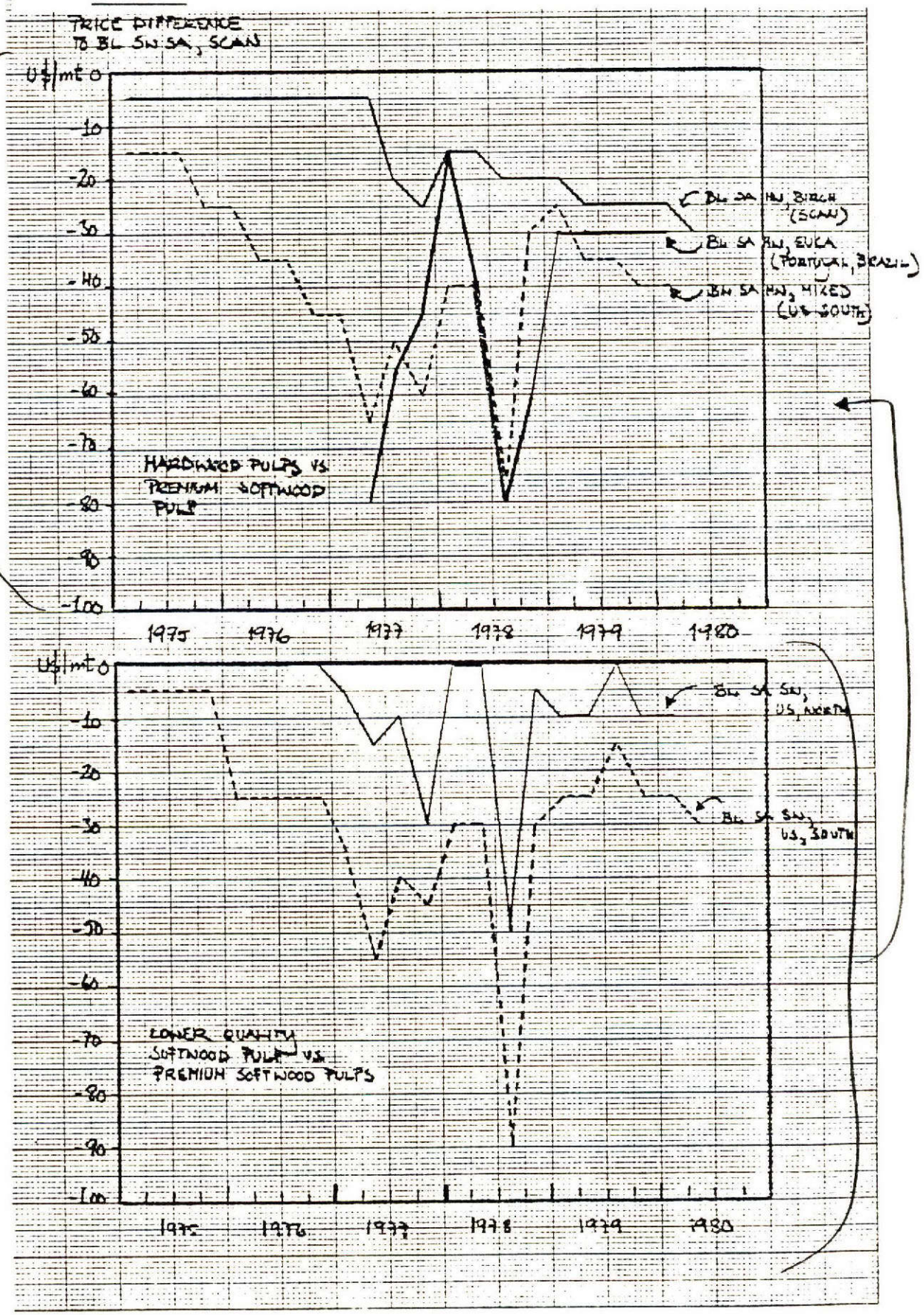
45. Recent announcements indicate that the difference between the prices of eucalyptus pulps from Brazil and Portugal and the price of Scandinavian birch has been only US$5. Lower quality hardwood pulp from the Southern states has been selling at US$10-15 lower than birch pulp.

D. Woodpulp vs. Other Products

46. From 1968 to 1973, the price relationship of bleached sulphate pulp to paper and board remained fairly constant, while since 1973 woodpulp prices have been rocketing in comparison with paper products. The price relationship widened from about 100 in 1973 to 150 in 1980. This indicates inter alia that capacity expansions in woodpulp industry would have been insufficient to meet rising demand (Figure 10).

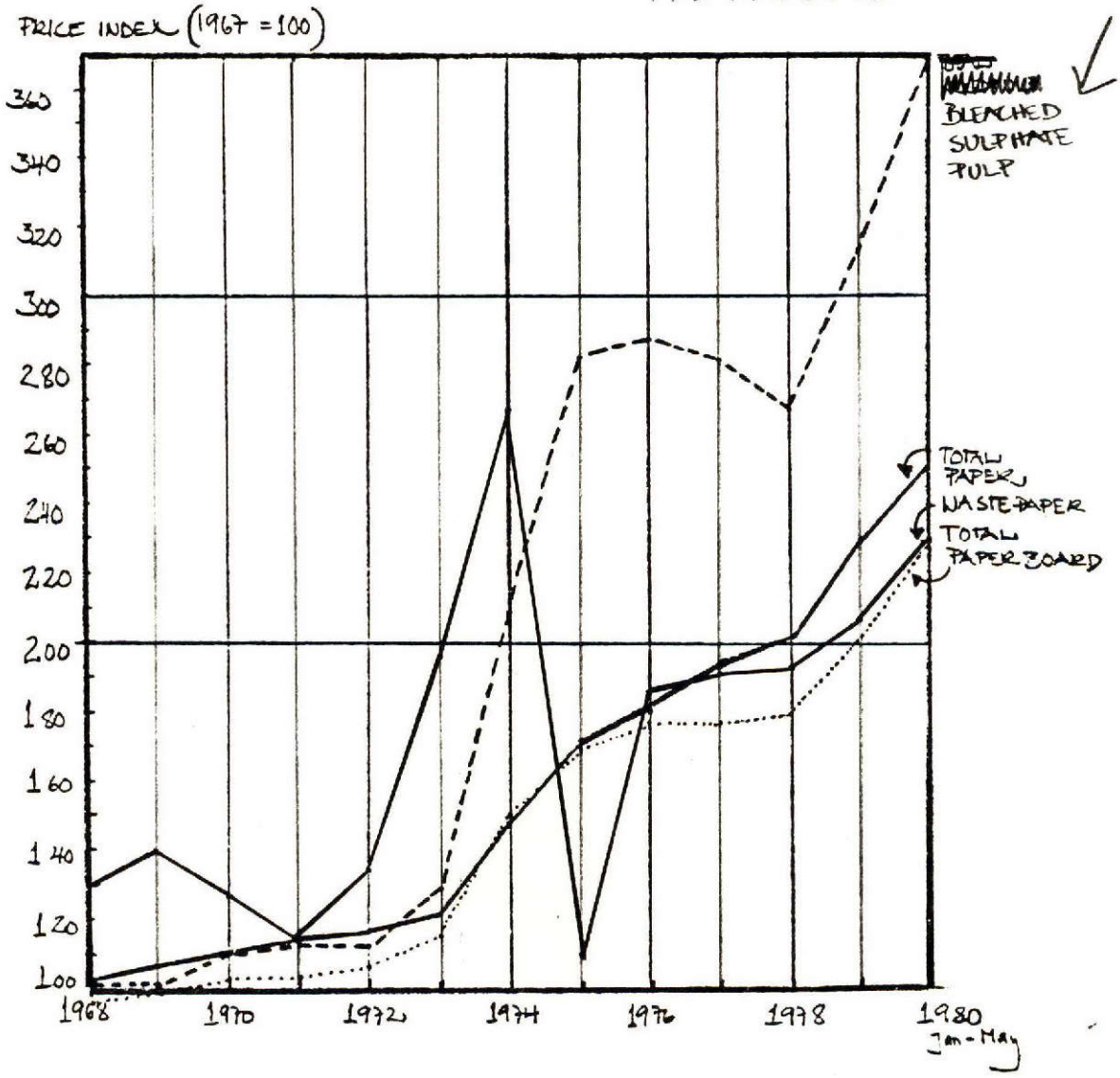
47. Price behavior of waste paper, which is the most important substitute for such woodpulp grades as unbleached chemical pulp and mechanical pulp, has been much more volatile than that of woodpulp. Presumably, wider fluctuations are caused by waste paper markets' strong dependency both on paper and paperboard markets and woodpulp markets. At first, wastepaper supply is tied to paper and paperboard utilization. Secondly, waste paper is increasingly used as raw material in paper making in a situation of scarce woodpulp supplies and so waste paper's utilization and prices would depend on woodpulp prices. In other words, it seems that woodpulp markets affect more waste paper markets than vice versa.

Figure 9: PRICE DIFFERENCES BETWEEN SOFTWOOD AND HARDWOOD PULPS



SOURCE : PULP AND PAPER INTERNATIONAL

Figure 10: PRODUCER PRICE INDEXES FOR WOODPULP, PAPER AND PAPERBOARD AND WASTEPAPER



SOURCE: U.S. Department of Labor, Bureau of Labor Statistics

V. EXCHANGE RATES AND INFLATION

48. Prices for market pulp sales are usually fixed for a half-year period, or on a quarterly basis. At present, all pulp prices are quoted in US dollars only. In early 1976, the Swedish producers started to quote their prices in US dollars to bring their pulp prices into line with Finland and North America, in terms of currency, in response to the Continental pulp buyers and in order to create an internationally more uniform price level of pulp.

49. In recent years, Canadian producers have been in a favorable position to improve their profitability as a result of the weakening Canadian dollar. In 1978, the Canadian dollar averaged 88 cents against one US dollar while in 1979, the average moved down to 85 cents and is at present (August, 1980) about 86 cents. 1/

50. Swedish and Finnish woodpulp producers have been at a disadvantage due to the fall of the US dollar. In March 1980, the Swedish Timber and Wood Pulp Journal stated: "This was the seventh quarter out of the past eight to bring increased prices. On the other hand, the previous increase of about US$25 is applicable to sales concerning deliveries during the first quarter of 1980 and was entirely neutralized through the drop at the rate of the dollar in late autumn. Thus, buyers will not be effected by any increase in costs."

1/ Source: IMF, International Financial Statistics.

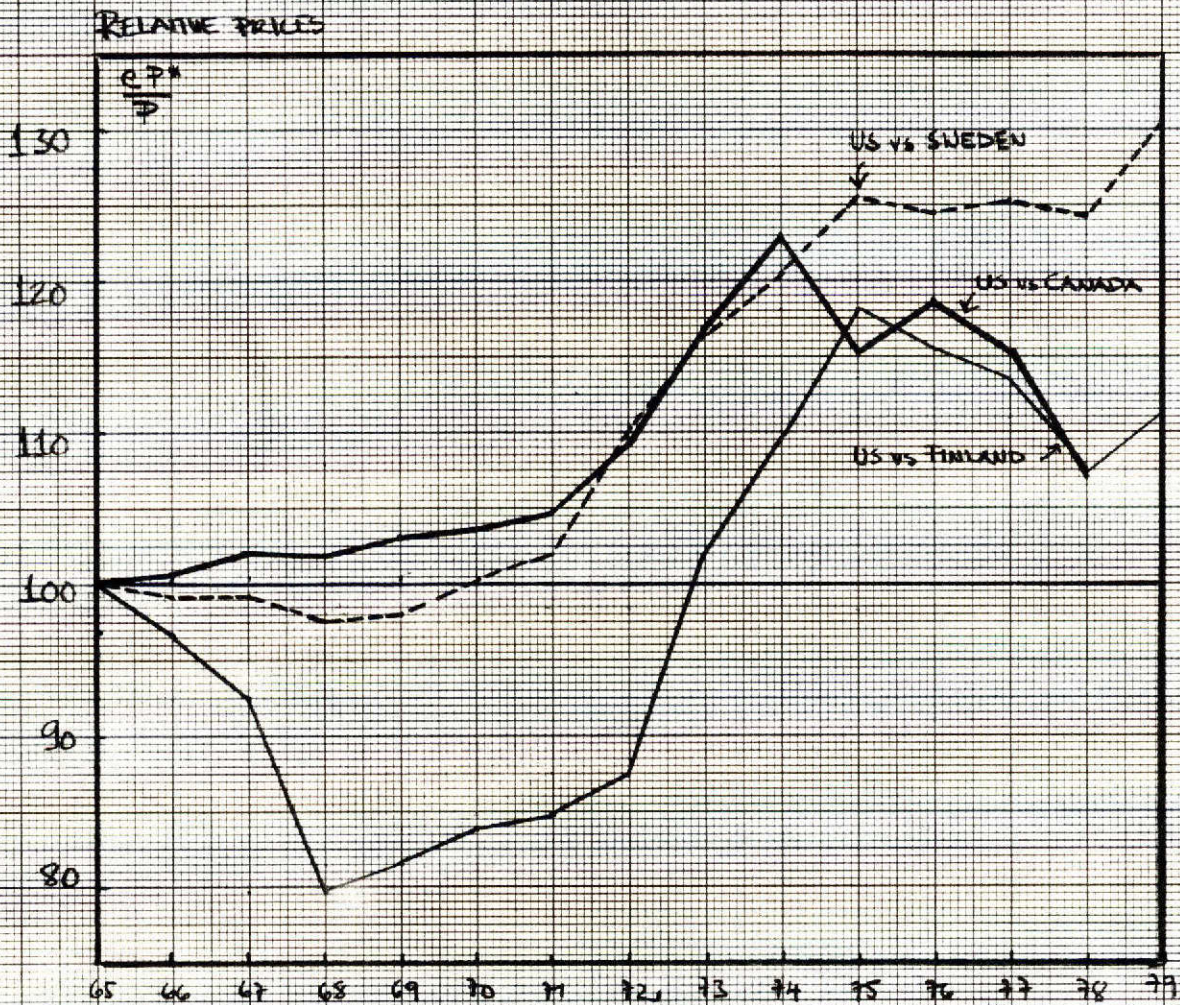
51. However, international cost competitiveness of commodity production does not depend only on exchange rates, but also on relative inflation rates. 1/ In Figure 11, international cost competitiveness of the US is compared in terms of relative prices 2/ with major woodpulp producers. In 1965-1971, the United States' competitiveness remained fairly stable in relation to Canada and Sweden, while competitiveness against Finland slackened; a higher inflation rate in Finland was offset by an appreciation of US dollars against Finnish mark.

1/ In theory, exchange rates should change only to the extent that inflation rates differ between nations. Such a relationship has not held in the past ten years, however, and has temporarily caused, for example, a greater weakness in the US dollar than might be expected.

2/ Relative prices are measured by $\frac{CP^*}{P}$,

where: P = price level in the United States, measured by WPI
P* = price level abroad, measured by WPI
C = the dollar price of foreign exchange.

FIGURE 11 COST COMPETITIVENESS OF UNITED STATES AGAINST MAJOR MARKET PULP PRODUCERS



$\frac{e P^*}{P} > 100$ US competitiveness improving

$\frac{e P^*}{P} = 100$ No change in competitiveness

$\frac{e P^*}{P} < 100$ US competitiveness slackening

SOURCES: INT, OECD

52. Since 1971, U.S. competitiveness against Sweden has increased rapidly due to high Swedish inflation rates and depreciating US dollar against Swedish Crown. U.S. competitiveness against Canada increased from 1971 to 1974, but since 1974 competitive advantage has diminished; Canadian dollar has been weakening and inflation rate have been higher than in the United States. As far as Finland is concerned, US competitiveness increased from 1972 to 1976, but since then the U.S. has lost part of its competitive edge.

VI. PRODUCTION COSTS

A. Cost Structure of Woodpulp Production

53. At existing mills, the most expensive cost item of woodpulp manufacturing is wood. 1/ In the U.S. Southern states and in British Columbia, wood costs accounted for about 30-35% of total costs in 1976 (Figure 12). 2/ In Scandinavia, the share of wood costs is even more dominant. In 1976, the share of other cost items in North American market pulp mills ranked as follows:

Transportation	13%
Labor	11-15%
Chemicals	9-13%
Other materials	8-11%
Energy	7-8%
Administration	5-9%
Depreciation	4-6%

At new pulpmills manufacturing costs are dominated by capital costs reflecting the highly capital-intensive nature of woodpulp production (Figure 13). In 1978, capital costs in Brazil were even higher than in other areas, owing to the

---

1/ It should be noted that the most expensive cost item of wood, as delivered to the mill, is labor.

2/ Sandwell Management Consultants Limited, Analysis of Manufacturing Costs in the North American Forest Products Industries, 1977.

Figure 12: STRUCTURE OF MARKET PULP MANUFACTURING COSTS AT EXISTING MILLS

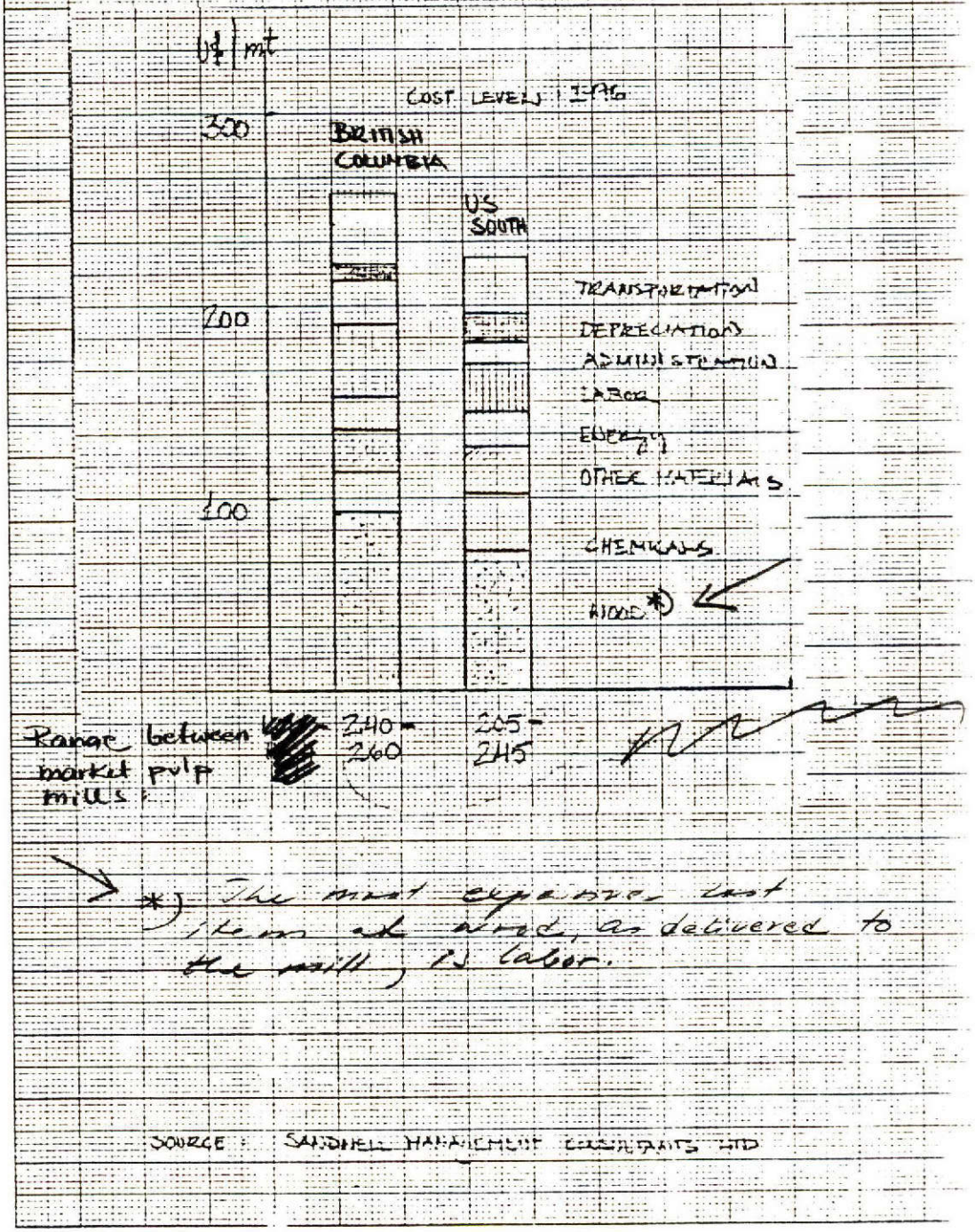
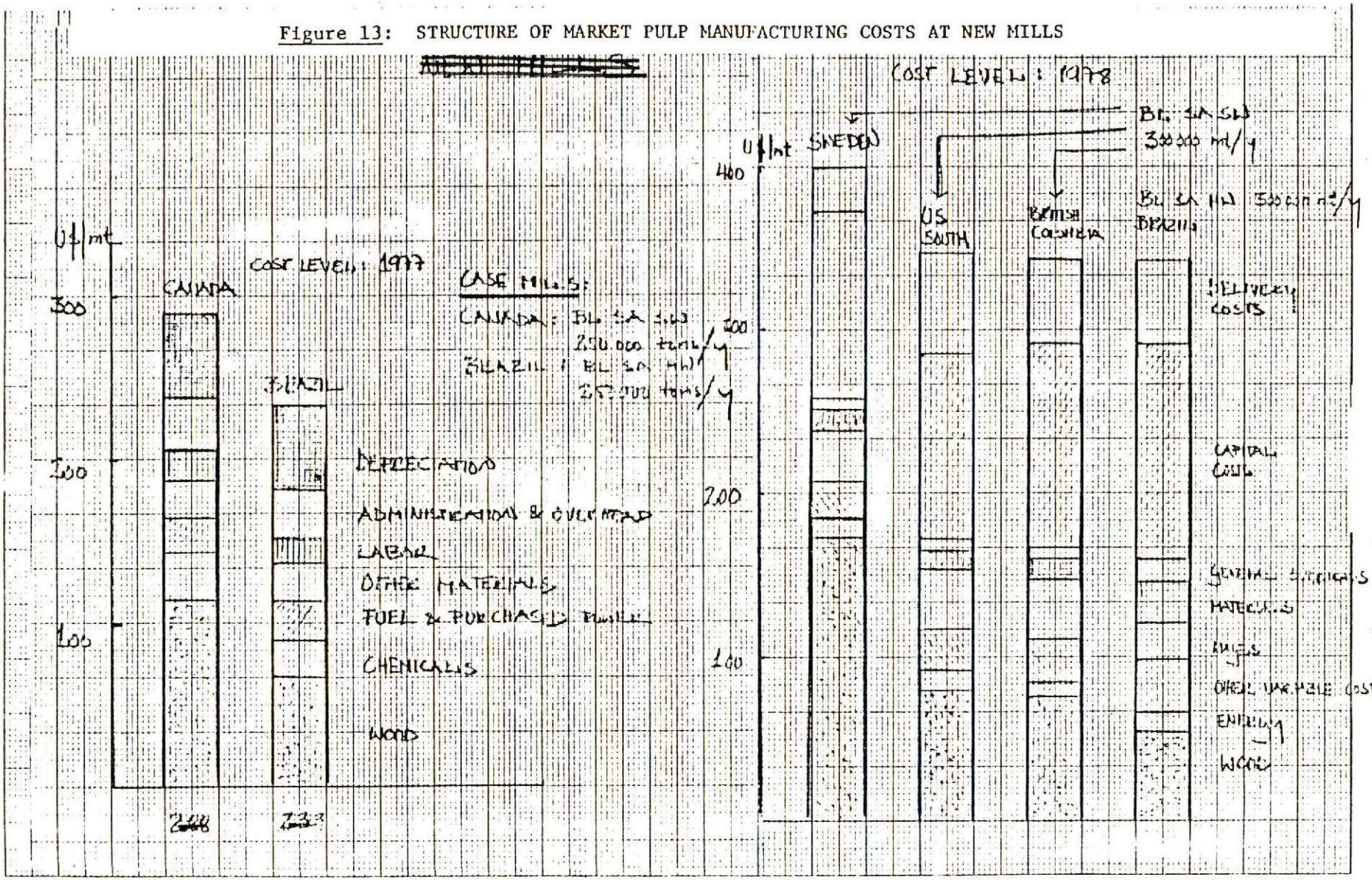


Figure 13: STRUCTURE OF MARKET PULP MANUFACTURING COSTS AT NEW MILLS



Source: World Bank, Industrial Projects Department

Source: Jaakko Poyry Consulting Oy

difficult construction conditions and more expensive domestic machinery and equipment even if the infrastructure is excluded. Swedish pulpmills enjoy an advantage in transportation due to geographical proximity to Western European markets. This cost advantage, however, is more than offset by very high wood costs.

B. Capital Costs

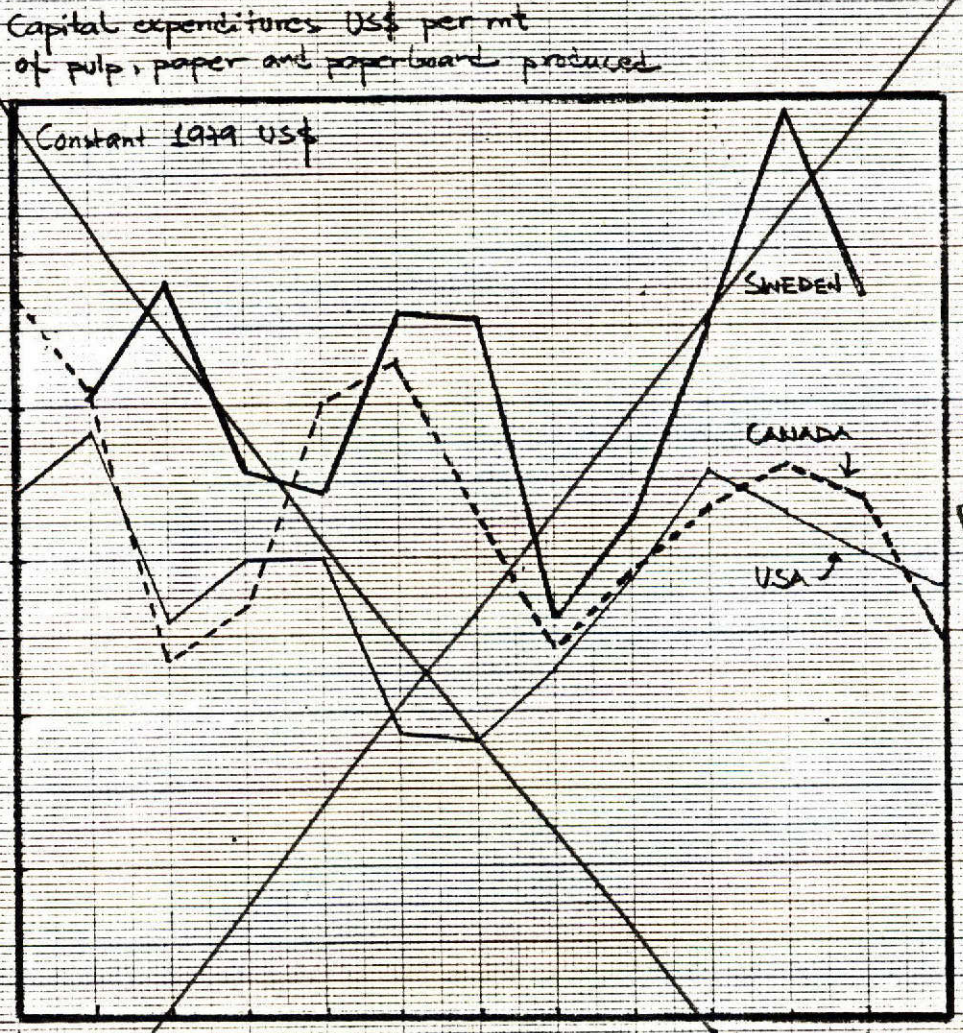
54. In recent years, capital intensity of the pulp and paper industry has been increased by growing mill sizes, more stringent environmental laws and goals to improve product quality and labor productivity and protection. Growth in unit sizes has often required new constructions with less pronounced economies of scale in capital costs. 1/ Particularly heavy investments are required when opening up new resources for pulp production where the establishment of a mill involves building up a new community with all its attendant services. The cost of infrastructure seems to be much a question of government financing. In Brazil, subsidies have been inter alia in the form of tax advantages in establishing plantations. ~~However, capital expenditures in relation to output of pulp and paper industries, do not clearly indicate that capital intensity in pulp and paper manufacturing would have greatly increased, at least not in North American markets (Figure 14). 2/~~

1/ Second World Pulp and Paper Industries Conference, Helsinki, 1975.

To analyze comprehensively the effect of capital costs on cost competitiveness of ~~the~~ pulp suppliers, it would be necessary to construct and compare mill cost indexes (including the economies of the scale ~~effects~~) and to evaluate the structure of financing (~~association~~, use of own versus borrowed capital, interest rates, borrowings from domestic versus foreign money markets, etc.)

effects of the and technological changes

Figure 14 CAPITAL EXPENDITURES AT PULP AND PAPER MILLS IN RELATION TO PULP, PAPER AND BOARD PRODUCTION



THIS FIGURE OUT

USA: Expenditure on new plant and equipment (paper and allied products)

CANADA: Capital and repair expenditures (pulp and paper mills)

SWEDEN: (pulp and paper mills)

SOURCES: US Department of Commerce, Bureau of Economic Analysis
CPPA Reference Tables & Statistics Canada
~~Source: Papperstidningen~~
Statistiska Centralbyrån

C. Wood Costs 1/

Cost Comparison

55. The movements of pulpwood costs in 1970-79 are shown by major region in Figure 14. Throughout this period Scandinavian countries have been high-cost areas and British Columbia, the U.S. South and Brazil have been low-cost areas. The difference has widened since the boom years of 1973-74. The variations in wood costs can be explained mainly by differences in stumpages and harvesting costs. The level of different cost items is dependent on the general wood supply situation, growing conditions, wage level and forest ownership structure. Also the form in which the wood is delivered to the mill causes differences in wood costs. For example, in British Columbia the wood used by the pulp and paper industry is mainly in the form of chips. Because wood costs have a significant effect on the competitiveness of the pulp industry in the international markets, anticipated increases in regional pulpwood costs are briefly discussed below.

The U.S. South

56. Resource Base. The total demand for roundwood is expected to grow faster than the supply at least on the coastal areas and also in some parts of the interior. The work of Dr. Bruce Zobel at North Carolina State University indicates that the major impact of the plantation programs in providing incremental wood will not sell much before 1990. The present shortage of chips is caused by low operating rates of the sawmills, which in turn is a consequence of the ongoing recession in housebuilding.

57. ~~Another important trend is~~ the speculative buying of forest land; the idea being that the timber will maintain its real value in the long run. Another aspect in forest land investments is the possibility of oil, gas or minerals occurring in the purchased areas. Wood as energy source may play some role in these deals.

1/ Majour Sources: The Growing Importance of Southern Timber by Morgan Stanley, Investment Research, 1980; USDA, Forest Service, An Analysis of the Timber Situation in the United States 1952-2030, 1980; American Pulpwood Association, ECE Timber Committee, European Timber Trends and Prospects 1950 to 2000, 1976; personal communication.

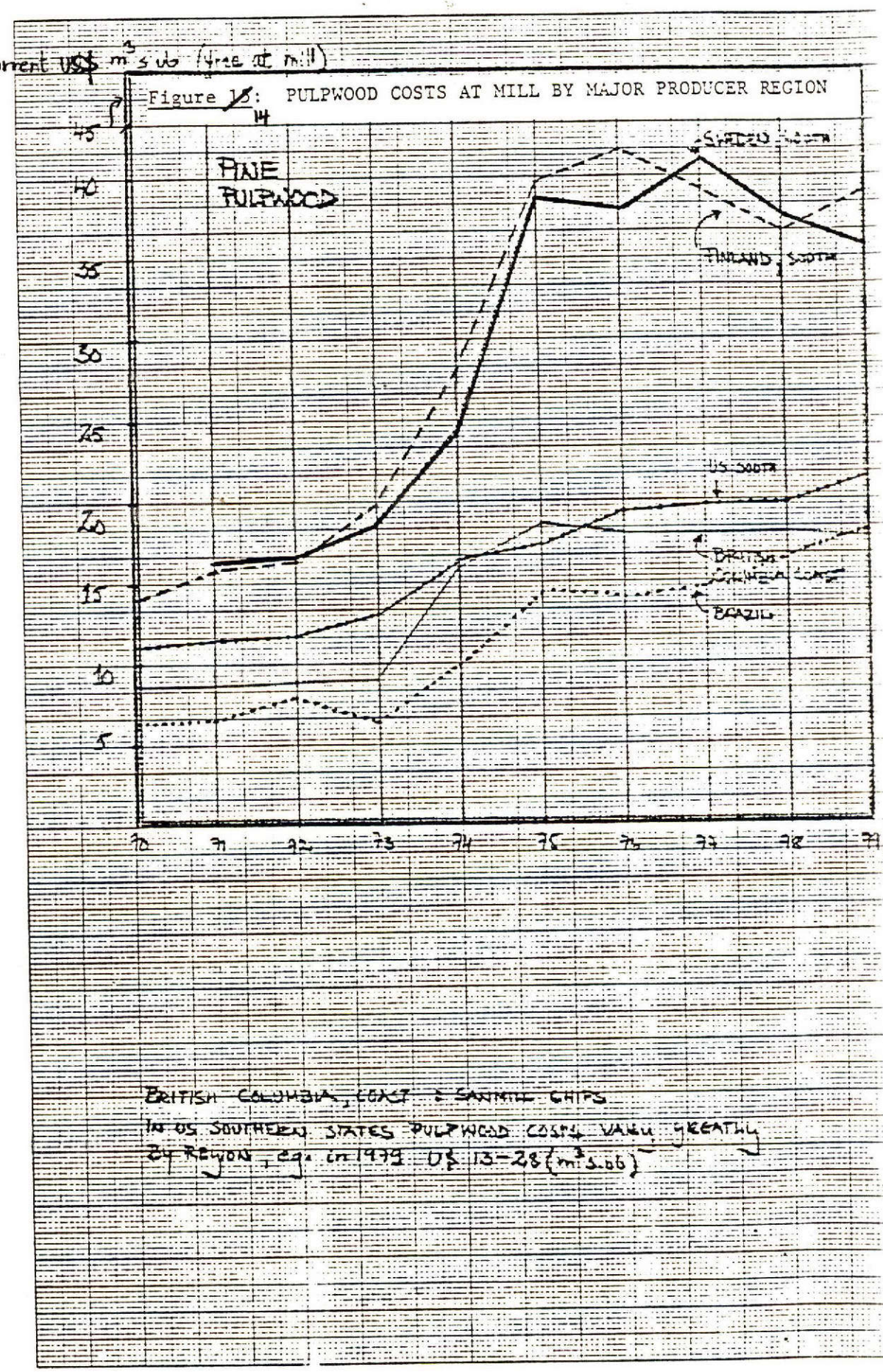


Figure 13: PULPWOOD COSTS AT MILL BY MAJOR PRODUCER REGION
14

BRITISH COLUMBIA, COAST & SAWMILL CHIPS

IN US SOUTHERN STATES PULPWOOD COSTS VARY GREATLY BY REGION, eg. in 1979 US$ 13-28 (m³ s.o.b.)

58. Labor and Wages. Two partly opposing trends can be detected. First, rationalization of agriculture and mining is still increasing labor supply but this situation may change rather soon, whereby shortage of labor may occur. On the other hand, the rate of urban unemployment is expected to increase, which would have the opposite effect.

59. Stumpage Prices. Due to the tightening pulpwood supply and speculation, a 2-4% rise in real value per annum might be anticipated.

60. Harvesting Costs. Harvesting costs are expected to rise with inflation, maybe no rise of real value. No noticeable improvement of productivity is foreseen, because labor is unskilled. Harvesting conditions are becoming worse which will partly compensate for potential improvement of productivity.

61. Transportation. By adding truck unit capacity it should be possible to cut down costs, so the real transport costs would be maintained at the present level. Railway transport costs may increase very slightly in real terms.

62. Total Wood Costs. Total pulpwood costs may rise 1-2% per annum in real terms.

Scandinavia

63. Resource Base. Availability of pulpwood is not increasing except in some parts of Finland where pulpwood from thinnings will be available (at least in theoretical calculations). In fact, Sweden is suffering from wood-supply shortage and is importing chips. In Sweden and Norway, round pulpwood from thinnings usually is uneconomical to harvest; leaves none, or negative stumpage.

64. Labor and Wages. No remarkable changes are expected to take place in labor situation in Scandinavia.

65. Stumpage Prices. Stumpage prices are expected to follow more flexibly end product prices than up to now, with a very slight potential increase in constant value (Finland). In Sweden, there may be a heavier demand to raise stumpages of pulpwood from private forests. In total, the rise of stumpage prices could be 0-1% per annum in real values.

66. Harvesting Costs. Mechanization will continue strongly in Finland, less in Sweden which already is highly mechanized.

67. Transportation. Not much can be done to improve the productivity from the present level, so the inflation will be transferred almost directly to the costs.

68. Total Wood Costs. Total wood costs increase in Scandinavia is expected to be 1.5-2% per annum in constant terms.

Brazil

69. Resource Base. Freezing of investments in pulping capacity is expected to cause an oversupply of eucalyptus, possibly also of pine in the 1980s. In the case of eucalyptus, this may partly be affected by its use for energy production and as a coal substitute in the steel industry.

70 Labor. Supply should be sufficient, although unskilled.

71. Stumpage Prices. In view of oversupply of wood, stumpages should stay reasonable and no increase of real value is expected.

72. Other Costs. The existing contractor system will probably maintain the real cost reasonably and in developed operations there may be some improvement possibilities of productivity. In transportation there is much improvement possibilities; apart from those mills where the transport system already is optimally designed.

73. Total Costs. Rather slight increase of real costs is expected. It should be pointed out that this concerns wood costs expressed in US$, cruzeiro costs may be different. The leading principle will be to maintain the costs at a lower level than in the U.S. South, measured in U.S. currency.

The Coast of British Columbia

74. Conditions. The resource base is deteriorating; harvesting is moving to worse terrain and further away. In addition, the labor supply is becoming more scarce and expensive and silviculture will have to be intensified.

75. Roundwood Costs. Stumpage can be expected to go down to maintain competitiveness of the industry, but silviculture is increasing cost. Harvesting costs will increase at above inflation-rate. Transport costs will also increase due to larger distances, but road costs may go down per kilometer constructed, so the increase may be moderate. Altogether, round pulpwood prices might increase 3% per annum at real terms, but part of this increase could be offset by lowering stumpage.

76. Chip Costs. Present high prices of chips are expected to hold as long as only house building in the U.S. is depressed and sawmills are working at low rates. However, it is possible that the British Columbian chip prices will be influenced by the chip export market prices more than until recently. Though the export chip business is not foreseen to grow, the export prices are expected "to stabilize at a level considerably above those of the past." 1/

1/ Source: Pulp and Paper, September 1980.

magnitudes. Since 1974 hourly earnings in Swedish pulp and paper industry have been even higher than in North America (Figure 15).

D. Labor Costs

77. Due to the highly automated processes of the pulp and paper industry, there is a great demand for management and skilled labor, resulting in higher wages than, for example, in ~~mechanical wood processing industries~~ lumber and plywood manufacturing. The average hourly earnings in the U.S. pulp and paper industry increased from US$2.88 in 1965 to US$7.40 in 1979. ~~In recent years, wage increases in Canada and Sweden have been of similar magnitudes as in the United States~~.

78. Cross-country hourly wage comparisons may, however, be misleading, since the relevant measure in determining international cost competitiveness is not labor cost per hour, but labor cost per unit of output or production volume in relation to work hours. In 1964-1976, labor productivity in the U.S. and British Columbian pulp and paper industries seem to have been superior to Canadian ~~(total)~~ as a whole and Scandianvian countries (Figure 16). 1/ Factors ~~like~~ such as changes in the industry's production structure, raw material differences, different ~~standards~~ emphasis in ~~mill~~ maintenance and renovation, technical considerations, organizational drawbacks (e.g., over-organization) are suggested to be responsible for productivity differences.

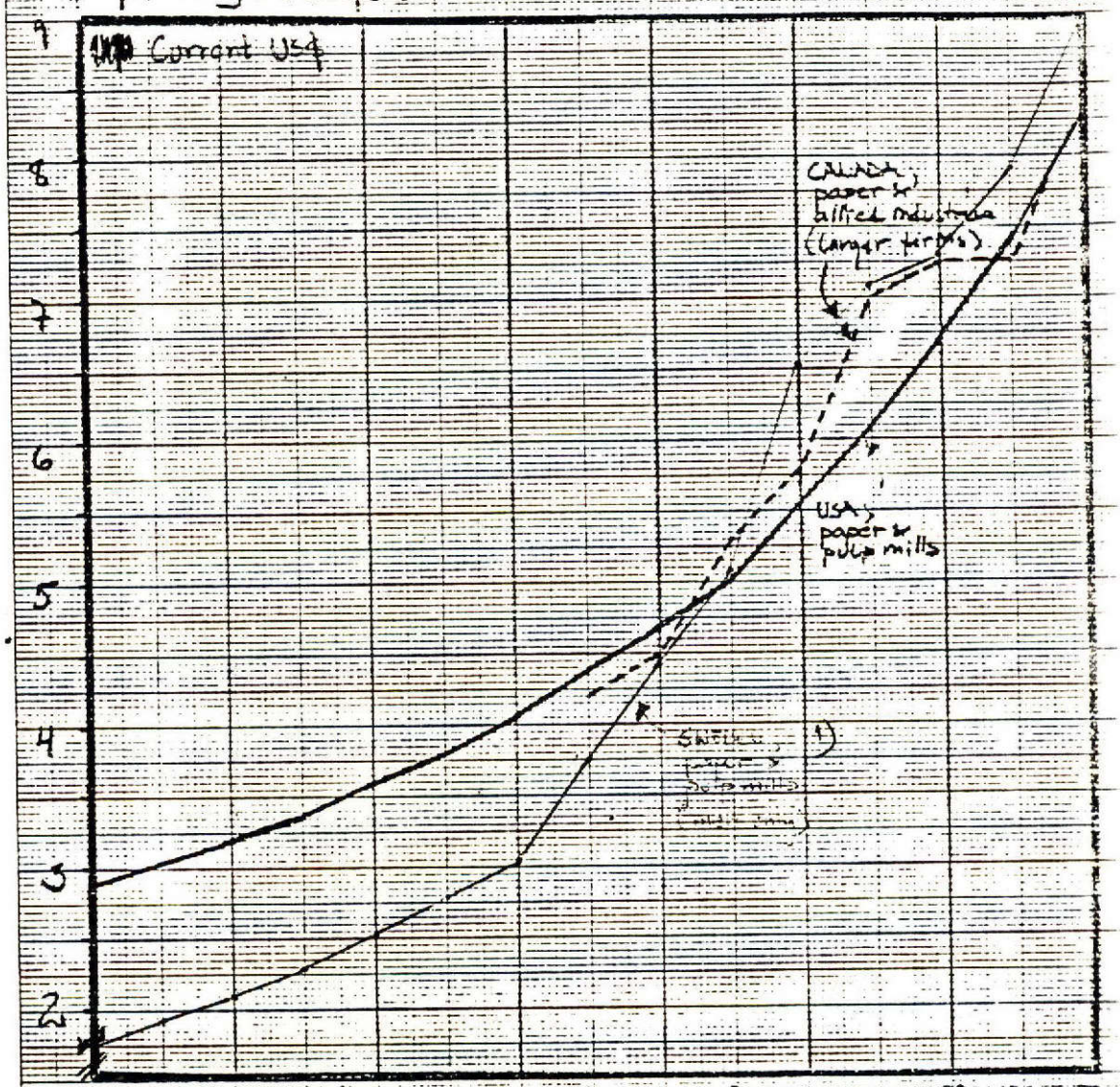
79. ~~As regards to~~ Regarding the developing countries, the sophisticated technology of pulp and paper industry ~~emphasizes the importance of human resources~~ results in a great need for skilled labor when ~~shifting this~~ creating production ~~into~~ facilities in new supply areas. A short-term and rather costly solution is the utilization of expatriates, at least during the start-up of new projects. In the long run, the availability of management and skilled labor cannot be secured without close coordination of educational and industrial policies. 2/

1/ Markku Simula, Productivity ~~of Forest Industry in Finland~~ in the Finnish forest industry and in its Major Competing Countries, [redacted], Helsinki, 1979.

2/ Second World Pulp and Paper Industries Conference, Helsinki, 1975.

15

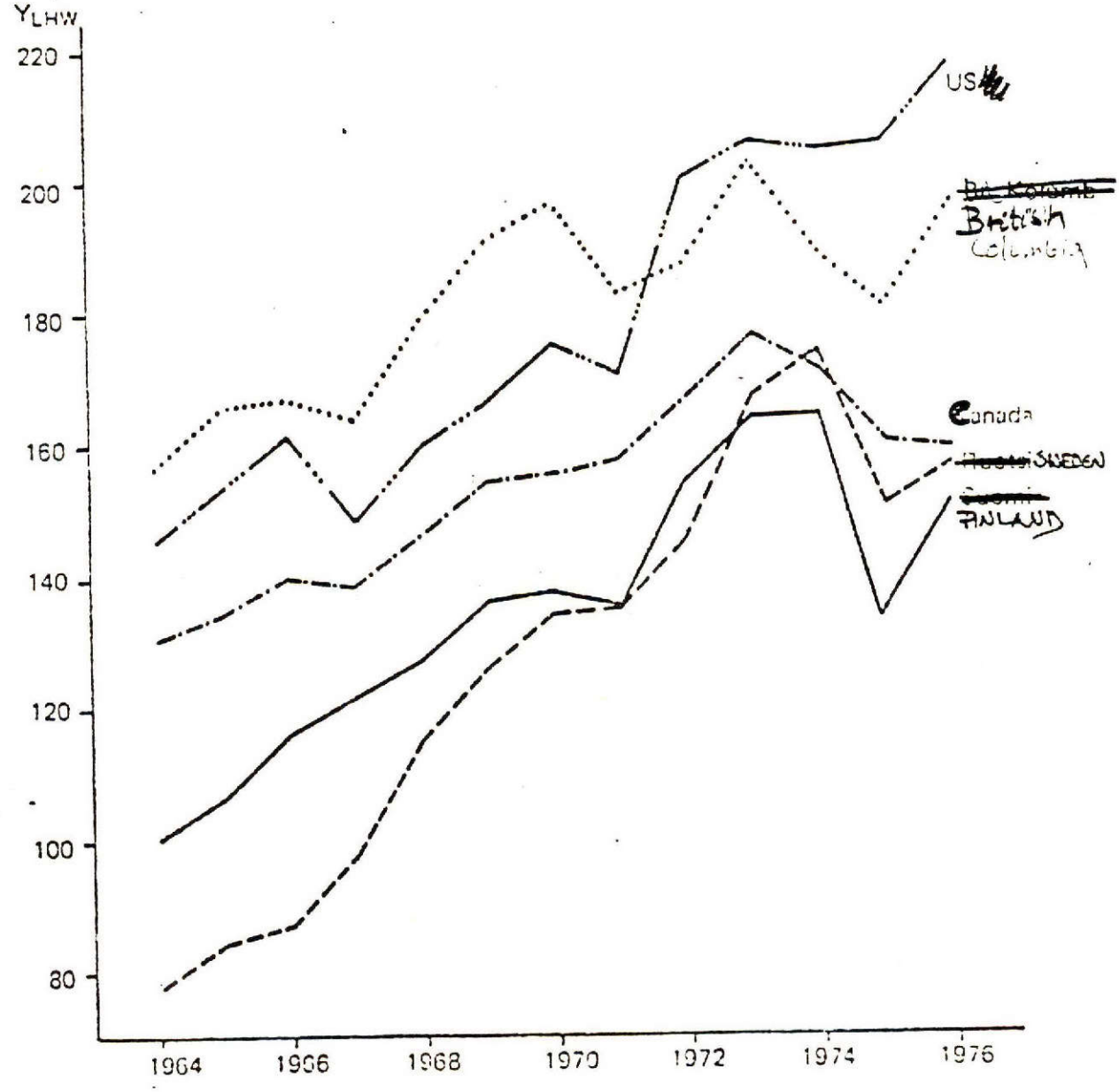
Figure ~~16~~: AVERAGE HOURLY EARNINGS AT PULP AND PAPER MILLS



1) Incl. some supplements

Sources: US Department of Commerce, Bureau of Economic Analysis
Statistics Canada
Statistiska Centralbyrån, Sverige

Figure 16/17: LABOR PRODUCTIVITY IN PULP AND PAPER INDUSTRY BY MAJOR PRODUCER



a/ Changes in integration and value-added are taken into account in measurements. Due to the complex nature of the measurement results are not necessarily identical to those supplied by official statistics

Y_{LHW} - physical production volume in relation to work hours

Source: Productivity in the forest industry in Finland and in its major competing countries, Markku Simula, Helsinki University, Helsinki, 1979

e. Transportation Costs

80. Shipping costs for pulp and paper products were relatively stable for many years with the introduction of larger, purpose-built vessels, specialized terminals and more efficient handling methods. 1/ The escalation of fuel costs and the higher capital costs of purpose-built vessels, however, have pushed shipping costs up considerably. In the long run transportation costs are expected to increase in accordance with increasing fuel costs, but with the efficiencies of scale and improved handling methods cost savings still can be achieved. Delivery costs of woodpulp to Western European market by traditional suppliers and by new supply sources, like Brazil and Portugal are presented in Figure 17; Nordic countries and Portugal enjoy a distinct transportation advantage over North Americans and Brazilians.

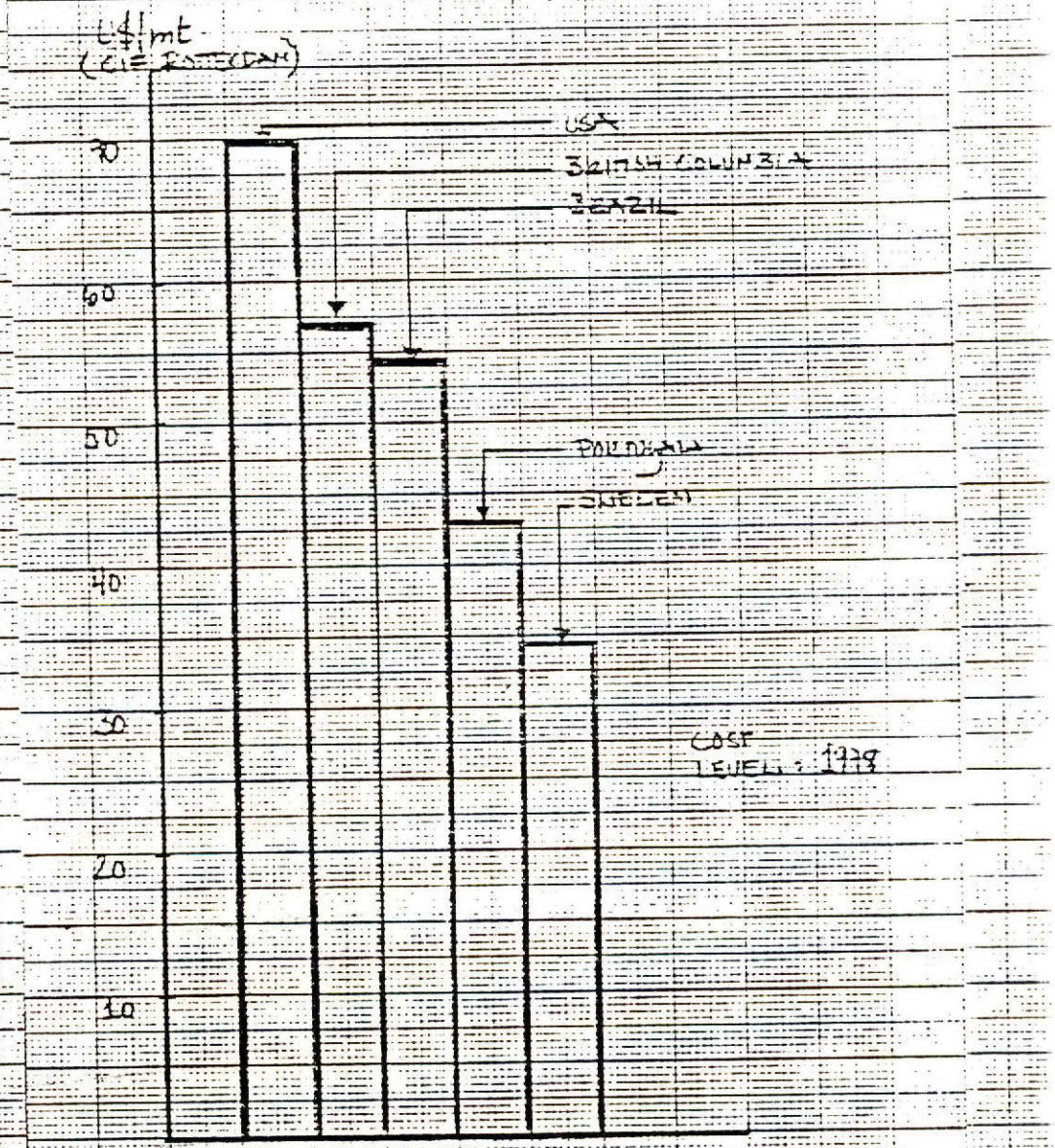
VII GOVERNMENT POLICY MEASURES

A. Tariffs

81. There are no trade barriers in the form of tariffs in international woodpulp trade in the case of Central and South European countries. In contrast, in Central Europe, paper and paperboard industry is large in terms of capacity and is protected to some extent by import duties on paper and paperboard. The picture is, however, changing; in early 1984 Nordic suppliers will be allowed to export paper and paperboard duty-free, though under some quotas. Also in the recent GATT negotiations, a compromise was reached in which the reductions for the North American paper industry would be phased in over an extended period of seven years.

1/ EVAF 10th Annual Conference, Copenhagen, 1975.

Figure ~~18~~ 17: DELIVERY COSTS OF BLEACHED WOODPULP TO WESTERN EUROPE



Source: Jaakko Pöyry Consulting Oy

82. Estimated nominal and effective rates of protection in wood and paper products in the EEC, Japan and the U.S. are given below: 1/

Importing Country	Wood Products		Paper Products & Woodpulp	
	Nominal /a	Effective	Nominal	Effective
EEC	8.2	9.5	7.4	20.1
Japan	12.4	22.0	6.6	12.1
United States	10.4	18.3	2.7	5.5

/a The tariff rates published in the country's tariff schedule (known as the "nominal" rate) does not convey the level of protection accorded to the domestic producers. While the effective protective rate measures the degree of protection given to domestic production activities.

~~Source: Morzecha, E. Kreinin, International Economics, 1979.~~

B. Subsidies and Incentives

83. The effect of sudsidies, incentives and other government policies on international trade of forest products is a complex issue; how to distinguish between the subsidies that affect the domestic market only, and those that have an impact on international trade.

84. In many countries forestry and forest industries based on renewable natural resources are a special target of government policy measures not only because of their important role in economic development but due to their great ecological and social impacts. 2/ For example, pulp industry with significant environmental implications is subsidized to encourage to install control equipment,

1/ World Bank Reprint Series, Number 130; Deepak Lal, "Market Access for Semi-Manufacturers from Developing Countries."

2/ For further discussion, see World Bank, Forestry, Sector Policy Paper, 1978.

or to compensate for increased costs resulting from government-imposed standards. 1/ Some government incentives and subsidies to forest industries are listed without trying to determine their impact on the competitive position of a country, if any, in the international markets. 2/

Nordic Countries

85. In 1979, the Swedish Government invested SKr 1,100 million in new equity capital in the two largest manufacturing concerns run by the forestry owners' cooperatives. In addition, even some stronger companies in Sweden needed the help of government guarantees to raise money to cover the operating losses of slump years 1977 and 1978 and to undertake even a moderate program of capital investments. In Finland, a company located in the Northern part of the country needed government funds to keep it going in 1979.

86. In Sweden, subsidies up to 30% of the investment costs are available for energy-saving improvements in all industries, including pulp and paper. During the recession the Swedish Government subsidized inventory build-up of the pulp industry. This support was available to all industries.

EEC Countries

87. The difficulties of the pulp and paper industry have forced the French Government to consider the provision of substantial funds to promote a reorganization of its industry into two major groupings. At present, manufacturers of newsprint receive subsidies per ton of paper produced, and investments for environmental protection entitle producers to receive credits for up to 50% of the total investment costs.

1/ For further information see World Bank, Environment & Development, 1979.

2/ Major sources: Financial Times Survey, May 15, 1979, Pulp and Paper, January 1979, Paper Trade Journal, January 30, 1979.

88. In the United Kingdom, where £23 million has already been allocated for modernizing the pulp and paper industry, the possibility of a very large subsidy is now being discussed for a possible new newsprint mill in Fort William, Scotland.

North America

89. In the United States the 3-5-10% tax exemption scheme for new facilities is an incentive toward increased capital investment. The 10% investment tax credit is given for purchases of recycling equipment for those paper and paperboard mills that use wastepaper as raw material.

90. Recently it was announced that at least Canadian $700 million should be spent by the Ontario provincial government over the next five to seven years to help the pulp and paper industry. Most of the proposed assistance would be used for pollution control. In New Brunswick about Canadian $1.1 billion in new investments would be needed to modernize the province's pulp and paper industry. This would be in addition to the Canadian $90 million already being invested in modernization and pollution programs.

Developing Countries

91. During 1976-79, about 100,000 ha of plantations in Chile received the subsidy of 75% of their net afforestation costs, to a total of over US$10 million plus US$250,000 for administration expenses. 1/ In Brazil, about 3.5 million ha of plantations have been established since the mid-1960s mostly with government support, i.e., as a part of the governmental export promotion policy. 2/

1/ Chile Forestal - Edicion especial, 1979.

2/ For further discussion on governmental export promotion policies see World Bank Report Series, Number 59, Bela Balassa, Export Incentives and Export Performances in Developing Countries. See also Forest Plantations in Brazil and Their Possible Effects on World Pulp Markets by Roger A. Sedjo, Journal of Forestry, November 1980.

VIII WOODPULP PRICE PROJECTIONS

A. Basic Data and Theoretical Framework

The highly competitive nature of the world woodpulp markets ties markets closely together and price movements in all major markets (North America, Western Europe and Japan) are highly correlated. Because Western Europe is the largest importer of woodpulp and is considered the most competitive market, Western Europen (i.e., West German) import price of bleached softwood sulphate (CIF North Sea ports of Europe) was selected as a representative international price of pulp for price projections. Instead of list prices, prices actually paid in markets were used in the analysis to avoid a bias often present in official price quatations.

The short-term price model was constructed using total quantities of white pulp[1] as an explanatory variable for major woodpulp markets as they are still in the 1980's expected to affect the price development in international pulp markets most decisively. Utilization of market white pulp quantities[2] would have been more preferable, but long-term time series were not readily available for all major market pulp producers. Utilization of total white pulp quantities to explain prices behavior of market pulp was considered justified after the movements in supply and demand forces in total and non-integrated pulp markets were found to be closely related. Basic data for white woodpulp price analysis are given in Annex Table X.1.

The basic framework of woodpulp price determination in international markets is displayed in Figure 18. It should be emphasized that demand for woodpulp is derived demand of producer demand; this means that also factors underlying paper and paperboard markets had to be considered in selecting variables for an inclusion in woodpulp price model.

1) Total white pulp = both integrated and non-integrated white pulp included.
2) Market white pulp = only non-integrated white pulp included.

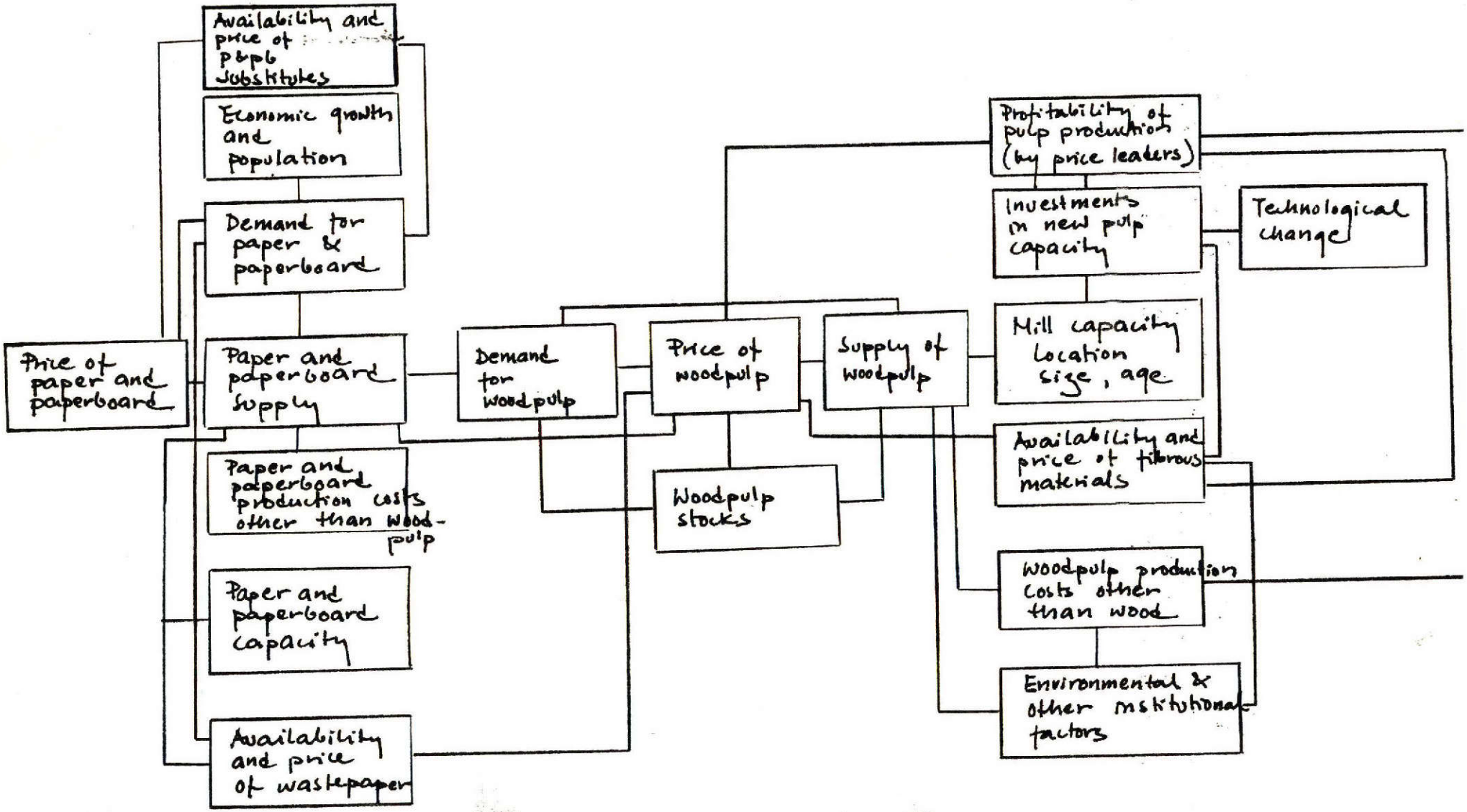


FIGURE 18. DETERMINANTS OF CHEMICAL WOODPULP PRICE

B. Short-term Outlook

When the short-term price model for woodpulp was constructed supply and demand equations were not estimated, but predetermined variables as present on supply and demand side were observed and used to yield a reduced form equation to explain woodpulp price determination.

The ratio of stocks to shipments, previous year's price and previous year's production were found to be the best explanatory, predetermined variables on the woodpulp supply side. Stock levels by themshelves may have limited economic meaning, but when related to shipments (or to apparent consumption) they indicate the length of time for which reserves are available. An increase in stocks will result in an increase in the relative stock level, which may result in a fall in both the price level and capacity utilization; lower capacity utilization results in lower production level reducing the stocks.

Because this is primarily a price explaining model, it was assumed that the stocks/shipments - variable is predetermined. In some other studies stocks have been considered endogenous. For example, Høsteland's[1] dynamic model, which was built to explain fluctuations in Norwegian bleached sulphite pulp markets was constructed using a number of differential equations, which were solved successively during the simulation, stocks were considered as a function of lagged stocks plus present production minus present sales (i.e., $L = L_{t-1} + P_t - S_t$). This handling of stocks is used also in a number of World Bank Group commodity studies, as tin and rubber.

Stock data used in this study include only pulp stocks held by pulp producers. Pulp stocks held by paper mills were ignored, because they seemed to have been at a fairly constant level from year to year, not indicating clearly that inventory buildup is undertaken in anticipation of high future demand as is a case with many other commodities.

1) Source: John E. Høsteland. Stock fluctuations in the pulp industry. Studia Forestalia Suecica. 1979.

Two dummy variables were introduced to capture the price effects of market abnormalities or rigidities, which took place in international pulp markets in 1975 and 1978[1]. In 1975, a slackening market outlook was not adequately taken into account in production plans of pulp manufacturers, which resulted in accumulating stocks, e.g., in Sweden, stock accumulation was subsidized by the Government. In addition, despite clear indications of approaching recession, prices were still considerably increased in 1975. If market forces had been allowed to function freely, an increase in relative stocks would have led, through declining prices and production to more stabilized markets.

In 1976 and 1977 woodpulp stocks increased further, but at this time markets responded as could be expected; woodpulp prices collapsed. Another year of market abnormality occurred in 1978, when ~~the four-year period of~~ extraordinary high stocks in woodpulp markets started to be levelled ~~ceased~~. In 1978 favorable demand and supply developments could have been expected to result in increasing woodpulp prices. However, inspite of a considerable decrease in relative stocks woodpulp prices declined further. Another dummy variable was needed to capture this market abnormality.

The other "supply-side" explanatory variables in the price equations are the lagged pulp price and the lagged production. The inclusion of lagged pulp price in a model is justified on the grounds that pulp prices are not very flexible downwards and that producers try to maintain past price levels.

Apart from sporadic spot sales, pulp prices in the international markets are usually fixed for a half-year period or on a quarterly basis, which means that a time-lag should be allowed for pulp prices to react to production changes. To test the length of decision-and-response period of price to pulp production, the one-year lag on

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1) Presumably, by utilizing quarterly data instead of annual data some difficulties encountered now in estimation procedures could have been avoided.

production was included in the model specification.[1)]

Economic growth was included in a model to introduce the effect of the "demand-side" on pulp prices. Paper consumption and paper production show a strong correlation with the economic growth. According to the close relationship between paper production and pulp demand, it is assumed that forecast of pulp consumption can be predicted using national income or gross domestic product.

The best regression results were:

~~Should be added here!~~ See the next page (P. 5a)

Price equation I describes the simplest form of the price function, in which price is determined by the previous year's price, stocks/shipments ratio and by two dummy variables which were introduced to capture the effects of market abnormalities in 1975 and 1978. In price equation II, a variable is added to include the effect of lagged production on present price. Both price equations I and II suggest that pulp prices in the international markets would be largely determined by "supply-side" variables of pulp markets. In price equation III gross domestic product per capita represents "demand-side" of pulp markets, but results do not differ significantly from those given by models dominated by "supply-side" variables.

The price equations I,II and III explained 86 to 91 percent of the total price variance. Not all the parameters in the estimated equations, however, had the expected sign. Economic theory suggests

1) When building a woodpulp price model, attempts were made to incorpora such "supply-side" variables as wages and energy price in a model, while wood prices were discarded as an explanatory variable due to their simultaneous determination with woodpulp prices. Results obtain with labor and energy prices were, however, not satisfactory and these variables were omitted from a model. In further work results possibly could be improved by minimizing erratic factors, e.g., by using market white pulp data insted of total white pulp data and by devoting more time for development of cost variables than was possibl when carrying out this study. For further discussion on effects of input costs, economies of scale, and technological change on international pulp and paper prices, see Joseph Buongiorno and James K. Gilless . . .Forest Science, No.2. 1980.

Bleached Softwood Sulphate Prices: 1965-1979

Price Equation 1:

$$\left[\frac{\text{WEBLSA}}{\text{IPI}}\right]_t = 103.20331 + \underset{(3.532)}{0.905447}\left[\frac{\text{WEBLSA}}{\text{IPI}}\right]_{t-1} - \underset{(-1.955)}{1226.403}\left[\frac{\text{STOCKS}}{\text{SHIPM}}\right]_t + \underset{(4.278)}{134.899303}\ \text{DUMMY 75} - \underset{(-4.041)}{122.568865}\ \text{DUMMY 78}$$

$R^2 = 0.86$ S.E.E. = 27.03 D.W. = 2.00

Price Equation 2:

$$\left[\frac{\text{WEBLSA}}{\text{IPI}}\right] = 41.146211 + \underset{(4.469)}{1.029393}\left[\frac{\text{WEBLSA}}{\text{IPI}}\right]_{t-1} - \underset{(-2.783)}{1595.517720}\left[\frac{\text{STOCKS}}{\text{SHIPM}}\right]_t + \underset{(2.003)}{0.003018}\ Q_{t-1} + \underset{(4.381)}{122.568865}\ \text{DUMMY 75} - \underset{(-5.063)}{130.323333}\ \text{DUMMY 78}$$

$R^2 = 0.91$ S.E.E. = 23.40 D.W. = 2.55

Price Equation 3:

$$\left[\frac{\text{WEBLSA}}{\text{IPI}}\right] = -72.116053 + \underset{(4.358)}{1.054868}\left[\frac{\text{WEBLSA}}{\text{IPI}}\right]_{t-1} - \underset{(-2.768)}{1703.273240}\left[\frac{\text{STOCKS}}{\text{SHIPM}}\right]_t + \underset{(1.837)}{0.021998}\left[\frac{\text{GDP}}{\text{CAPITA}}\right]_t + \underset{(4.930)}{138.638696}\ \text{DUMMY 75} - \underset{(-4.869)}{134.980996}\ \text{DUMMY 78}$$

$R^2 = 0.90$ S.E.E. = 24.04 D.W. = 2.66

Where:

WEBLSA = Price of BL SW SA (CIF North Sea Ports of West Germany), Annual Average of US$/mt

IPI = International Index of inflation (1979-100)

STOCKS = Total paper woodpulp stocks at pulpmills in major markets (1,000 mt)

SHIPMENTS = While pulp production plus imports minum exports in major markets, shipments may be considered synonomous with apparent (assumptions 1,000 mt)

Q - Production of white pulp in major markets (1,000 mt).

$\frac{\text{GDP}}{\text{CAPITA}}$ = Gross Domestic Product per capita in major markets (US$ GDP at constant 1977 prices)

DUMMY 75 = Dummy variable for price vs. market abnormality (set to 1 for 1975 and to 0 for all other years).

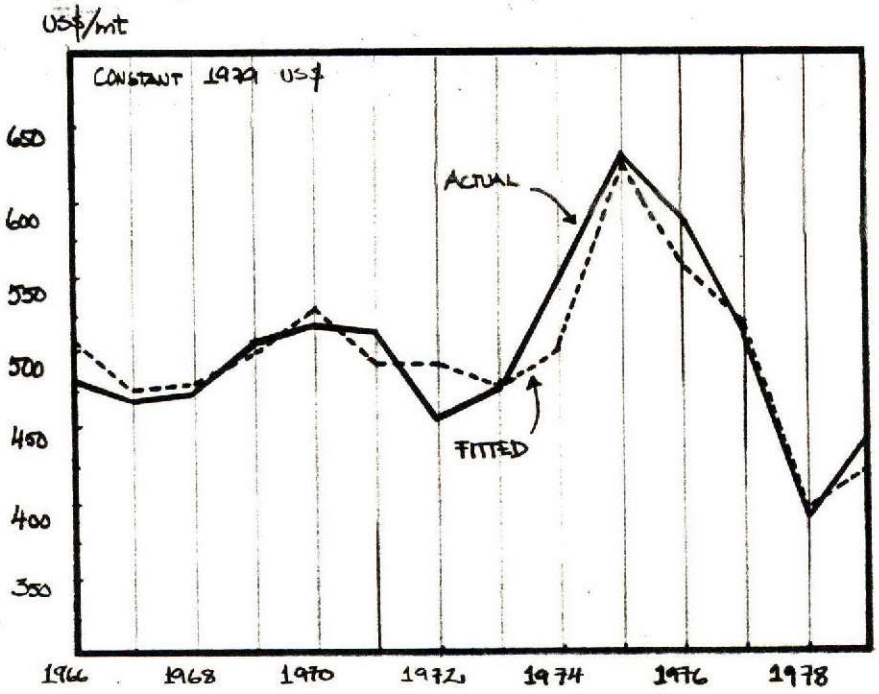
DUMMY 78 = Dummy variable for price vs. market abnormality (set to 1 for 1978 and to 0 for all other years).

that the estimates with the lagged production should have a negative sign; i.e., when production increases prices should decline. Price equation III did not conform to expectations based on economic theory.

Figures 19 and 20 show how the price models I and II for bleached softwood sulphate fit the data.

Price equations I and II were used to project the short-term price outlook for bleached softwood sulphate. The price model including the lagged production was not considered suitable for projection purposes due to incorrect sign of the parameter. When reviewing the results obtained it must be noted that price projections are estimates of what the woodpulp prices might be, if assumptions regarding future stocks/shipments ratio , overall economic performance and population growth materialize.

As a measure of economic growth, prospects for Gross Domestic Product prepared by the World Bank were used. Population estimates were those originally supplied by FAO. Stocks/shipments ratio was assumed to be the average yearly rate established during 1963-74 and 1979. However, to provide some flexibility, projections were also made under somewhat lower assumptions about this ratio, i.e., ratio of 0.025 was used instead of 0.042. Results of short-term woodpulp price projections are shown in Table 9.

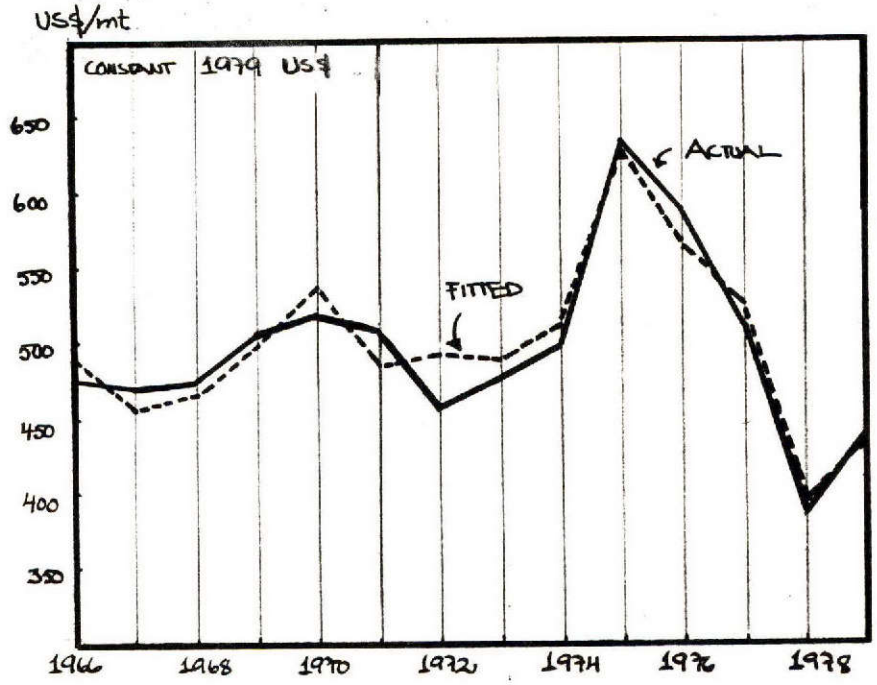


WORLD INDICATOR PRICE:
BLEACHED SOFTWOOD SULPHATE
[CIF NORTH SEA PORTS OF EUROPE]

$$\left[\frac{WEBLSA}{IPI}\right]_t = \underset{(3.532)}{103.20331} + \underset{(-1.955)}{0.105447}\left[\frac{WEBLSA}{IPI}\right]_{t-1} - \underset{(4.278)}{1220.403014}\left[\frac{STOCKS}{SHIPM}\right]_t + \underset{(-4.041)}{134.899303}\,DUMMY75 - 113.890241\,DUMMY78$$

$R^2 = 0.86$ S.E.E = 27.03 D.W. = 2.00

Figure 19 OBSERVED AND PREDICTED PRICES OF BLEACHED SOFTWOOD SULPHATE PULP IN INTERNATIONAL MARKETS 1966-79 (EQUATION I)



WORLD INDICATOR PRICE:
BLEACHED SOFTWOOD SULPHATE
(CIF NORTH SEA PORTS OF EUROPE)

$$\left[\frac{WEBLSW}{IPI}\right]_t = -72.116053 + \underset{(4.558)}{1.051868}\left[\frac{WEBLSW}{IPI}\right]_{t-1} - \underset{(-2.768)}{1703.273246}\left[\frac{STOCKS}{SHIPM}\right]_t + \underset{(1837)}{0.022000}\left[\frac{GDP}{CAPITA}\right]_t + \underset{(4.930)}{138.63869}\,DUMMY75 - \underset{(-4.896)}{134.980996}\,DUMMY$$

$R^2 = 0.90$ S.E.E = 24.04 D.W = 2.66

FIGURE 20 OBSERVED AND PREDICTED PRICES OF BLEACHED SOFTWOOD SULPHATE PULP IN INTERNATIONAL MARKETS 1966-79 (EQUATION II)

Table 9: SHORT-TERM OUTLOOK FOR BLEACHED SOFTWOOD SULPHATE WOODPULP (CONSTANT 1979 ~~PRICES~~ US$) a)

	1979	1980	1981	1982	Average Annual Growth (1979-82)	Assumptions
	----(US$ per metric ton)----				--(% pa)--	
ACTUAL	439	483				1/ b
ALT. I		~~467~~ 512	~~499~~ 545	~~538~~ 585	~~3.0~~ 10.0	S/S; average as established 1963-74 and 1979 GDP/capita; WB estimates, population growth; FAO
ALT. II		449	458	467	3.5 ~~2.1~~	S/S; as above
ALT. III		470	498	524	7.5 ~~6.0~~	S/S; optimistic assumption
ALT. IV		470	477	505	6.3 ~~4.8~~	S/S; 1980 1/ c optimistic, otherwise average as established 1963-74 and 1979.

1/ b S/S = stocks in relation to whitepulp shipments in major markets.
1/ c Estimate based on preliminary market data available for 1980.

a) West-German import price of bleached softwood sulphate (CIF North Sea ports of Europe)

Only Alternative I fully captured the considerable real price increase which took place in international pulp markets in 1980, showing in total, however, an unrealistically high increase in real price. On the other hand, all alternatives indicated an increase for real pulp prices in 1981, though with the slackening demand in paper and board markets woodpulp price increases are very unlikely to occur. In spite of the uncertainties related these short-term projections, they indicate that woodpulp prices could be expected to grow in real terms in the future, if economic conditions improve and if stocks/shipments ratio will follow a development path observe in the past.

C

Impact of Production Costs on Woodpulp Prices

Pulp

~~Plywood~~ costs

108. Almost in all traditional woodpulp producing areas, possibilities for further expansion of pulpwood ~~supply~~ output will be limited in the future; the industry faces the prospects of competing to an increasing degree with other wood-using industries for the available wood supplies, which tends to result in rising real wood prices as well as rises in real product prices, like woodpulp. The tightening wood raw material situation cannot be mitigated by importing chips, because export chip prices in world markets are foreseen to stabilize at a level above that of the past, with only a slight increase in volume.

109. An evaluation of the impact of wood costs on woodpulp prices, as shown below, should be considered only indicative, because a vast number of uncertainties introduced by the hetrogenity of pulpwood as a pulping raw material; chips versus roundwood, utilization of softwoods versus hardwoods, utilization of chips from integrated sawmilling and plywood production versus "free-market" chips, supply of roundwood from ~~own~~ company-owned forests vs. buying from ~~competitive markets~~ outside suppliers, etc. For example, in British Columbia, pulp industry relies predominately on low-cost chips. In the U.S. Southern States chips and roundwood ~~proportions are half and half~~ are used in equal proportions, while in Scandinavia, roundwood is used almost exclusively. Consequently, the Scandinavian case, it would be necessary to investigate how woodpulp prices are transmitted to stumpage prices and with what possible effects on ~~stumpage~~ pulpwood supply and demand. In North American markets the impact of sawmill and plywood markets on chip pricing would require further investigation.

1/ The most important cost items of round pulpwood, as delivered to the mill, are stumpage, logging costs and long-distance transportation costs.

110. Generally, pulpwood demand is not considered price sensitive. Over periods of one year or less, rigidities in physical production processes and the costs associated with idle pulping capacity combine to render pulpwood demand insensitive to price movements. In the long run, output level and factor proportions can be economically changed in response to shifts in relative input costs, but even over time, output/factor ratios can be expected to change along predetermined trends rather than in direct response to relative price movements. 1/

111. On a pulpwood supply side, a fair increase in real prices will mobilize further resources. "If stumpage prices are high, owners are generally more willing to sell timber.... On the other hand, if the sum of stumpage, harvesting, and processing costs is greater than the sale price of the resulting product, the stumpage is not economically available." 2/

112. The ~~indicative~~ expected annual increases in real pulpwood prices by region and their possible impact on bleached softwood sulphate market pulp prices are summarized ~~below.~~ in Table 10.

1/ ~~Davis~~ Darius M. Adams and Richard W. Haynes: The 1980 Softwood Timber Assessment Market Model: Structure, Projections, and Policy Simulations, Forest Science, 1980. Source:

2/ USDA, Forest Service, An Analysis of the Timber Situation in the United States, 1952-2030, Review Draft, 1980. Source:

~~Indicative Real Annual Increases~~

Table 10. Annual Price Increase for Pulpwood Prices and Their Possible Impact on Woodpulp Prices (Constant US$)

	Stumpage	Total Pulpwood Price	BL SW SA Price /a
	---(% ~~pa~~ p.a. per m^3 sub)---		--(% ~~pa~~ p.a. per mt)--
The U.S. South	2-4	1-2	0.4-0.7 /b
British Columbia Roundwood (coast) Chips	3	1-2 +	(0.4-0.7 /b
Scandinavia	0-1	1.5-2	0.6-0.9
Brazil	None	+	
Chip prices in export markets		+	

/a Estimated based on costs of producing bleached softwood sulphate market pulp in first quarter of 1980 (US$/mt, FOB mill). Source: Pulp and Paper, September 1980.

/b If chip prices do not follow an increase of 1-2% pa, the impact of wood costs on woodpulp prices will be less.

If raw material costs of bleached softwood pulp production would grow at ~~an~~ estimated growth rates assuming no real increases in other cost items, woodpulp prices are suggested to grow at an annual rate of 0.4-0.9 percent in world markets. Because North American pulp producers are expected to be in a position to influence increasingly international woodpulp trade flows, it is obvious that it will be more ~~is more~~ their cost structure than that of Scandinavians which will ~~determine~~ affect future woodpulp prices in world markets.

Other production costs

113. Also, other production costs (like labor, fuel, chemicals, capital, etc.) can be expected to increase ~~at least slightly~~ in real terms in the long run. However, the pulp as well as paper industries have a consistent historical record of cost-saving

technical improvements at all levels of processing. It is assumed here that these improvements will continue in the future and will offset the most of these cost increases. This view was originally put forward by USDA, Forest Service

D. Long-term Price Projections and Discussion on Results

Besides short-term outlook and long-term price trend (based on 1960-80 price data) two additional sets of long-term price alternatives were calculated. (Table 11 and Figure 21). In light of increasing real woodpulp prices in the 1970's (see Chapter IV), it was assumed that a real price increase around 0.25-0.50 percent per annum would materialize in the future. Especially the anticipated real price increases in pulping raw materials in major woodpulp producer areas, as a result of tightening wood supply and deteriorating possibilities to switch to cheaper raw materials, are bound to create price pressure on wood which might be reflected in woodpulp prices. In fact, the results obtained in Chapter IV imply that even faster increases in real woodpulp prices, than indicated above, may materialize.

Table 11. Long-term Price Projections for Bleached Softwood Sulphate Market Woodpulp[a] (Constant 1979 US$)

	1980	1981	1982	1983	1984	1985
	- US$ per metric ton -					
Alternative I[b]	495.3	495.7	496.1	496.5	496.9	497.3
Alternative II[c]	495.3	496.5	497.8	~~498.0~~ 499.0	~~499.2~~ 500.3	~~500.5~~ 501.5
Alternative III[d]	495.3	497.8	500.3	~~501.6~~ 502.8	505.8	~~508.1~~ 507.8

a) West German import price of bleached softwood sulphate (CIF North Sea ports of Europe)
b) $\ln P = a + bT$; b = 0.08 percent per annum
c) An annual increase of 0.25 percent was assumed.
d) - " - of 0.50 percent - " -

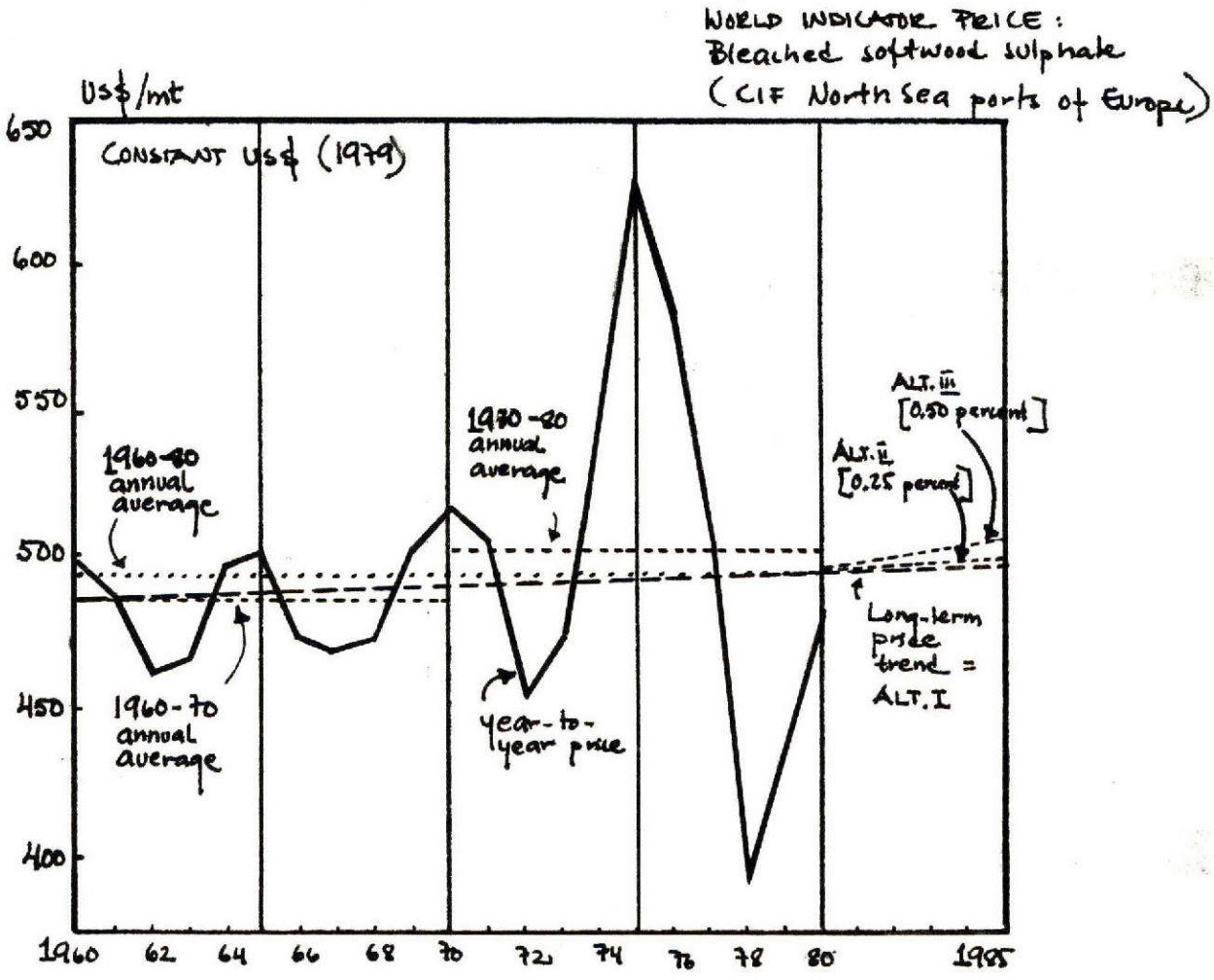


FIGURE 21. LONG-TERM PRICE PROJECTIONS FOR BLEACHED SOFWOOD SULPHATE MARKET WOODPULP (UP TO 1985)

As a result of the relatively small size of the anticipated increase in real woodpulp prices in the long run[1] and of fairly inelastic demand for pulp, the price rise can be expected to have ~~very~~ little effect on pulp demand. The main reason for inelasticity of woodpulp is that paper and paperboard manufacturers cannot readily turn to some substitute materials which would give similar quality characteristics of virgin fiber to their products[2]. Wastepaper is used to so extent, but more to substitute mechanical pulp and unbleached grades than bleached pulps. Substitution of high-priced bleached softwood pulps with lower-priced hardwood pulps is, however, more and more common and will increase further in the long run.

As far as pulp supply is concerned, it is not self-evident that an annual real price increase of magnitude of 0.25-0.50 percent or less would be enough to attract a large amount of capital required to build up the capacity to meet the rising demand for pulp. Real price increases beyond that predicted above may be required to encourage investments. For example, in 1979 and 1980 a considerable increase in real prices was required to offset cost increases, not at that time reflected in current prices and to justify new capacity investments.

---

1) Apart from short-term price fluctuations it is assumed here that real woodpulp prices would increase at an annual rate of 0.25-0.50 percent or less in the long run.

2) For further discussion on elasticities in pulp and paper industry see FAO, Forestry Paper 4/1, 1977, John A.Guthrie, An Economic Analysis of the Pulp and Paper Industry, 1972 and USDA, Forest Service, An Analysis of the Timber Situation in the United States 1952-2030, Review Draft, 1980. Price elasticities for most important paper and paperboard grades, as given by FAO, are shown in Annex Table XI.1.

F. Hardwood Pulp versus Softwood Pulp

An expected price differences between softwood and hardwood pulps are briefly commented upon, based primarily on a quarterly price data for 1975-80. In case of a new pulp grade, like eucalyptus, an appropriate time interval is usually required, after introductory sales with rebates, to determine its place in the range of traditional market pulp prices; the eventual price represents the papermaker's willingness to pay for a new product, adjusting for quality. For example, eucalyptus pulp from Brazil, was introduced in the mid 1970's, but only the recent price announcements have started to show its proper price relationship to traditional pulp grades.

In the future, the price differences between bleached softwood sulphate and good-quality bleached hardwoos sulphate will largely be determined by short-term supply and demand forces. With strong demand, suppliers will sell top-quality hardwood pulp, such as eucalyptus, at a price difference of US$ 25-30 (in nominal terms) relative to softwood pulps and at almost no price difference with respect to birch pulp. Lower quality hardwood pulps (e.g., from the US Southern States and the developing countries) are anticipated to sell at prices US$ 10-15 (in nominal terms) lower than birch pulp. However, with slackening demand price differentials tend to grow wider.

REVIEW OF WORLD BANK GROUP INDUSTRIAL FORESTRY PROJECTS 1/

1. MADAGASCAR

92. In the Mongoro forestry project a conservative price estimate of woodpulp was chosen for project calculations, though the report indicated that a substantial reduction in pulp prices is not likely in view of the projected increase in demand for pulp and the limited possibilities for expanding mill capacity and taking into account increasing wood shortage in the world in the next ten years (Annex Table I.1 and Annex Figure I.1). In the long run no real price increases were assumed, though this was seen possible. The comparison of price estimates used in project calculations (net mill price) 2/ and woodpulp prices paid by Western European paper and board producers (CIF North Seas ports of Europe) during the last seven years suggests that the utilization of conservative price estimates was fairly justifiable. It seems, however, that this price alternative was slightly on the low side and even somewhat higher mill net prices could have been used (Annex Figure I.2).

1/ Only projects with further plans to establish woodpulp productions are included. Because Western Europe is a primary export target for proposed pulp mills, prices used in calculations are compared with actual prices paid by Western European papermakers. If pulp is exported to nearby regional markets, results given here are subject to revision.

2/ Adjustment for ocean freight, insurance, commisions and deliverance, dock handling and loading, possible cash discount, etc., is required.

2. LIBERIA

93. In Liberian forestry project, Industrial Project Division calculations 1/ were used as a basis for the net mill pulp prices in calculations. Sales prices requirements at hypothetical pulp mills can be used to evaluate the adequacy of present prices starting from a required rate of return on new investment. An assumption applied in this methodology is that pulp producers will adopt marginal pricing policies. Normal industry practice, however, is to value assets at historical rather than replacement cost which leads to apparently acceptable profit ratios when prices are lower than the production costs. Because the objective of an analysis was to determine the pulp prices "given" by the established industry, representing international prices, an adjustment for this factor was made. Long-term prices acceptable by the industry were expected to be those which provide the required return for a blend of old and new plants. Considering the pulp and paper industry as a whole, an adjustment lowered the calculated 1977 prices by 10%.

94. However, it seems obvious that in international woodpulp markets, woodpulp pricing is predominately based on production cost structures of existing mills. For example, in 1974-1977, about 2 million tons of new market woodpulp capacity was started up by pulp producers. but only about 10% of it at new mills. This suggests that price projections of woodpulp should not exclusively rely on sales price requirements of new mills, even if adjusted; calculated prices tend to be high. This is confirmed by Annex Figure I.3. which indicates that the mill net price of US$ 390 for bleached softwood sulfate used at project work was on a high level (after adjustment for ocean freight, commissions, etc.). However, it must be

1/ Andrew Ewing. IPD, World Bank/International Finance Corporation: Office memorandum, Pulp and Paper Prices, February 2, 1978.

admitted that, for example, in the 1970s increases in real prices were needed to offset past cost increases and to justify investments in ~~net~~ new capacity.

3. NIGERIA

95. In Nigerian forestry project a possible pulp mill was foreseen to export surplus pulp to Southern Europe until domestic demand for paper matches supply. The quality of Gmelina pulp was seen to be similar to higher grade Scandinavian birch; mill net price of US$ 280 was considered to be competitive and acceptable in European markets. In terms of prices paid by papermakers in Western European markets in the 1970s, as shown in Annex Figure I.4., Nigeria can be expected to earn at least US$ 280 from their export pulp sales.

4. PORTUGAL

96. Economic values of eucalyptus and pine wood were derived at based on actual export prices of woodpulp. If these values were derived exclusively based on 1979 export prices of woodpulp, it is possible that basic wood values used in project calculations were on a ~~cost~~ low side, taking into account the long-term price development of woodpulp, say, that (which) was experienced in Western European markets in the last 7 years. 1/

1/ This statement is subject to revision after checking Price Annex of Staff Appraisal Report No. 2837-PO, May 5, 1980.

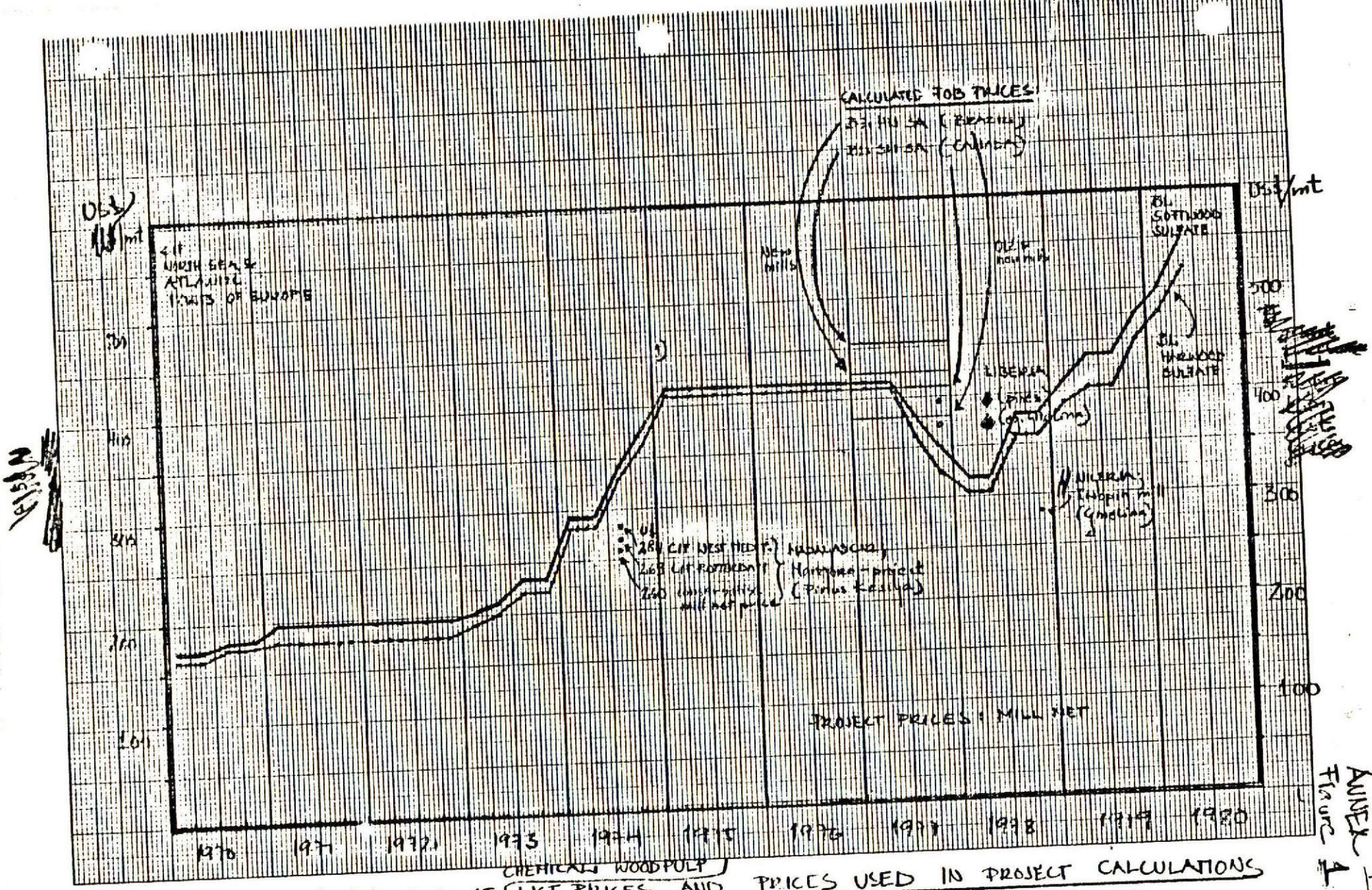
ANNEX I
Table 1

REVIEW OF WORLD BANK GROUP INDUSTRIAL FORESTRY PROJECTS

Sources:	Objectives of Project:	Pulp Grades:	Prices used in Calculations or Referred
PROJECT: MADAGASCAR, Forestry Project			
Appraisal of the Mangoro Forestry Project; Dec. 6, 1974, Report No. 590-MAG President's Report No. P-1539 - May MAG	The proposed project would, over five years provide for the planting of 35,000 of pine plantations as well as for the development of infra-structure and forest services within the project area. Based on the results of an evaluation of the alternative industrial uses for the wood from Mangoro plantations, it was concluded that a 200,000 ADTPA bleached kraft pulp mill using all the wood resources should be selected as the basis on which to evaluate the viability of the plantation program. The proposed mill in Madagascar was expected to be able to sell all of its pulp excess to domestic and regional sales on the European market after 1985.	Bleached softwood sulfate	Actual woodpulp market prices were used as a basis of mill net price. Mill net prices: US$ 284 Western Mediterranean US$ 269 Rotterdam US$ 260 Conservative Alternative In an economic analysis the conservative mill net price was used. JUSTIFICATION: The main risk involved in the project concerns the projected price of pulp and consequently the viability of the proposed pulpmill. Therefore, although present price forecasts for pulp are favorable, a conservative market price has been used in the economic evaluation to take into account the possibility of a slower price increase than expected.
PROJECT: LIBERIA, Forestry Project			
Staff Appraisal Report No. 1954-LBR, June 27, 1978 President's Report. No. P-2362 - LBR June 27, 1978	The primary objective of plantation development programs is to produce low-cost long-fiber softwoods (e.g., pines) and shoft-fiber hardwoods (e.g., Gmelina) in significant quantities for export in manufactured form, either pulp, chips, or sawn timber integrated with chips, primarily to Western Europe.	Bleached softwood sulfate Bleached hardwood sulfate 250,000 ADTPA	Mill net prices: US$ 395 BL SW SA US$ 370 BL HW SA JUSTIFICATION: Bank IPD projections.

ANNEX I
Table 1:
Continued

Sources:	Objectives of Project:	Pulp Grades:	Prices used in Calculations or Referred
PROJECT: NIGERIA, Forestry Plantation Project			
Staff Appraisal Report No. 2160 UNI, March 14, 1979 President's Report No. P-2487 - UNI	The project would cover five years of a long-term plantation development program, which would increase roundwood production for utility-grade timber, provide short fiber pulpwood for the pulp and paper industry; assess the viability of supplying locally-grown long-fiber pulpwood to the pulp and paper industry, improve forest plantation management in three states; strengthen FDF's planning capabilities; provide employment and social services; and increase food production in the rural areas. The Gmelina mill at full production is foreseen to export surplus pulp to Southern Europe until domestic demand for paper matches supply (1990-1995).	Bleached hardwood sulphate (Gmelina)	Mill net price US$ 283/mt JUSTIFICATION: No specific justification is given.
PROJECT: PORTUGAL, Forestry Project			
Staff Appraisal Report No. 2837 - PO May 5, 1980 President's Report No. P-2805-PO	The primary objective of the proposed project is to increase outputs of forest products by introducing a long-term forest development strategy, modernizing management practices on existing forest lands and by increasing the areas under forest to meet long run demand by forest based industries serving the domestic and export markets, thereby increasing foreign exchange earnings and promoting economic growth. Portugal's most promising export prospects in the short term are pine lumber, particle board and bleached chemical pulp. In the long term, prospects are most favorable for the expansion of exports of Eucalyptus-based bleached chemical pulp.	A long term target is to produce bleached hardwood (Eucalyptus) pulp.	Since about 80% of the project output is expected to be used for producing pulp, the price derived from the export of pulp were used as the basis for economic evaluation of the project. The current farmgate economic prices for eucalyptus and pine wood were derived by deducting marketing and processing costs from export prices of pulp. Because of the projected world shortage of industrial wood relative to demand, the real prices of wood were projected to rise at annual rate of 1.5% in the long run.



CHEMICAL WOODPULP

COMPARISON OF LIST PRICES AND PRICES USED IN PROJECT CALCULATIONS

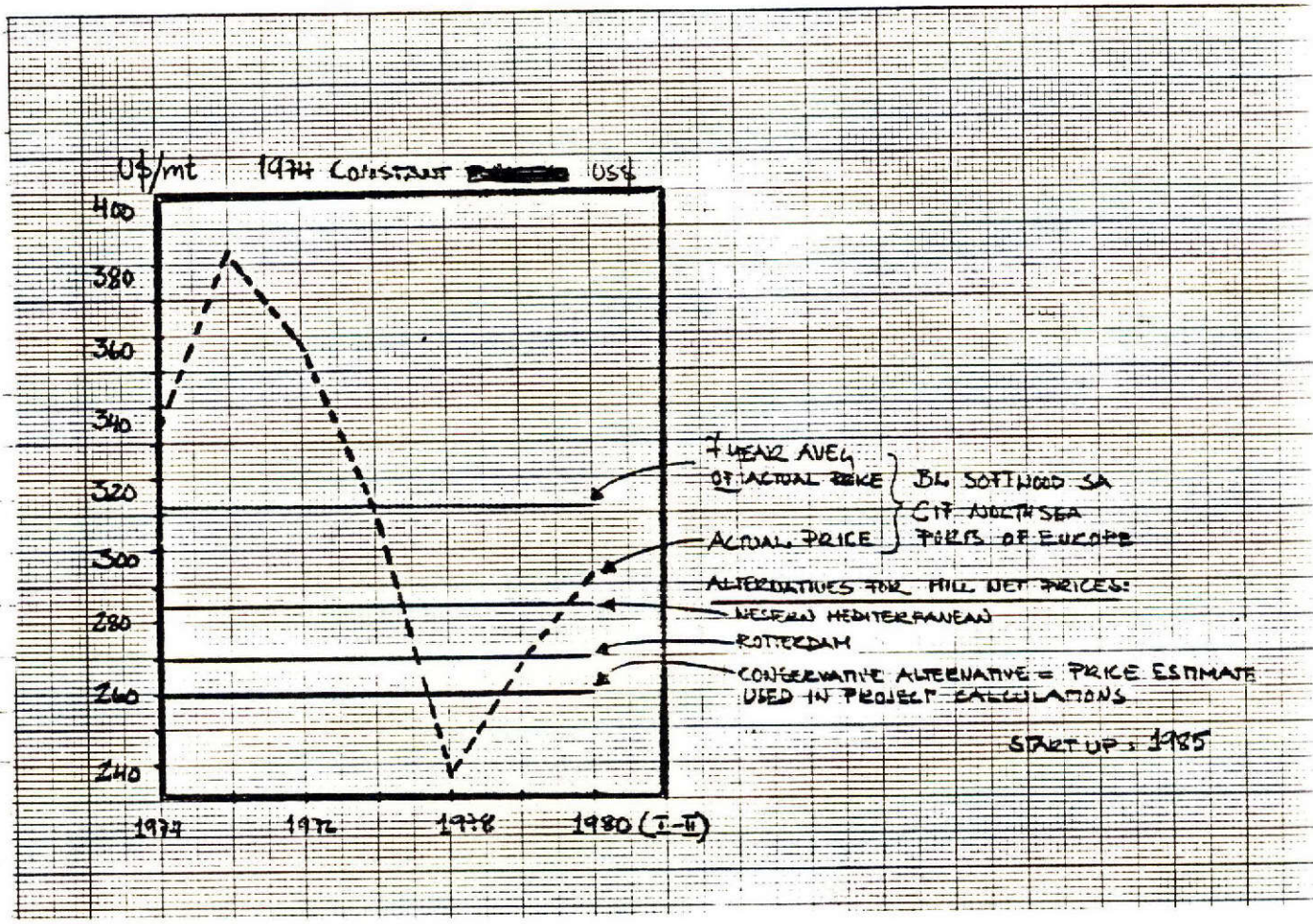
(In nominal terms)

ANNEX Figure 4

1) In 1975 II-IV actual prices were abt US$ 35 higher than list prices

Figure 2

MADAGASCAR, Forestry Project



ANNEX 1
Figure 3

LIBERIA, Forestry Project

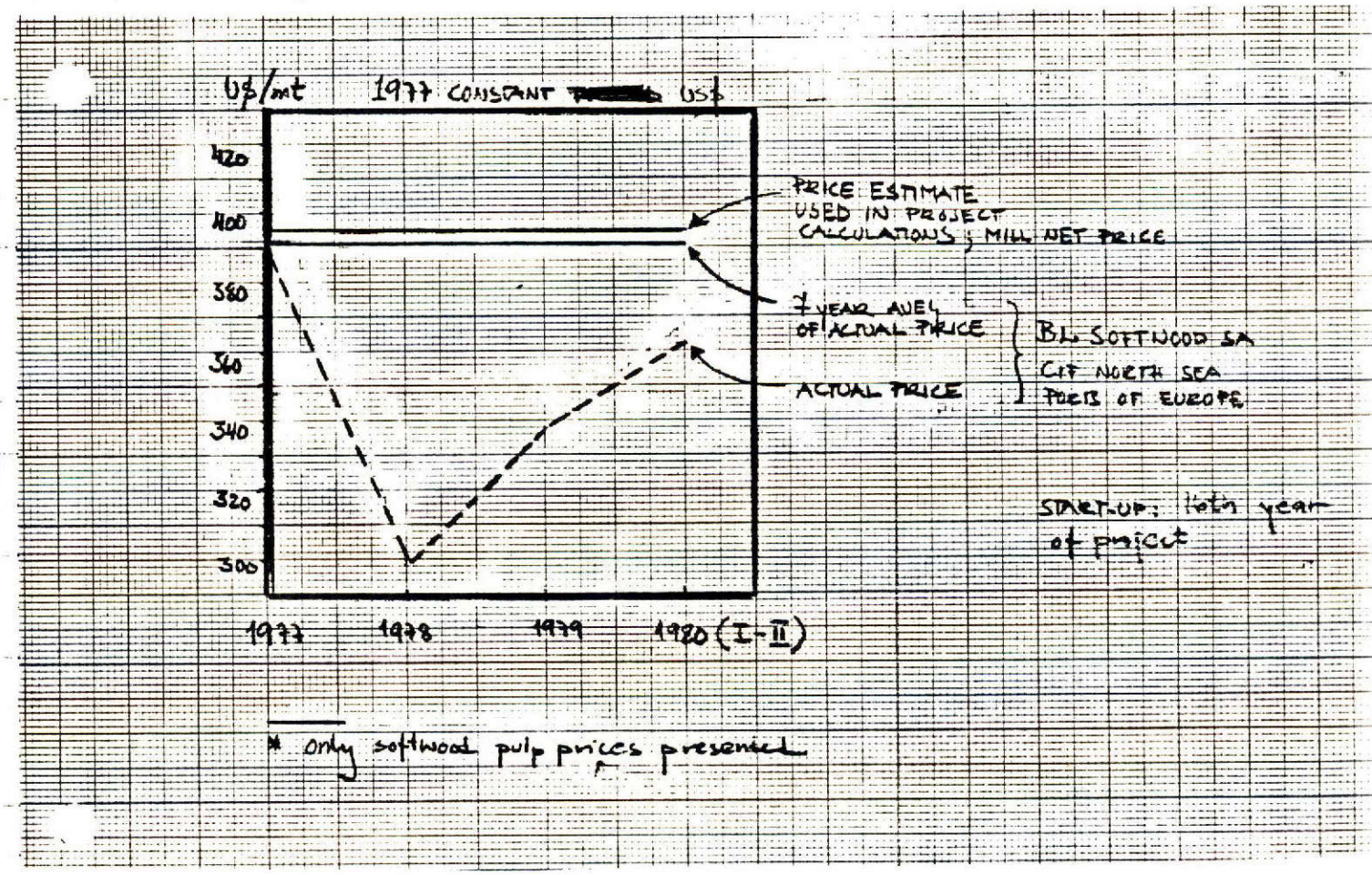
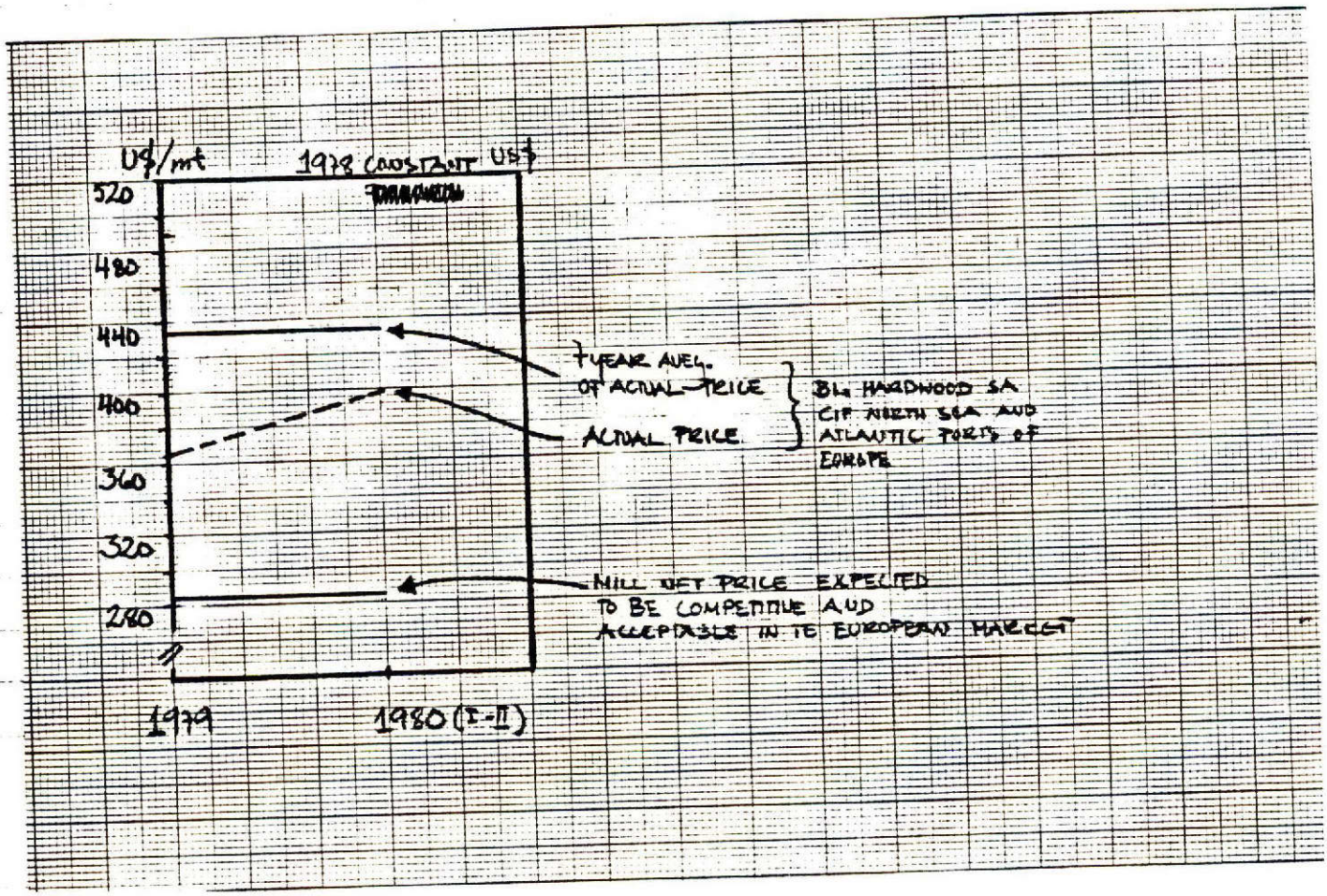


Figure 4

NIGERIA, Forestry Project



DEFINITIONS 1/

PULP GRADES:

Bleached Pulp:	A chemical pulp which is altered by an oxidizing or reducing agent so that the pulp has G.E. brightness over 75.
Bleached Sulphate Pulp:	Includes semi-bleached sulphate and soda pulp.
Chemical Pulp:	Includes white pulp and unbleached sulphate pulp (excluding dissolving and special alpha pulps).
Mechanical Pulp:	Pulp in which defibering is completed by mechanical means such as the stone groundwood process or the thermomechanical process. Mechanical pulp is used to make newsprint, coated and uncoated magazine, catalogue and directory papers, etc.
Non-Wood Fiber Pulp:	Pulp which is processed from other raw materials than wood, e.g., bagasse, reed, straw, etc.
Semi-Bleached Pulp:	A chemical pulp which is altered by an oxidizing or reducing agent so that the pulp has a G.E. brightness between 45 and 75 (in statistical tabulations, included with bleached).
Semi-Chemical Pulp:	High yield pulp in which delignification is only partially completed by some chemical agent such as neutral sulphite (NSSC), alkaline cook, etc. Semichemical pulp is used to make corrugating medium and paperboard.
Soda Pulp:	Soda pulp is a chemical pulp produced by high temperature digestion of wood with caustic soda (for statistical purposes, soda pulp is included with sulphate pulp).
Sulphate Pulp:	Sulphate pulp is a chemical pulp produced by the digestion of wood with a sulphate compound cooking liquor.
Sulphite Pulp:	Sulphite pulp is a chemical pulp produced by the digestion of wood with a sulphite compound cooking liquor.
Total Woodpulp:	Includes chemical, semi-chemical and mechanical pulps (such specialities as dissolving, special alpha are excluded. Also fibers other than wood are excluded).

1/ A principal source: American Paper Institute.

Unbleached Pulp:	A chemical pulp which is altered by an oxidizing or reducing agent so that the pulp has a G.E. brightness less than 45.
White Pulp:	Includes bleached and unbleached sulphite and bleached sulphate pulp.

CONVERSION FACTORS

Metric ton	= 1.1023 short tons
Cord	= 2.55 m^3 (solid basis) 3.62 m^3 (stacked basis, including air space)
m^3 s. ub.	= m^3 solid basis, under bark

REAL GDP GROWTH IN THE WORLD, ACTUAL AND PROJECTED

	Actual			FAO-PROJECTIONS (GDP) /1 a Low			FAO-PROJECTIONS (GDP) /1 a High			INDUSTRY WORKING PARTY (GDP) /1 a			WORLD BANK PROJECTION /1 b		
	60-65	65-70	70-75	75-80	80-85	85-90	75-80	80-85	85-90	75-80	80-85	85-90		80-85	85-90	80-90
	(% per annum)															
INDUSTRIALIZED COUNTRIES	5.3	4.7	2.9	4.3	4.2	4.3	5.4	5.5	5.7					3.5*	4.0*	
North America	4.8	3.2	2.2	4.6	4.1	4.1	5.8	5.7	5.7	3.3	3.2	3.0		3.0	3.9	
Canada	5.7	4.8	4.4	5.0	5.2	5.5	6.0	6.5	7.0	3.2	3.3	3.5		3.9	4.1	
United States	4.7	3.1	2.0	4.6	4.0	4.0	5.8	5.6	5.6	3.3	3.2	3.0		2.9	3.9	
Western Europe	5.1	4.7	4.6	3.6	3.7	4.1	4.7	4.9	5.3	3.3	3.2	2.9		3.4	3.8	
Japan	10.1	11.6	5.3	6.0	5.8	5.5	7.0	7.0	7.0	6.3	5.3	4.3		5.5	5.9	
Oceania	4.7	5.4	2.6	3.7	3.8	4.1	4.5	4.7	5.2	4.0	3.9	3.5	Aust.	3.4	4.1	
													N.Z.	3.1	3.3	
CENTRALLY PLANNED ECONOMIES	5.4	6.0	6.3	5.1	5.5	5.5	6.3	6.7	6.8	6.1	6.0	5.7				
DEVELOPING COUNTRIES	5.3	4.7	2.9	4.3	4.2	4.3	5.4	5.5	5.7							5.6
Latin America	5.4	5.7	6.0	5.0	5.4	5.5	7.0	7.6	7.7	5.8	5.7	5.2				
Near East & North Africa	7.0	7.5	8.9	9.1	8.1	8.3	12.3	11.1	11.4	10.0	9.0	8.0				
Africa (South of Sahara)	4.7	5.6	4.0	3.5	4.7	5.2	4.8	6.0	6.6	4.3	4.2	3.8				
Other Far East	4.2	5.3	4.5	5.3	5.8	5.9	6.9	7.4	7.5	4.5	4.5	4.5				

/1 a FAO Forestry paper ~~April 1~~ No 4/1 ; World Pulp and Paper Demand, Supply and Trade, 1977

/1 b World Bank Report No. 814/80, Price Prospects for Major Primary Commodities, January 1980.

* in all industrialized countries.

WORLD DEMAND FOR PAPER AND PAPERBOARD

	1960	1965	1970	1973-75	1979	Low Income Assumption 1980	Low Income Assumption 1985	Low Income Assumption 1990	High Income Assumption 1980	High Income Assumption 1985	High Income Assumption 1990	IWP Forecasts 1980	IWP Forecasts 1985	IWP Forecasts 1990
	(million metric tons)													
Industrialized Countries	60.60	79.60	102.01	112.22	130.94	138.89	166.31	202.96	147.01	184.97	240.73	137.70	161.85	187.21
North America	36.10	45.39	53.42	57.90	68.87	71.22	84.74	101.94	75.85	95.17	122.75	69.74	80.29	91.75
US	33.86	42.30	50.08		64.25							65.13	75.07	85.72
Canada	2.24	3.09	3.34		4.62							4.61	5.22	6.03
Western Europe	19.13	25.69	34.17	37.36	42.16	44.95	52.52	64.08	47.32	58.15	75.05	46.12	53.79	61.31
EC	15.96	20.72	27.08	28.68	33.34	34.12	39.45	47.62	35.72	43.41	55.02	35.19	40.48	45.16
Nordic Countries	1.49	2.18	2.66	3.09	3.34	3.74	4.40	5.41	3.94	4.78	6.11	3.29	3.54	3.94
Others	1.68	2.79	4.43	5.58	5.48	7.09	8.66	11.05	7.66	9.96	13.92	7.65	9.77	12.21
Japan	4.34	7.07	12.55	14.77	17.53	20.02	25.83	33.11	21.08	28.30	38.70	19.07	24.38	30.09
Oceania	1.03	1.45	1.87	2.19	2.38	2.70	3.22	3.83	2.76	3.34	4.23	2.77	3.39	4.06
Centrally Planned Economies	8.12	10.91	14.70	18.09	20.61	25.14	33.12	43.72	27.21	38.15	54.90	24.10	30.44	37.30
Developing Countries	4.67	6.82	10.95	13.30	19.00	18.47	24.47	33.77	22.12	33.89	54.69	17.94	23.92	31.32
Latin America	2.45	3.53	5.58	6.57	8.85	8.70	11.01	14.48	10.50	15.49	24.53	8.93	11.85	15.40
Africa (South of Sahara)	0.54	0.82	1.29	1.44	1.64	1.82	2.21	3.20	2.16	3.03	5.10	3.93	5.56	7.79
Near East & North Africa	0.46	0.59	0.89	1.25	1.65	1.98	2.92	4.36	2.41	4.17	7.26			
Far East	1.22	1.88	3.19	4.04	6.86	5.97	8.32	11.73	7.05	11.20	17.80	5.08	6.51	8.13
WORLD TOTAL	73.39	97.33	127.66	143.62	170.55	182.50	223.90	280.45	196.34	257.02	350.32	179.75	216.20	255.82

Source: FAO, Forestry Paper. [illegible], 1977 and 1979 figures from Pulp and Paper International, Annual Review, 1980.

ANNEX III
Table 1.

DEMAND FOR WHITE PULPS

	1972-74				1980				1990			
	Total SI	BL. HW SA	BL. SW SA	Total White Pulp	Total SI	BL. HW SA	BL. SW SA	Total White Pulp	Total SI	BL. HW SA	BL. SW SA	Total White Pulp
	(1,000 metric tons)											
Industrialized Countries	9,341	11,520	16,780	37,641	8,271	14,748	19,692	42,711	6,646	21,023	25,238	52,907
North America	4,038	5,533	10,944	20,515	3,423	6,699	12,184	22,306	2,722	8,630	14,746	26,098
US	2,224	5,183	9,691	17,098	1,870	6,249	10,818	18,937	1,550	8,085	12,956	22,591
Canada	1,814	350	1,253	3,417	1,553	450	1,366	3,369	1,172	545	1,790	3,507
Western Europe	4,850	2,945	4,681	12,476	4,603	4,043	5,987	14,633	3,744	6,422	8,052	18,218
EC	2,347	1,945	3,039	7,331	2,445	2,542	3,616	8,603	1,844	3,803	4,952	10,599
Nordic Countries	1,550	500	1,100	3,150	1,268	714	1,592	3,574	1,090	1,320	1,952	4,362
Others	953	500	542	1,995	890	787	779	2,456	810	1,299	1,148	3,257
Japan	370	2,896	996	4,262	245	3,816	1,193	5,254	180	5,665	1,949	7,794
Oceania	83	146	159	388	-	190	328	518	-	306	491	797
Centrally Planned Economies	3,430	225	642	4,297	3,450	770	1,812	6,032	3,300	1,500	4,420	9,220
Developing Countries	457	690	760	1,907	140	1,271	1,317	2,728	95	2,567	2,297	4,959
Latin America	200	475	517	1,192	140	940	705	1,785	95	2,075	1,028	3,198
Africa (South of Sahara)	22	35	120	177	-	70	189	259	-	150	311	461
Near East & North Africa	3	10	46	59	-	31	84	115	-	54	258	312
Far East	232	170	77	479	-	230	339	569	-	288	700	988
WORLD TOTAL	13,228	12,435	18,182	43,845	11,861	16,789	22,821	51,471	10,041	25,090	31,955	67,086

Source: FAO, Forestry Paper, [illegible] 1977.
No H/1

Annex IV
Table 1

STRUCTURE OF WOODPULP TRADE (1978)

Importers	CAN Exports		US Exports		SWE Exports		FIN Exports		CAN,US,SWE,FIN EXPTS.		Total OECD Exports		Total Imports	
	Chemical WP (Total)	BL. SA.	Chemical WP (Total)	BL. SA.	Chemical WP (Total)	BL. SA.	Chemical WP (Total)	BL. SA.	Chemical WP (Total)	BL. SA.	Chemical WP (Total)	BL. SA.	Chemical WP (Total)	BL. SA.
	(1,000 metric tons)													
OECD - Europe	1,924.8	1,767.6	907.3	828.0	2,499.5	1,836.1	1,082.2	756.3	6,413.8	5,188.0	7,521.6	5,845.4	8,283.8	6,233.0
EEC Countries	1,887.9	1,667.2	888.0	785.6	2,113.2	1,539.0	888.5	668.7	5,777.6	4,660.5	6,752.7	5,227.1	7,227.7	5,569.8
US	3,138.8	2,585.2	-	-	20.0	3.8	11.9	6.4	3,170.7	2,595.4	3,249.4	2,660.4	3,291.3	2,670.5
Japan	560.0	512.0	219.0	145.0	243.0	183.0	46.0	22.0	1,068.0	862.0	1,090.0	873.0	1,162.0	944.0
TOTAL OECD	5,692.0	4,927.8	1,214.9	1,066.0	2,741.3	1,996.8	1,161.4	815.4	10,809.6	8,806.0	12,086.4	9,528.2	13,000.8	9,996.2
Non-OECD-Europe	24.0	17.3	10.7	4.5	208.9	91.7	82.0	19.2	325.6	132.7	387.0	140.0	n.a.	n.a.
Latin America	90.8	77.3	181.8	120.8	24.6	9.6	5.9	2.9	303.1	210.6	309.6	214.4	n.a.	n.a.
Asia	284.5	235.8	138.4	96.1	207.9	65.5	114.6	99.0	745.4	496.4	899.6	592.2	n.a.	n.a.
Africa	45.3	44.1	68.3	67.2	56.4	18.4	13.4	6.2	183.4	135.9	215.4	162.0	n.a.	n.a.
Total Non-OECD	444.6	374.5	399.2	288.6	499.0	186.4	215.9	127.3	1,558.7	976.8	1,822.5	1,109.8	n.a.	n.a.
TOTAL	6,136.6	5,302.3	1,614.1	1,354.6	3,240.3	2,183.2	1,377.3	942.7	12,368.3	9,782.8	13,908.9	10,638.0	n.a.	n.a.

Source: OECD, The Pulp and Paper Industry 1978-79, Issue 1980.

ANNEX V
Table 1

ANNEX V
Table 1.

LARGEST MARKET PULP PRODUCERS AMONG THE WORLD'S TOP 100 PAPER COMPANIES

Rank Order Among Top 100 in the World	% of Sales from Pulp, Paper, Converting	Production 1978 (1000 mt) Market Pulp	Paper & Board	Converting	No. of Countries with Manufacturing Operations
1. Georgia-Pacific (USA)	22	437	1,488	450	2
2. International Paper (USA)	79	1,114	5,879	1,829	9
3. Weyerhaeuser (USA)	36	917	2,291	1,310	6
4. Champion International	49	100[e]	2,148	1,000[e]	3
5. Reed International (UK)	50	175	1,276	626	5
6. Bowater Corp. (UK)	35	339	1,787	n.a.	6
7. Boise Cascade (USA)	53	158	1,901	n.a.	5
8. Crown Zellerbach (USA)	36	222	2,015	535	4
9. Mead Corp. (USA)	44	317	1,974	638	8
10. St. Regis Paper (USA)	82	130	3,094	1,183	10
11. Kimberley-Clark (USA)	90	100[e]	1,142	370[e]	22
12. MacMillan Bloedel (Canada)	51	431	1,607	n.a.	3
13. Scott Paper (USA)	92	140[e]	1,700[e]	1,030[e]	17
14. Sanyo-Kokusaku Pulp (Japan)	65	377	789	n.a.	2
20. Svenska Cellulosa (Sweden)	38	227	810	230	11
21. Domtar (Canada)	62	180[e]	900[e]	n.a.	2
22. Jujo Paper (Japan)	87	191	1,160	49	3
25. Consolidated Bathurst (Canada)	n.a.	220	1,260	n.a.	2
33. ITT Rayonier (USA)	100	1,100	-	-	2
35. Willamette Industries (USA)	53	137	755	703	1
36. PWA (Fed. Rep. Germany)	100	146	762	322	1
38. Enso-Gutzeit (Finland)	73	131	927	110	2
39. Stora Kopparberg (Sweden)	59	543	529	-	2
41. Borregaard (Norway)	35	240[e]*	209	40[e]	2
42. Sodra Skogsagarna (Sweden)	62	700	256	40	1
43. British Columbia Forest Products (Canada)	55	448	525	-	2
49. Statens Skogsindustrier-Assi (Sweden)	49	186	472	190	4
50. Norrlands Skoysagares Cellulosa (Sweden)	80	392	400	106	6
51. Mo och Domsjo (Sweden)	88	551	302	77	4
52. Mitsubishi Paper Mills (Japan)	98	141	413	-	1
56. Temple-Eastex (USA)	40	110	325	-	1
60. Billerud-Uddeholm (Sweden)	78	318	449	260	6
69. Federal Paper Board (USA)	63	147	652	n.a.	1
71. Iggesunds Bruk (Sweden)	50	155	178	-	1
72. New Zealand Forest Products (NZ)	65	141	334	20	1
86. Papyrus (Sweden)	82	149	308	-	2
87. Wilh. Schauman (Finland)	42	209	103	62	2
91. Great Lakes Forest Prod. (Canada)	86	327	362	-	1
95. Korsnas-Marma (Sweden)	80	140	247	45	3
100. Groupement Europeen De La Cellulose (France)	98	527	-	-	2

*Includes Brazilian pulp (from Riocell) bleached in Norway

Source: Pulp and Paper International, September 1979

INCREASES IN CHEMICAL WOODPULP CAPACITY 1974-1984

	Capacity			Total Increase		Average Annual Increase	
	1974	1979	1984	1974-79	1979-84	1974-79	1979-84
	(1,000 metric tons)					(% p.a.)	
World Total	83,732	93,499	104,671	9,767	11,172	2.2	2.3
Industrialized Countries	72,063	77,346	83,259	5,283	5,913	1.4	1.5
North America	45,671	49,665	53,531	3,994	3,866	1.7	1.5
Western Europe	18,068	18,334	19,569	266	1,235	0.3	1.3
Japan	7,096	8,123	8,873	1,027	750	2.7	1.8
Oceania	958	924	964	-34	40	-0.7	0.9
Others	270	300	322	30	22	2.1	1.4
Centrally Planned Economies	8,668	11,218	13,808	2,550	2,590	5.3	4.2
Asia	1,090	1,619	1,993	529	374	8.2	4.2
Eastern Europe	1,918	2,399	3,115	481	716	4.6	5.4
USSR	5,660	7,200	8,700	1,540	1,500	4.9	3.9
Developing Countries /1	3,001	4,935	7,604	1,934	2,669	10.5	9.0
Africa	265	340	786	75	446	5.1	18.2
Latin America	2,181	3,931	5,536	1,750	1,605	12.5	7.1
Asia	555	664	1,282	109	618	3.7	14.1

/1 Developing market economies.

Source: FAO, Pulp and Paper Capacities, Survey 1979-1984, 1980

CHEMICAL MARKET WOODPULP PRICES 1960-1980 (I-II)

	North American Markets			
	US domestic BL SW SA/dd	US domestic BL HW SA/dd	CAN to USA BL SW SA/dd	CAN to USA /a BL HW SA/dd
	(US$ per metric ton)			
1960	169	164	169	
1961	160	152	160	
1962	157	152	158	
1963	153	146	155	
1964	162	148	164	
1965	165	149	165	
1966	165	149	165	149
1967	165	149	165	149
1968	165	149	165	149
1969	165	149	165	150
1970	182	164	182	164
1971	188	166	188	162
1972	188	166	188	162
1973	200	187	221	202
1974	310	302	335	326
1975	392	361	406	391
1976	375	361	406	391
1977	358	329	398	345
1978	328	299	342	307
1979	409	385	429	417
1980 I-II	493	460	511	473

/a No price announcements for 1960-1965

Source: Paper Trade Journal

CHEMICAL MARKET WOODPULP PRICES 1960-80 (I-II)

	WESTERN EUROPEAN MARKETS							JAPANESE MARKETS
	SCAN /a BL SW SA CIF EUROPE	SCAN /a BL HW SA CIF EUROPE	WG IMPORTS/b BL SW SA CIF N.SEA	FIN TO WG /c BL & SEMIBL SA, FOB	FIN TO UK /c BL & SEMIBL SA, FOB	SWE TO WG /d BL & SEMIBL SA, FOB	SWE TO UK /d BL & SEMIBL SA, FOB	JAP DOMESTIC /e BL HW SA, dd
	(US$ per metric ton)							
1960	156	-	153	122	122	138	136	148
1961	157	140	151	123	126	138	137	148
1962	146	129	141	115	119	127	127	120
1963	148	133	144	118	117	128	128	143
1964	159	144	156	125	128	138	138	152
1965	167	149	162	132	126	143	143	133
1966	156	135	154	124	123	135	135	142
1967	156	135	154	119	119	134	133	151
1968	146	130	146	114	116	129	125	153
1969	156	144	158	123	119	140	135	157
1970	175	167	177	134	143	162	160	172
1971	186	179	188	134	156	177	174	162
1972	186	179	186	126	155	174	172	192
1973	219	207	232	177	181	210	202	279
1974	324	313	334	275	248	296	282	412
1975	415	410	441	387	378	429	420	421
1976	415	410	418	377	370	399	395	422
1977	390	376	391	343	349	372	371	..
1978	350	331	344	283	294	330	320	..
1979	439	415	439	368	371	396	384	..
1980I-II	532	498	521					

/a Finncell, Helsinki & Pulp and Paper International
/b Preise und Preisindizes im Ausland, Reihe 4. Statistisches Bundesamt, Wiesbaden
/c Finnish Export Statistics, Suomen Tilastollinen Paatoimisto, Helsinki
/d Swedish Export Statistics, Statistiska Centralbyran, Stockholm
/e The Industrial Bank of Japan, Finance and Industry, Quarterly Survey, Tokyo

ANNEX VIII
Table 2

CORRELATION MATRIX OF NOMINAL CHEMICAL WOODPULP PRICES 1961-1979

	US Domestic BL SW SA dd	US Domestic BL HW SA dd	CAN to USA BL SW SA dd USA	SCAN to WE BL SW SA CIF Europe	SCAN to WE BL HW SA CIF Europe	FIN to WG BL & SEMIBL SA FOB	[redacted] to UK BL & SEMIBL SA FOB	SWE to WG BL & SEMIBL SA FOB	SWE to UK BL & SEMIBL SA FOB	WG Import BL SW SA CIF	JAP Domestic /1 BL HW SA dd
US domestic BL SW SA, dd	1.000	.998	.998	.998	.996	.992	.992	.993	.992	.997	.962
US domestic BL HW SA, dd		1.000	.997	.996	.995	.993	.989	.990	.987	.995	.968
CAN to USA BL SW SA, dd USA			1.000	.998	.997	.994	.993	.993	.992	.997	.974
SCAN to WE BL SW SA CIF Europe				1.000	.999	.994	.995	.996	.994	.998	.968
SCAN to WE BL HW SA CIF Europe					1.000	.994	.996	.998	.997	.999	.966
FIN to WG BL & SEMIBL SA FOB						1.000	.994	.994	.994	.995	.955
FIN to UK BL & SEMIBL SA FOB							1.000	.997	.998	.995	.943
SWE to WG BL & SEMIBL SA FOB								1.000	.999	.998	.958
SWE to UK BL & SEMIBL SA FOB									1.000	.996	.950
WG Imports BL SW SA CIF										1.000	.942
JAP domestic BL HW SA, dd											1.000

/1 Based on 1960-1976 data.

INDICES OF FLUCTUATIONS ON CHEMICAL WOODPULP PRICES (REAL PRICES) /1

	Moving Average /2 3-year	Annual Average /3 Change	
	% p.a.		
North American Markets	1960-1980 (I-II)	1960-1970	1970-1980 (I-II)
US domestic BL SW SA/dd (USWPI)	2.52	3.02	11.04
US domestic BL SW SA/dd (IPI)	2.65	2.59	11.58
US domestic BL HW SA/dd (USWPI)	2.77	2.82	12.85
US domestic BL HW SA/dd (IPI)	2.93	2.56	11.45
CAN to USA BL SW SA/dd (USWPI)	2.70	2.93	9.88
CAN to USA BL SW SA/dd (IPI)	2.89	2.59	9.70
CAN to USA BL HW SA/dd (USWPI)		1.45	12.70
CAN to USA BL HW SA/dd (IPI)		2.35	18.72
Western European			
~~SCAN to Western Europe~~			
BL SW SA/CIF Europe (IPI)	2.78	3.21	9.93
BL HW SA/CIF Europe (IPI)		5.01	10.70
WG Imports BL SW SA/CIF (IPI)		3.33	11.07
FIN to WG BL & SEMIBL SA/FOB (IPI)		3.67	16.60
FIN to UK BL & SEMIBL SA/FOB (IPI)		4.38	12.23
SWE to WG BL & SEMIBL SA/FOB (IPI)		3.93	11.40
SWE to UK BL & SEMIBL SA/FOB (IPI)		3.88	11.67
Japanese Markets			
JAP domestic BL HW SA/dd (IPI)		7.84	12.25

/1 Annual price data in 1979 constant US dollars.

/2 The average % deviation from the moving average:

$$\left(\frac{|P_t - P'_t|}{P'_t} \right) \times \frac{1}{n} \times 100$$

P_t = the price in year t

P'_t = the moving average centered on the year t

n = the number of observations of the relevant moving average

/3 Average of annual percentage change, ignoring negative signs

BASIC DATA FOR WHITE WOODPULP PRICE ANALYSIS AND PROJECTION

	BL SW SA Price /a	Shipments /b of White Pulp /c	Stocks of Total Paperpulp at Pulpmills /c	White Pulp Capacity /c	White Pulp Production /c	Operating Ratio	IPI
	---(US$ per mt)---		----------(1,000 metric tons)----------				
1965	162.0	24,414	1,310	27554	24,855	90.2	32.2
1966	153.8	26,109	1,076	29778	26,648	89.5	32.5
1967	154.3	27,318	1,219	32199	27,960	86.8	33.0
1968	146.3	29,242	1,158	33562	29,961	89.3	30.9
1969	157.7	31,936	837	34807	32,376	93.0	31.2
1970	177.4	33,366	829	37,391	34,272	91.7	34.4
1971	188.4	32,840	2,085	39,242	33,822	86.2	37.2
1972	186.0	34,848	1,987	40,432	35,814	88.6	41.0
1973	231.6	36,942	1,133	42,216	38,527	91.3	48.9
1974	~~33.7~~ 333.7	38,837	~~9,421~~ 942	43,249	39,807	92.0	60.9
1975	441.4	33,927	2,885	43,681	34,976	80.1	70.1
1976	418.2	37,667	3,597	44,350	38,575	87.0	71.4
1977	391.1	37,577	3,516	45,156	38,519	85.3	76.7
1978	343.8	39,681	2,009	46,063	40,211	87.3	88.3
1979	440.0	42,379	1,202	46,860	42,717	91.2	100.0
1980				48,047			110.5
1981 (Jan-May)	521.3 /d			49,057			120.5
1982				50,028			130.1

/a West German import price of bleached softwood sulphate (CIF North Sea ports of Europe).

/b Shipments = White pulp production plus imports minus exports in major markets. Shipments may be considered synonymous with apparent consumption.

/c Data on North America, Western Europe and Japan included.

/d 1980 I-IV: US$ ~~483~~ 533.8

Annex A
Table 1

CARRYING CAPACITY, POPULATION GROWTH, AND SUSTAINABLE DEVELOPMENT

World Development Report VII Background Paper

Office of Environmental and Scientific Affairs

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The Concept of Carrying Capacity:

The carrying capacity of a particular region is the maximum population of a given species that can be supported indefinitely, allowing for seasonal and random changes, without any degradation of the natural resource base that would diminish this maximum population in the future. The concept of carrying capacity is familiar to biologists and wildlife managers, who devised it to express the capacity of natural areas (ecosystems) to support animal life. With modifications, it is also an important measure of the ability of regions to support human populations. Carrying capacity is, therefore, an important concept for the work of development economists, planners, and political decision makers.

In the study of natural ecosystems, application of the carrying capacity concept is relatively straightforward. For example, the number of deer that can survive in a temperate forest may be determined by the availability of winter browse. In such a case, if too many deer are born in any given year and the surplus is not removed by predation, disease, or other means, winter starvation will reduce the population to the forest's carrying capacity. In other words, the deer population is constrained by the availability of food in the winter.

In ecosystems managed by humans, defining and measuring carrying capacity is essential for sustainable natural resource use. On managed rangeland, for example, humans have controlled the predators that would have limited the population of grazing animals on natural rangeland. Consequently, ranchers must assess the carrying capacity of the range and control the grazing herds accordingly. If the herd size exceeds the long-term carrying capacity of the range, immediate starvation (as in the case of the forest

deer) is unlikely. Instead, the animal production of the range probably will increase for a brief period. Over the short term, more grass will be converted to meat. Over the long term, however, overgrazing will interfere with the reproduction and growth of the range grass, ultimately causing irreversible damage to soil productivity, thereby reducing the number of animals that the range can feed. Overgrazing boosts animal production briefly, but does so at the expense of permanently eroding the carrying capacity of the rangeland resource base.

As this example illustrates, it is usually possible to exceed the carrying capacity of a region temporarily . A natural resource base cannot sustain a population beyond its carrying capacity indefinitely, however, and will suffer a reduction of its inherent productivity as a result of being overexploited. Managing such resources is difficult because the decline of the carrying capacity is usually evident only some time after the damage has been done, and because over the short term the production of the resource has actually increased.

A useful analogy is an interest-bearing bank account. The "carrying capacity" of the bank account is the interest. It is possible to siphon off the interest without impairing the account's ability to produce more interest. However, if money is withdrawn from the account faster than it is being generated (thereby temporarily increasing the "yield" from the account) the process is unsustainable, as the future "carrying capacity" of the account is reduced. Similarly, the carrying capacities of some ecosystems can be exceeded for a while, but they cannot be exceeded sustainably.

Thus far, this discussion of carrying capacity has considered only one kind of resource, food. Food availability readily comes to mind in discussions of carrying capacities of developing regions, since it can be a constraint to population growth. However, in highly concentrated urban

centers (if food is readily available through trade with outlying areas), the carrying capacity is often determined by other factors, such as the availability of living space or the ability of natural or human-designed systems to dispose of wastes and pollutants. In other areas of the world, future population growth may be constrained, not by the supply of food itself, but instead by the availability of fuelwood to cook it. A region's carrying capacity is ultimately determined by its scarcest vital resource.

A region's carrying capacity exists for humans, as it does for every other form of life. To date, little effort has been spent on defining and measuring the human carrying capacity of natural systems. Applying the carrying capacity concept to humans is also complicated by several factors. One such factor is that per capita natural resource consumption by humans is often extremely variable, whether within the same society or among different societies competing for the same natural resources. Another complicating factor is people's ability to control, to some extent, the natural resources upon which they depend. Unlike other species, human beings can expand the carrying capacity of their environment by using technological innovation and trade. However, humans can also diminish the carrying capacity of a region through various forms of environmental mismanagement leading to long-term natural resource degradation. Such human-induced degradation often results from various short-term human pressures, which occur largely in response to rapid population growth. These points are elaborated in the following three sections.

The Role of Technology:

Through technological change, humans can increase the productivity of natural resources, thereby expanding the carrying capacity of a region. Technology can increase the carrying capacity of a given region in two ways. First, it can allow people to substitute, to some limited extent, a natural

resource that is not scarce for one that is. Fertilizers, for example, allow farmers to compensate for a shortage of arable land by applying chemicals that are not in short supply--at least until the petrochemical or coal feedstocks used to synthesize many of them become too expensive. Second, technology can increase the efficiency of conversion of natural resources into economic goods, thereby allowing people to "squeeze" more economic value from a given natural resource base.

While technological advances can expand the carrying capacity of a region to a considerable extent, they ultimately reach diminishing returns and do not make unlimited population growth possible. For example, at high application levels, fertilizers exhibit sharply declining marginal returns and cause serious environmental complications (such as eutrophication of lakes and health-endangering nitrate levels in drinking water). At some point, increased fertilizer use will result in nutrient "poisoning" of crops and an actual drop in yields. By contrast, some production functions used in economic analysis (such as the Cobb-Douglas function) assume that factors of production are infinitely substitutable for one another, and that using any resource more intensively guarantees an increase in output.

Moreover, technology cannot increase the total quantity of natural resources ultimately available on this planet. It cannot create more raw materials out of nothing--nor can it increase the efficiency of conversion of these materials into economic goods beyond the constraints imposed by the physical laws of thermodynamics. For example, intercropping or rotation cropping of compatible species can result in greater food "outputs" from the same farm "inputs", but no conceivable combination of technologies could produce more food energy "output" than was available as (solar and other) energy "input" to the farm. Therefore, no technological advance can eliminate natural resource constraints entirely. Furthermore, technology cannot

increase the Earth's natural waste assimilation capacity, although it can be used to reduce the volume of pollutants or other wastes that are generated. Thus, while technological advances can expand a region's carrying capacity to some extent, they cannot replace the need for eventual population stabilization. In the shorter term, the rate of population growth cannot exceed the rate at which technological advances increase carrying capacity without reducing people's standard of living and risking an overshoot of the carrying capacity.

China provides an example of both the potential and the limitations of improved technology for expanding carrying capacity in terms of food production. In China, the carrying capacity has increased substantially as the intensity of food production has risen and new management practices and technologies have defined more productive agro-ecosystems. For example, in a pastoralist China, one hectare of grazing land could support only 1-2 persons. Traditional farming with careful recycling of organic fertilizers raised the carrying capacity to 5-6 people per hectare. Today's cultivation, relying increasingly on large inputs of nitrogenous fertilizers, can sustain 10 people per hectare as the national average; in Sichuan, China's most populous province, 17 people are fed from each hectare.

Carrying capacity has thus been raised impressively over the past several thousand years in China. However, as some constraints to food production were removed (e.g., dieback of herds during cold winters or crippling pest damage to crops), new ones have emerged in their place. Today, China's carrying capacity rests critically on the availability of fossile fuels and electricity to provide synthetica fertilizers and to pump the water needed for new, high-yielding crop varieties.

Carrying capacity is thus not an immutably fixed number. Proper management of areas endowed with suitable soils, moisture, and growing season can raise carrying capacity by minimizing or even removing old constraints. But new constraints always emerge, and even in the best croplands there is a limit to continuous, steady improvements. Moreover, areas of marginal or poor cropland are suffering from severe soil erosion and degradation, deforestation and a resultant increase in flooding, desertification, and toxification. Such environmental stresses suggest that the carrying capacity of these regions has often been reached; even the best available practices may not be able to accomodate all of the people living in such stressed regions.

The Role of Trade:

Another means of pushing back natural resource constraints is trade. Trade can expand local carrying capacity by exchanging resources that are locally plentiful for those that are locally scarce. For example, countries in the Persian Gulf can support populations far in excess of their local agricultural carrying capacities by trading oil for food. Similarly, city-states such as Singapore and Hong Kong support population densities roughly 100 times higher than the local carrying capacity by paying for food with the value added to labor-intensive goods. In other words, trade allows one region to make use of the excess carrying capacity of another.

Trade can expand local carrying capacities only in certain circumstances, however. The resource that is scarce in one region (e.g., food) must be available in surplus elsewhere, and the region's plentiful resource (e.g., oil, phosphate rock, or cheap labor) must be scarce elsewhere. Trade cannot alleviate global scarcity, as there is no other "globe" nearby with which to trade! The difference in value between the exported and imported goods must be enough to pay the costs of transportation

both ways, which for small, remote, or landlocked countries (or those lacking good internal transportation) can be enormous. Transportation costs are a particularly great obstacle to commerce in high-bulk, low-value commodities such as food staples, or many raw materials. As fossil fuels become more scarce and their cost rises, many opportunities for trade are likely to become uneconomical because of higher transportation costs.

Finally, there is a distributional issue that is easily overlooked if the country is treated as the basic unit of analysis. The foreign exchange earned by the exports must somehow find its way into the sectors of the economy that need the imports in question. For example, if rural people export cash crops rather than growing their own food, distribution mechanisms are needed to ensure that these people will be able to buy enough food to meet at least their basic needs.

The examples of Singapore and Hong Kong, which survive by marketing the value added to goods by human labor, deserve special attention. Many nations would like to emulate their relative affluence, despite their high population densities and lack of exploitable natural resources. Of the many countries that would like to be the next Hong Kong, any one could conceivably succeed. But they probably cannot all succeed in doing so, because there does not seem to be a sufficiently large, unmet global demand for human labor to add value to goods. With unemployment at relatively high levels in even the world's most affluent countries, and with population growth swelling the world's labor force every day, it seems unrealistic to expect that most of the Third World will be able to solve its carrying capacity problems by marketing its surplus labor through international trade.

Human-induced Reduction of Carrying Capacity:

Societies display two very different patterns of adaptive response to carrying capacity constraints. The first is to bring the population and the carrying capacity into balance by limiting the former, or, more commonly, expanding the latter. The second pattern of adaptive response is to exploit the resource base beyond its carrying capacity (akin to "deficit spending" in the bank account analogy), thereby liquidating natural capital for one-time use.

It is difficult at first to distinguish these two patterns of adaptation, because their short-run effects are superficially similar. In both cases, the supply of goods per capita increases in the short run. But the difference between the two approaches is crucial. The first is sustainable, while the second damages the long-term carrying capacity. Recognizing this difference is both difficult and vital, because any damage is likely to be apparent only after a substantial time lag and after it has become largely irreversible.

When populations press against or exceed the limits of their natural resource base, they are driven by their circumstances to patterns of adaptive response that are not sustainable. It is cheaper, in the short run, to exploit a resource base beyond its carrying capacity than it is to expand the carrying capacity or to limit population growth. Populations that have reached their upper limits, and whose surplus resources are in critically short supply, will adapt to their circumstances in the cheapest possible way (particularly if the competitive market is the only mechanism of adaptation). In so doing, they will ultimately decrease the productivity of their natural resources, and thus generate even stronger pressures for the same counterproductive patterns or adaptation. The result is a downward spiral of resource productivity and living standards.

It appears from historical records that some of the world's most advanced societies have been destroyed by following the second path of adaptive response. A growing number of scholars believe that the Mayan civilization vanished when population pressures caused deforestation and soil erosion, resulting in the collapse of its agricultural system (Deevey, et al., 1979). Valleys in Greece that once were the site of some of the most intensive irrigated agriculture in the western world will now support only scrub growth and grazing animals. During the days of Caesar, northern Africa was the granary of the Roman Empire; it has long since been unable even to feed itself.

Fortunately, science has provided the means for averting similar disasters. We can detect natural resource degradation in time. What is needed is the political wisdom to act on the signs that indicate that a particular pattern of development is not sustainable. Later in this paper, we detail some illustrative scenarios of local populations and carrying capacities that are, or soon may be, out of balance.

The Global Carrying Capacity Debate:

Ever since the days of the British economist Thomas Malthus, the question of global carrying capacity has been a subject for lively discussion. Despite this discussion, which has greatly intensified during the last decade, no consensus has emerged on this issue.

Some scientists, such as Westing (1981) and Mann (1981) argue that the world cannot sustainably support a human population of more than about 2 billion. Westing (1981) bases his calculation on such assumptions as:

(1) A global level of per capita consumption that is "affluent", i.e., the average of those of the world's 27 richest nations.

(2) Existing levels of technology.

(3) Existing policies and practices of natural resource utilization, i.e., no major changes in market or non-market mechanisms to encourage increased efficiency in natural resource use.

Based on this analysis, there are several reasons why the world is presently supporting a population that is substantially in excess of its carrying capacity. One is that a sizable proportion of the population does not have an "affluent" level of per capita natural resource consumption. Another is that nonrenewable natural resources, 1/ particularly fossil fuels, are being exhausted, thus enabling humanity to live "on borrowed time" in escess of its carrying capacity. A third reason is that renewable natural resources (such as soils, grazing lands, forests, and fisheries) are being overexploited at unsustainable rates, thereby temporarily increasing present production at the expense of future production. The logical conclusion from this analysis is that the human population should be stabilized and subsequently reduced by all humane means possible, in order to bring it into balance with its carrying capacity.

At the opposite extreme are persons such as Simon (1981) and Kahn (1982), who insist that the world's natural resources are not meaningfully finite, or at least are sufficient to support unrestrained population growth for centuries to come. To support these views, Simon and Kahn cite what they believe to be the huge size of the Earth's remaining natural resource base,

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1/ Renewable natural resources include living resources (plants and animals) and other natural resources (particularly soil and water) that create or sustain life and that are self-renewing if not overexploited or otherwise mismanaged. Nonrenewable natural resources are not self-renewing. The include minerals (which can often be profitably recycled) and fossil fuels (which cannot). Care is also required in the extraction and processing of nonrenewable resources to prevent unnecessary environmental damange.

the ability of technological progress to advance more rapidly than population growth, and the ability of market forces will automatically keep natural resources and the demand for them in balance. In this view, there is no need for efforts to stabilize population size.

In between these extremes are a variety of estimates of global carrying capacity. Some of these estimates are in excess of the most recent United Nations projections of future stationary population size. For example, Kovda (1980) has stated that in the view of some Soviet scientists, the world can support a population of 14 billion. On the other hand, other estimates are lower than projected future population size. Gilland (1982) suggests a global carrying capacity of 7 billion.

Aside from the poor quality of much of the available natural resource data, the principal reason for such huge discrepancies in global carrying capacity estimates (ranging from 2 billion to no limits) is the very different assumptions that are used. Among the most pivotal assumptions which influence global carrying capacity estimates are the following:

(1) The rate at which advances in technology can <u>sustainably</u> expand carrying capacity. In this regard, a critical question is the rate of such technological progress versus the exponential growth rate of population.

(2) The size of the essential natural resource base.

(3) The extent to which market or non-market (political or social) mechanisms will ensure the efficient use of scarce natural resources.

(4) Levels of per capita consumption of natural resources.

As this controversy shows, the actual carrying capacity of the planet is unknown and perhaps unknowable. In the face of such uncertainty, it is most prudent to proceed cautiously. It would be inadvisable to rush headlong

into a possible confrontation with our limits to growth, foreclosing options for the future along the way. Even if incontrivertible evidence existed that technological progress can continue to expand global carrying capacity indefinitely, there is still the crucial issue of timing--over time, the rate of population growth must be no more than the rate of carrying capacity growth, if carrying capacity is not to be exceeeded.

Carrying Capacity and Optimal Population Size:

The global carrying capacity debate is one of how large the earth's population could become, not how large it should become. The optimal population size is not necessarily the same as the carrying capacity. Human populations can be sustained at any level up to the carrying capacity of the natural resources that support them. A common assumption is that the population should be encouraged--or at least allowed--to grow just to the carrying capacity, and stabilize there. Implicitly, then, many people believe the largest possible population size to be also the optimal population size.

There is no a priori reason why this should be the case. Populations pressing against their carrying capacities are likely to have low standards of living and slim prospects for substantial socioeconomic improvement. The definition of what population size is "best" is inherently a matter of value choice rather than scientific fact. Many human values are, arguably, better served by a stable population size substantially below the carrying capacity.

For populations just at the limit of the carrying capacity, vital resources are in critically short supply. There is no surplus. Because resources are being spread among as many people as possible, per capita consumption of goods is at the lowest possible level. This realization demonstrates the fallacy of Bentham's credo, "the greatest good for the

greatest number" (aside from the logical impossibility of double maximization). Moreover, it shows that the concept of carrying capacity embodies critical social choices.

Some people maintain that human welfare is essentially independent of population size. In this view, the productivity of each worker is a constant, so each doubling of the population will--by definition--double the productivity of the economy as well. This argument overlooks the fact that as the population grows, the raw materials available from a constant resource base will provide fewer inputs per worker. Therefore, all else being equal, the productivity of the economy per worker, and thus the level of goods available per capita, must decline as a growing population approaches the carrying capacity.

The main implication of this analysis is that, beyond a certain population density, a fundamental tradeoff always exists between further increases in population size versus per capita consumption. To illustrate this point, Thomas Malthus stated that there should never be more people than can enjoy a piece of meat and a glass of wine with each dinner. This statement implies, of course, that population density should be sufficiently low to enable enough land to be used to produce such "luxury" products as meat and wine for everyone. While not all cultures place a high value on meat or wine consumption, the desire to consume at a level well in excess of bare survival needs is almost universal. People will disagree on the ideal choice between more people versus a higher standard of living per person. However, if societies do not make such choices through population policy decisions, their population growth may proceed to a point where a large population with low per capita consumption is unavoidable.

Not only must conventional economic goods be shared by more people as the population grows, but "noneconomic" and "amenity" goods become scarcer as well. For example, open space, natural recreation areas, and wildlife become scarcer as more land is allocated to meeting the food, housing, and other needs of a growing population. Leisure time becomes more dear as more time is required for providing for basic needs (because, as noted above, the labor efficiency of the economic process decreases as natural resources become scarce). In the Gambia and central Tanzania, for example, population growth has made firewood so scarce that each household requires 250-300 worker-days to meet its annual fuelwood needs (FAO, 1978; Moris and Openshaw, 1979).

Moreover, as natural resources become more scarce, the administrative structure and coercion required to enforce efficient resource allocation increases. For example, allocation of irrigation water where it is scarce has long been a source of friction between nations and among factions within individual countries. Even when farmers have decided on a formula for dividing the water supply, they must also agree to coordinate all of their cropping activities. Greene, 1966 notes:

> "Failure to observe these practices injures not only the individual farmer but his neighbours also; irrigation implies a uniformly high standard of farming; losses are severe if this is not kept up."

When populations press relentlessly against (or temporarily exceed) the limits of their local or national carrying capacity (no matter how much it is augmented by trade or technology), the development process can be crippled. Economic development depends upon the successful reinvestment of surplus resources. When a population reaches the carrying capacity of a region, such that all the region's available resources are supporting the largest possible number of people, all production is devoted to immediate consumption needs. There is no surplus to invest for the future.

There are profound value judgments implicit in declaring any one population size as "optimal" for a given country or region. The only imperative is that no population can be supported sustainably above the carrying capacity provided by the available natural resources. Because population size and per capita consumption are ultimately constrained (at some uncertain limit) by natural resource availability, and because (in modern times) it is much easier to allow a population to grow than to force it to contract, the path of caution is to seek as little population growth now as possible. In so doing, we would foreclose the fewest lifestyle and resource use options, and preserve the widest range of choices for future generations.

The Role of Population Growth in Environmental Degradation and Natural Resource Scarcity:

When international development specialists discuss "the population problem," they are actually confronting two distinct, though obviously related, classes of issues. The absolute population size of some countries, or regions within countries, threatens their standard of living and the viability of their natural resource base. The rate of population growth of other countries and regions, even those with relatively low population densities, is sufficient to cause severe economic, social, and environmental dislocations, while foreclosing a range of options for the future. Even if a country's population size is well below its optimum level (however "optimum" might be defined), its rate of population growth may be well above the optimum.

It should be evident from the preceding discussion that the population size and population density of countries are not per se the causes of problems such as natural resource degradation or hunger. Rather, these problems arise when the population becomes too large in relation to the productivity of the resource base upon which it survives. Low population densities do not necessarily mean that carrying capacity constraints pose no

problems. Most of the "empty quarters" of the world are empty for a very good reason: their resources cannot support many people. Africa provides perhaps the clearest example of how much of a seemingly "underpopulated" continent may, in fact, be too crowded.

SUGGESTED BOX: AFRICA: THE CROWDED CONTINENT

Africa seems, at first glance, a vast and empty continent. But on closer inspection, it appears that many countries in Africa are becoming very crowded indeed. Africa has been described as "underpopulated" because its population density is relatively low. Compared with most of Asia or even Central America, Africa seems uncrowded. Population density, however, is just one side of the population-natural resources balance; land productivity is the other. About 80 percent of the continent cannot be considered cultivable. Half the potentially arable soils are lateritic, and thus largely unsuited for permanent field crop agriculture. Of the land that is arable, only 7 percent has naturally rich alluvial soils (Revelle, 1976). Much of Africa's drier land can support only economically marginal, land-extensive uses, such as nomadic pastoralism, or, at best, only one meager grain crop per year. There are frequently good reasons why vast, unsettled areas have remained so. It was not by chance that they were left until last. Many regions that are unsettled today are empty precisely because they cannot support sustained settlement.

There is evidence that Africa's population is even now straining the continent's renewable natural resource base. According to a recent FAO study (Harrison, 1983), almost half of Africa's land area is unable to support its current population, using current technology. By the year 2000, the study concludes, 30 countries out of 51 in the region will be unable to feed their populations with current levels of inputs. Increased technological inputs,

such as irrigation, can improve yields, but at great financial expense, and with high environmental costs and public health risks (Tillman, 1981). As real energy costs rise, so do the costs of irrigated agriculture, which depends on electricity or liquid fuel for pumping, and often also upon such energy-intensive inputs as fertilizers and biocides. 2/ Excessive irrigation in dry climates often leads to salinization or alkalinization of crop land, such that much of the available water must eventually be used to flush away salts, rather than to irrigate crops.

Population growth rates in Africa are among the highest in the world. At current growth rates, Africa's current population of nearly 500 million will double in less than 30 years. Where high-potential lands already are crowded, the population spills over onto marginal lands, which produce low yields and are often susceptible to rapid degradation in the absence of proper management. These marginal lands are farmed ever more intensively as human numbers grow.

Yield figures suggest the stress on Africa's natural resources. Between 1969-71 and 1977-79, average annual yields of maize, millet, wheat, and cotton declined for the continent as a whole. Yields of sorghum, groundnuts, and pulses were lower in 1977-79 than in 1961-63 (World Bank, 1981). Declining yields per hectare often indicate either that more marginal land is coming into production, or that the fertility of the land is declining through overuse. Such land degradation severely reduces future carrying capacity.

2/ Biocides, literally chemical "killers of life", is the generic category which includes, herbicides, insecticides, fungidices, molluscicides, rodenticides, etc.

Declining food production per capita is another indication that population growth is outrunning the land's resources. For the continent as a whole, food production per capita, declined 9 percent between 1969-71 and 1977-79. In 1980, 26 nations in sub-Saharan Africa relied on food imports for meeting the basic needs of their populations. Food imports per capita rose 15 percent in the region between 1974 and 1979 (World Bank, 1981), (END BOX).

Food Supply:

Chronic hunger and starvation do not arise purely by chance. They are caused by population growth outstripping agricultural production, by severe poverty, and by economic and environmental mismanagement.

Nearly 60 percent of the people of the developing world live in regions that have insufficient agricultural resources to support their current population densities, even if all their cultivable lands were put into production, using current technologies. That surprising statistic is the result of the most complete study of population and carrying capacity to date, to be released soon by the United Nations Food and Agriculture Organization (FAO). According to a preliminary report on this study, the developing world as a whole has the potential to support nearly twice its existing population, even with the relatively inefficient agricultural techniques currently in use (Harrison, 1983). However, both agricultural resources and human populations are distributed very unevenly among countries and regions, leaving many countries' food security in a precarious position.

The ratio of population to food production has become increasingly less favorable in recent years. FAO's World Food Surveys indicate that in many regions, population growth has slowed, but the growth in food production has slowed still further. Global per capita food production once was growing, but is now declining (FAO, 1977a).

Egypt is a telltale example of the growing imbalance between growth in population and food production. For example, while Egypt's population growth rate between 1960 and 1976 dropped from 2.5 to 2.4 percent per year, its agricultural production growth rate fell from 3.3 to 1.4 percent per year. Despite the Aswan High Dam, the total area of irrigated farmland in Egypt has remained largely unchanged through the last two decades. While additional areas are being brought under irrigation, existing arable lands are being lost to urbanization. Moreover, salinization, alkalinization, and waterlogging are impairing agricultural productivity on much of the existing irrigated cropland.

Kenya's experience illustrates how one country's food security prospects can rapidly shift from optimistic to grim. Kenya's population growth rate remained roughly constant, at 3.3 percent per year, over the period 1960-1976. During the 1960's, cereal grain production grew even faster, at 5.5 percent per year. But between 1970 and 1976, growth in agricultural production stopped (FAO, 1977a). Cereal production per capita, once growing at 2.1 percent per year, was shrinking at 4 percent per year by the end of the period. Under exponential population growth, with short doubling times, change comes quickly indeed.

The distribution of income and nutrition can reveal hunger that is hidden in statistics describing average living standards. Ghana, according to the 1977 FAO World Food Survey, grew enough food in 1972-1974 to meet its people's food energy requirements of 2300 kcal/person/day. During the same period, however, one out of every five Ghanaians was undernourished, with a calorie intake of less than 1500 kcal/person/day (FAO, 1977b). High population growth rates tend to widen income disparities and reduce the living standards of the "poorest of the poor" further still.

Some regions have sufficient natural resource endowments to support significantly larger populations in the future. However, in many cases it may be impossible to develop these resources quickly enough to support high rates of population growth. When populations grow rapidly, resources must be diverted from development to basic sustenance. The acceleration of the Mahaweli Ganga regional development program in Sri Lanka illustrates how this problem arises.

SUGGESTED BOX: THE ACCELERATED MAHAWELI REGIONAL DEVELOPMENT PROGRAM

The Mahaweli program was originally conceived as an ambitious plan to relocate one out of ten of Sri Lanka's people in previously undeveloped lands, triple electrical generating capacity, cut unemployment, and guarantee food self-sufficiency. Begun in the 1970's as a 30-year program, the Mahaweli scheme became more ambitious still when it was "accelerated" to a six-year plan in 1977. Like any large project, the Mahaweli program has had its problems. Some of these problems, however, have arisen entirely from accelerating the program, in response to the social, economic, and political pressures resulting from rapid population growth.

The frantic pace of the accelerated development scheme made successful planning very difficult. In the rush to begin the program, for example, too little thought was devoted to planning a road network. Had the development plan been pursued more slowly, there would have been time to correct the problem when it became obvious. The short timetable of the Mahaweli plan also made it difficult to arrange financial assistance quickly enough.

Perhaps the most ominous consequence of the speeding up of the timetable, however, has been the resulting emphasis on activities that generate output in the short term rather than on those that protect important

natural resources for the long term. For example, the hillsides above the Mahaweli River are severely deforested. Replanting efforts have been too little, too late, because most of the program's resources have been devoted to making the dams and the croplands productive as soon as possible. Ironically, the productivity of the very dams and croplands is now threatened by sedimentation, as the denuded hillsides are eroded by rains.

Similarly, the trees that will be needed near the settlements to provide fuelwood have not yet been planted. For the moment, fuelwood is plentiful because the forest is being cleared for cropland. But when land clearing stops, the immediate supply of fuel will stop as well. Without woodlots, either severe fuel shortages or deforestation and watershed damage will result.

The final irony of the accelerated Mahaweli program is that even this crash program is not enough. Even if the full program were completed in the intended six years, it would not keep pace with Sri Lanka's population growth during this time. (END BOX).

Of course, population growth is not the only cause of hunger in the Third World. In some countries, it is not even the primary factor. Economic mismanagement, such as pricing policies that provide inadequate producer incentives, can stifle agricultural productivity in countries well endowed with natural resources. Environmental mismanagement, such as land use and land tenure policies that encourage the farming of marginal lands, can cause permanent damage to the agricultural potential of a region.

Deforestation:

Population pressures in much of the Third World are leading to deforestation on a massive scale. Deforestation, in turn, is causing acute human suffering, reduction in carrying capacities, and long-term damage to the prospects for sustainable development in many areas.

Demand for firewood is a leading cause of deforestation, particularly in the more arid and high altitude regions where wood grows relatively slowly. In many areas, the population has grown beyond the carrying capacity of the local wood supply. In order to meet their daily energy needs, 1.3 billion people must cut firewood faster than it can be replaced by natural regrowth (Poore, 1983). As the forest are depleted by overcutting, the carrying capacity falls still further. As sustainable production falls, the tree stock is depleted still further. If uncorrected through some type of intervention, this process continues until no economically accessible tree stock remains.

Unfortunately, it is often difficult for those who are depleting the "natural capital" of the forest to recognize that they are doing so (or to have the means available to control it). Obtaining adequate wood supplies is typically seen simply as a problem of cutting enough wood, not as one of protecting the resource base that supplies wood. Usually the depletion of the tree stock is apparent only because obtaining adequate supplies has become difficult.

Managed village woodlots or more efficient wood stoves could greatly expand the energy component of the carrying capacity of these regions. However, successful introduction of fuelwood plantations, energy-efficient stoves, and other forest-conserving measures is often not easy. Such measures require local testing and adaptation, large numbers of trained personnel, and adequate economic and institutional incentives to succeed. For example, people will not plant trees on public lands if they fear that other persons will cut them down. Even in areas of low population density (e.g., much of sub-Saharan Africa), rapid population growth impedes forest conservation efforts. The large outlays of private and public capital needed for

successful reforestation are diverted instead into supporting the rapidly growing population. Skilled administrative talent, one of the scarcest resources in most developing countries, is used for managing societal adjustments to high population growth, rather than for preserving economic and social sustainability through reforestation or the other activities needed to keep the natural carrying capacity from declining.

What does firewood scarcity imply for the quality of life of Third World families? In China, more than 70 million (out of 170 million) rural households--about 350 million people--suffer serious fuel shortages for up to six months each year when crop residues are exhausted and wood is unavailable in deforested areas (Smil, 1983). In much of West Africa, two meals were traditionally cooked each day. Now many families can only eat cooked meals once each day or once every other day, because wood is so scarce (FAO, 1978; Hoskins, 1979). In Senegal, according to one peasant, "one can starve with a full granary if one has no fuel with which to cook the meal" (Hoskins, 1979). Soybeans have been introduced in Upper Volta. They are exceptionally nutritions and have grown well, but they have not been used widely because they require long cooking times (Hoskins, 1979). Similar experiences have been reported in Haiti (FAO, 1979). To the extent that there is insufficient fuel to heat foods and boil water, diseases spread more rapidly. As the forest perimeter is cut back, families unable to afford kerosene must devote increasing amounts of labor or income to obtaining firewood. These resources are necessarily diverted from improving the household's living standards.

Another major cause of deforestation is the expansion of agriculture. According to FAO, over 11 million hectares of forest are being cleared annually by the extension of agriculture onto marginal lands (Poore, 1983), primarily in response to population pressures. These marginal lands

are usually unable to support permanent agriculture, at least in the absence of very high levels of commercial inputs. When ecologically fragile marginal lands are cultivated, they tend to become quickly eroded and infertile. When this happens, the settlers move on to clear more forest, thus repeating what is often a destructive and unsustainable process.

Soil degradation due to deforestation is most acute in tropical moist forests. Despite their lush plant growth, most tropical rainforests grow on infertile, highly acidic soils. In these ecosystems, most nutrients essential to plant growth are stored in the vegetation, not in the soil. Thus, when the forest is cleared, minerals essential to crop growth either volatilize or wash deep into the soil, beyond the reach of non-tree crops. This soon breaks the nutrient cycle, making it difficult to sustain more than 2 or 3 harvests of annual crops. The application of fertilizers as a remedial measure is usually uneconomical, because of the high cost of fertilizers and because soil conditions in many tropical areas limit their effectiveness. Moreover, with forest cover removed, the exposed ground often becomes heavily eroded; sometimes, it bakes under the tropical sun into a hard, uncultivable surface. These ecological realities were primarily responsible for the relative lack of success of Brazil's Transamazonica Highway project, designed to settle large numbers of small farmers in the Amazon region. After four years, the project was judged by Brazilian officials to be less than 7 percent successful, primarily because of unsuitable soils (NAS, 1980).

In addition to the fuelwood and other important products they supply, forests provide a wide range of "environmental services" that support economic development in such sectors as agriculture, energy, and transportation. These environmental services, such as protection of soil and maintenance of water flow patterns, are frequently overlooked or underestimated because they are

"public goods", not priced in the marketplace. Nonetheless, the loss of these environmental services through inappropriate deforestation often causes costly development failures and much human suffering. Human population growth is one of the principal forces (though by no means the only one) behind rapid deforestation in much of the developing world (Ledec, 1983; NAS, 1980).

Forests support the agricultural sector in a number of important ways. By retaining water and releasing it gradually throughout the year, forests prevent or minimize excessive flooding during rainy periods. This helps prevent the erosion of productive soils in downstream agricultural areas (World Bank, 1978). Forests also protect soils on agriculturally marginal lands, until economically viable and ecologically sustainable cropping or silvicultural techniques can be introduced. Conserving natural forests is often far less costly than rehabilitating marginal lands degraded by inappropriate clearing or subsequent misuse.

Even more importantly, forests and other well-vegetated natural areas help maintain the productivity of irrigated agriculture. By releasing water gradually on a year-round basis, they help ensure an adequate water flow to support irrigation during the dry season and prevent inundation of crops during the wet season. Furthermore, by stabilizing soils, they greatly reduce sedimentation of irrigation canals, thereby preventing the need for costly inputs of labor and capital to keep these systems functional. All told, some 40 percent of developing world farmers live in villages that depend upon the watershed functions provided by forests. Agricultural export crop production valued at $36 billion per year depends upon the water supply and soil stabilization functions of forests (Clay, 1982).

When forests or other well-vegetated wildlands are eliminated, the damage to agricultural output can be severe. For example, the capacity of India's Nizamsagar Reservoir has been reduced from almost 900 million m^3 to

less than 340 million m^3 by sedimentation resulting from deforestation. As a result, there is now not enough water to irrigate the 1,100 km^2 of rice and sugar cane for which the reservoir was intended, and local sugar facotires have considerable underutilized capacity (IUCN, 1980).

Aside from their provision of fuelwood, forests are important to the energy sector of developing countries by protecting and enhancing the power production of hydroelectric dams. When forests or other well-vegetated watersheds are cleared, reservoirs often become much shallower due to sedimentation. As a result, less electricity can be generated (because less water can flow through the turbines) and the useful economic life of the hydroelectric investment is shortened. For example, the useful life of the Ambuklao Dam in the Philippines has been cut from 60 to 32 years because of deforestation (USAID, 1979). Deforestation has also led to daily electricity rationing in Bogota, Colombia, by causing the Guatavita hydroelectric complex to operate at only one-sixth of normal capacity (World Environment Report, 1981). In recent years, China has built dams to add about 260 million cubic meters of new water storage capacity per year; however, about 80 million cubic meters (30 percent) are being lost each year due to sedimentation (Smil, 1983). Such losses in power generation capacity translate into impaired industrial growth or the massive expenditures required for reservoir flushing or dredging (even if practicable) or construction of replacement facilities for generating power.

Forest cover is often also important in maintaining the efficiency of the transportation sector. For example, the flood control and soil stabilization functions of forest help protect roads in mountains and high rainfall areas from being made impassable by floods and landslides, both serious problems in steep deforested areas such as Nepal and parts of

Colombia. By preventing soil erosion and the resulting sedimentation, forests and other natural areas similarly help keep harbors and navigation canals functional. Deforestation is jeopardizing the continued operation of Panama's most important economic asset, the Panama Canal, which suffers from heavy sedimentation and a lack of sufficient water during the dry season to operate the locks for the larger ships (USDS, 1978). Similarly, it costs Argentina $10 million per year to dredge silt from the Plata River mouth and keep Buenos Aires open to shipping; 80 percent of sediment load comes from only 4 percent of the drainage basin--the small but heavily overgrazed watershed of the Bermejo River, 1,800 kilometers upstream (Pereira, 1973). In Thailand, important waterways are no longer navigable because of sedimentation resulting mainly from deforestation (Clay, 1982). The careless cutting of forests (or other forms of environmental mismanagement) can thus entail serious economic losses in maintenance expenditures, foregone revenues, and generally reduced economic activity.

Deforestation also increases the human and economic losses from natural disasters. Storms, floods, and droughts become major catastrophes when vegetation buffers are removed. For example, typhoon damage in the Philippines amounts to roughly $20 million per year, through floods and landslides that are greatly intensified by deforestation of upland watersheds and removal of mangrove or other coastal swamps, which can buffer coastal flooding (UNEP, 1980). In China, severe deforestation and erosion in Sichuan and Yunnan provinces have been identified as important causes of record floods along the middle course of the Yangzi River in 1982 and 1983. India and Bangladesh suffer billions of dollars of property damage and tragic losses of life in annual floods of the Ganges River, made more serious by deforestation in northern India and Nepal.

SUGGESTED BOX: RECLAIMING THE HIMALAYAN WATERSHEDS

The Ganges River, which flows through India and Bangladesh, floods annually, causing millions of dollars of damage and incalculable human suffering. These annual floods are made much more severe by two types of population pressure. In the lowland areas surrounding the Ganges, population growth and competition for land has forced many people to live too close to the river, in the path of the annual floods. In the mountainous watersheds of northern India and Nepal, population growth has led to severe deforestation, causing the area's heavy rains to run off rather than soak into the soil. As testimony to the effects of population growth, the severity of flooding has increased exponentially over the past 20 years, even though the annual rainfall has remained essentially the same.

To help combat the problem, the World Bank is funding a pilot project in Uttar Pradesh State, India, to develop nine small watersheds covering 312,000 hectares. The project will attempt to reclaim denuded hillsides by establishing extensive tree plantations. To help alleviate the erosion caused by free-running livestock, stall-feeding of livestock will be encouraged. Terracing of agricultural lands will further slow runoff and erosion.

One pilot project cannot put an end to either the destruction of the Himalayan watersheds or the destructive flooding of the Ganges. But it can demonstrate a workable approach for addressing both of these problems. (END BOX).

Desertification:

Closely related to the environmental problem of deforestation in the more arid climates is desertification. Desertification is a human-caused process by which the inherent productivity of semi-arid land is lost, often irreversibly through mismanagement. The effects of desertification are often confused with those of drought. Drought results from natural fluctuation in

weather patterns; desertification results from human mismanagement of lands that are often prone to droughts. In both cases, the economic productivity of the land is reduced, sometimes to zero. However, droughts, no matter how severe, are ephemeral occurrences; when the rains return, the land's inherent productivity is fully restored. If desertification occurs, however, a return to normal rainfall can never fully restore the land's productivity. If the desertification is severe, the land may remain unproductive for many human generations, unless costly remedial measures are taken. While drought can trigger rapid desertification and can make its effects more keenly felt by those living in the affected area, most scientists agree that changes in climate are not responsible for the vast areas of semi-arid land going out of production each year (Grainger, 1982).

The economic and human losses related to desertification can be staggering. Although some 100 countries are affected by desertification, the process is most serious in sub-Saharan Africa (particularly the Sahel), southwestern Asia, and the Middle East. Every year, some 200,000 km^2 (an area larger than Senegal) are reduced by desertification to the point of zero economic yield (Grainger, 1982). The lost agricultural production is about US$26 billion per year--roughly equivalent to the Gross Domestic Product of Thailand (Grainger, 1982). The human costs of desertification often include malnutrition, the threat of famine, and the dislocation involved when peasants or pastoralists must abandon their lands to seek employment elsewhere (e.g., in urban slums). The United Nations Environment Program (UNEP) Executive Director, Dr. Mostafa Tolba, wrote in 1982 that despite all efforts to control it, there is no doubt that the process of desertification actually is accelerating. More than 20 percent of the earth's surface--presently the home of 80 million people--is directly threatened by desertification (Grainger, 1982).

The proximal causes of desertification include overcultivation, overgrazing, and deforestation. All of these activities strip vegetation from the topsoil and deplete its supply of nutrients and organic matter, thereby leaving it exposed to the eroding forces of the sun and wind. The topsoil can become as dry as dust, and blow away in the wind. The remaining subsoil can become hard and impervious. It then can no longer absorb the rains when they come, and the water flows away over the surface, carrying away soil and cutting gullies which become deeper and wider year by year. In all of these situations, people are taking more from the soil than they should. They are not replacing soil nutrients, allowing the land enough time to recover under fallow, or restoring vegetative cover so that it can protect the soil from erosion. In this manner, they are consuming the land's natural capital, rather than sustainably living off the interest.

To a large extent, the proximal causes of desertification are "driven" by the pressures of rapid population growth. As rapidly expanding farmer or pastoralist populations require more food for themselves and their livestock, they frequently exceed the limited carrying capacity of semi-arid areas. When they attempt to keep production levels high during times of drought, they reduce the land's natural resilience and initiate a process of permanent degradation. Even in those situations where the existing population size is not pressing against the land's carrying capacity limits (even during dry years), a high rate of population growth makes it exceedingly difficult to control desertification. The methods needed to control desertification include grazing controls, tree planting, and improved agricultural techniques. To be effectively implemented, such activities require administrative talent and large numbers of trained personnel. Such resources, always at a premium in the developing world, become especially scarce when they are diverted to address the numerous economic, institutional, and social

adjustments that become necessary as a result of high population growth. Rapid population growth brings about the need for governments to feed or employ thousands or millions of more people each year; in the face of such pressures, longer-term problems like desertification receive insufficient attention.

Loss of Biological Diversity:

One of the irreversible consequences of today's rapid population growth is the loss of biological diversity, at a rate and scale that may be unprecedented in the history of life on earth. The best available estimates suggest that if current trends continue, some 15-20 percent of the estimated 3.5-10 million species of plants and animals alive today may become extinct by the year 2000 (CEQ, 1980; Myers, 1979; and Ehrlich and Ehrlich, 1981). The most important cause of today's species extinctions is the disappearance of the natural ecosystems upon which the species depend. Because they are naturally so rich in species, the loss of tropical forests is particularly important in reducing the earth's stock of species. As indicated above, population growth is only one of the causes of tropical deforestation (or the loss of other ecosystem types); however, it is one of the most important.

Why is biological diversity important? There are compelling ethical, aesthetic, and economic reasons for humanity to take all reasonable measures to avoid causing the extinction of other species. The ethical justification is that a growing number of people believe that human beings do not have the right to obliterate other species of living things at will--even those species not known to have any practical value to humankind. Although this ethical value is not universally shared, extinction is a completely irreversible process, and to extinguish other species is to deny the options available to all future generations of human beings. For essentially one or two generations of humans to eliminate unnecessarily a sizeable proportion of the

diversity of life on earth is, at the very least, an act of considerable arrogance. Therefore, while human society is confronted with numerous pressing short-term problems, any action with such profound and everlasting consequences as causing an extinction should also be weighed carefully.

The aesthetic justification is that many wild species of plants and animals are an irreplaceable source of wonder, inspiration, and joy to humans. This aesthetic value has only partially been translated into economic value. For example, bird watching, bird feeding, wildlife photography, and general wildlife observation accounted for expenditures of $7-15 billion in the United States alone in 1980 (3-6 percent of GNP--U.S. Fish and Wildlife Service, 1982). However, millions of people derive enrichment merely from knowledge of the existence of many wild species they never see; this "vicarious satisfaction" has no market value.

The main economic justification for species preservation is that numerous wild plant and animal species are "undeveloped resources," in that they have major economic potential that is currently undiscovered or underutilized. Biological resources are the most essential natural resources that support human existence, and the preservation of biological diversity is important to the maintenance and improvement of agriculture, forestry, ranching, fisheries, medicine, and industry. For example, a recently discovered species of wild perennial corn (Zea diploperennis) may become of considerable importance in promoting increased food production, even though it seemed at first to be "just another weed" growing on a hillside in Jalisco, Mexico. Human society is indeed likely to be better off because this apparent weed was not eliminated by conversion of all of its natural habitat to agriculture or other uses (USDS, 1982).

Similarly, over 40 percent of all prescriptions written in the United States contain one or more drugs originating from wild species (Farnsworth, 1982). In some cases, it is impossible or more costly to synthesize these compounds than to obtain them from living sources; in other cases, it would not have been possible to know what compound to synthesize without first having the natural model.

Wild plant and animal species are also of great importance to industry, providing tannins, resins, gums, oils, dyes, and other commercially useful compounds. Even the rubber tree (Hevea basiliensis) was once just another Amazon tree species of unknown value. There is tremendous, although impossible to quantify, potential for new industrial products from currently unknown or poorly-known plant and animal species. These may even include hydrocarbons for an oil-short world: it was recently discovered, for example, that Copaifera langsdorfii, a tree that grows in northern Brazil, manufactures sap that can be used directly in diesel engines (IUCN, 1980a).

These few examples illustrate the range of economic uses of many wild plants and animals. It is important to note that 80 percent or more of all the world's species of plants and animals have never even been catalogued and given a scientific name, much less studied thoroughly for possible human uses (NAS, 1980b). Biological resources, unlike petroleum and other fossil fuels, are completely renewable, but only if care is taken not to destroy them before their value can be realized. Eliminating much of the world's vast wealth of biological diversity, because of lack of attention or short term expediency, has been likened to "burning the world's libraries for one winter's warmth."

Pollution and Public Health:

Although more localized and reversible than problems of natural resource degradation, pollution in developing countries can also have debilitating effects on economic development and human well-being. One of the

most important forms of pollution in LDCs is biocide abuse. While they are of considerable value (especially when used judiciously in a system of "integrated pest management"), biocides can do far more harm than good when applied excessively or without proper precautions. They destroy the natural predators of insect pests and the pollinators of crops, promote the rapid evolution of biocide-resistant insect varieties (whether crop pests or disease vectors), kill fish, and poison some 500,000 peasants each year (NRDC, 1980). A variety of industrial chemicals also kill crops and fish and damage human health in LDCs. While limited in area, urban air and water pollution in some developing country cities (such as Bangkok and Mexico City) may be so extreme as to limit economic development by choking off certain growth possibilities, forcing expensive and unwieldy industrial decentralization plans for outlying areas, and damaging the health of the urban labor force (Leonard, 1983). Another, more widespread health problem in LDCs is the mounting incidence of water-borne diseases that accompanies the construction of large dams and irrigation projects. Poor sanitation and the frequent lack of safe drinking water continue to be serious public health problems, as witnessed by the millions of children who die annually from diarrheal and other sanitation-related diseases.

These and other types of pollution can all be readily controlled, if adequte investments are made in the appropriate machinery or techniques. However, it is difficult to summon the necessary financial capital and scientific and administrative talent when these scarce resources are already stretched to their limits in managing the necessary societal adjustments to rapid population growth. Furthermore, very high urban population densities, which are in part the result of rapid nation-wide population growth, tend to concentrate pollutants, thereby making effective control more difficult and expensive.

Population Growth and the "Low-Potential Region" Phenomenon:

It is not difficult to understand that the most attractive regions for human habitation tend to be the ones that are presently the most densely settled. High-carrying capacity (or "high potential") regions tend to have fertile soils, adequate fresh water, easy access to transportation links, and abundant natural resources; they yield relatively high returns on investments made. Consequently, they attract large numbers of people and substantial investment capital. Rapid population growth, however, induces many people to move from high carrying capacity regions to those of lower carrying capacity. This can occur because employment creation does not grow as rapidly as the population, or because the existing high population density compels people to overexploit the region's natural resources, thereby overshooting (and further reducing) its carrying capacity.

Low carrying capacity (or "low potential") regions, on the other hand, are relatively poor in accessible natural resources; they may be too dry, lacking in good soils, disease-ridden, or unduly remote (thereby inhibiting trade). Investments in low potential regions yield relatively low returns; in many cases, the benefits of such investments do not exceed the economic costs. Because the costs of bringing low capacity, or "marginal," lands into production can be very high, it is economically preferable to invest in measures to reduce population growth, thereby minimizing the need to make expensive investments in expanding the carrying capacity of marginal lands. The experiences of Indonesia's Transmigration Program (see box) illustrate this point.

SUGGESTED BOX: THE CASE OF INDONESIA'S TRANSMIGRATION PROGRAM:

Indonesia, the world's fifth most populous nation, is characterized by a very uneven distribution of its population. Of the country's roughly 150 million people, some 65 percent live on Java and the smaller islands of Bali

and Madura, which together comprise only 7 percent of Indonesia's land surface. In contrast, large areas of the "Outer Islands," including Sumatra, Kalimantan (part of Borneo), Sulawesi, and Irian Jaya (part of New Guinea), are very sparsely populated. This apparent imbalance is in large measure explained by environmental factors. Java, with hundreds of volcanoes, is blessed with exceptionally fertile volcanic soils, which permit extremely intensive agriculture and sustain a rural island-wide population density of over 600/km^2 (up to 2,000/km^2 in some rural districts). On the other hand, large areas of the Outer Islands are characterized by highly infertile, acidic, thin soils that are poorly suited for intensive agriculture. As people have migrated among Indonesia's islands for centuries, it is understandable that so many have settled on Java.

Java's rapid population increase is testing the island's agricultural carrying capacity. If current trends continue, Java will have less than 0.1 hectare of land per capita by the year 2000 (Goodland, 1981). Population pressure on Java is encouraging ecologically unsound agricultural practices (e.g., cultivation of very steep slopes), which has already degraded over 23 million hectares of what the Government calls Tanah Kritis ("Critical Lands") (Goodland, 1981). Moreover, a sizable proportion of Java's labor force is unemployed or underemployed, as employment creation has failed to keep pace with population growth.

For these reasons, migration to the Outer Islands can seem attractive as a "safety valve" for Java's population growth. The Indonesian Government is conducting its transmigration program in order to move large numbers of people from Java and Bali to the Outer Islands. Since 1978, the transmigration program has entailed expenditures of roughly US$2 billion, of which approximately US$350 million was loaned by the World Bank.

Like many other large scale, government-assisted land settlement schemes, the transmigration program has achieved mixed results. Agricultural yields on many sites have been disappointingly low, while the economic costs of clearing and preparing the land and providing the necessary infrastructure have been high. Significant environmental costs have also occurred, including deforestation, soil degradation, and the increased incidence of malaria and other public health problems. In part because of the emphasis on settling large numbers of families quickly, the program's costs have been high--roughly US$5,000 per family settled.

Despite the large financial investment and the high priority given by the Government to transmigration, the program has never succeeded in moving even 100,000 people per year, while Java's annual population increase is more than 2 million (Goodland, 1981). Clearly, transmigration is not a viable option for solving Java's population problem. A more important justification for the transmigration program than relieving population pressure on Java has been to promote the economic development of the Outer Islands by increasing their labor supply. However, given the difficult nature of the soils and other development constraints of the transmigration sites, the most efficient development of the areas can be obtained only through adequate advance planning and site selection. To the extent that it has provided an impetus for accelerating the program, the population pressure on Java has made such careful planning more difficult. As a result, many natural and financial resources have been wasted.

In 1966, the Government reversed Indonesia's pronatalist policies. In 1969, it launched a vigorous national family planning program. Since then, population growth on Java has fallen from 2.1 to 1.5 percent. Indonesia's family planning program has been distinguished by strong Government support and a highly acclaimed local approach that goes far beyond the more

traditional clinic system. The direct involvement of local village leaders as motivators, field workers, and even contraceptive distributors has been central to the program's success to date. The annual cost of Indonesia's family planning program from 1979 to 1983 has been roughly US$53 million. This compares favorably with the annual costs of transmigration (approximately US$400 million)--and the results, in terms of reducing population pressure on Java and Bali, have been far more impressive. (END BOX).

Indonesia is not the only country where investments in expanding the carrying capacity of low-potential regions are not likely to be as effective as family planning in reducing population pressures in high-potential regions. Other examples of economically and environmentally costly land settlement schemes, stimulated at least in part by population pressures in high-potential areas, include the Northwest Region and Transamazonica Highway projects in Brazil, several in the Amazon regions of Peru and Colombia, Sri Lanka's Mahaweli Ganga program (see other box), Nepal's Terai settlement, and Kenya's Bura Irrigation Settlement project.

SUGGESTED BOX: CONVERGING DEMANDS ON SCARCE NATURAL RESOURCES

A growing problem in many developing nations is the competition for different products from limited land resources. Often land, whether cropland or forest land, is in short supply. Where this is the case, allocating those scarce lands among competing uses becomes a major concern.

Production of food crops faces increasing competition with energy crops for valuable land space. Energy cropping has great potential for providing fuelwood and, in some cases, liquid fuels to fuel-poor Third World nations. However, energy cropping in land-poor countries usually requires diverting land from food to non-food crops.

Establishment of fuelwood plantations requires first and foremost an investment of land sufficient for growing trees. Often such land would otherwise be used for food production. However, competition for land can be reduced if wood production can be accomplished on otherwise unused land. In South Korea, fuelwood is grown on mountain slopes of little agricultural value. The tree plantations also serve to reduce flooding and soil erosion on the steep slopes.

Social problems inherent in large-scale production of energy crops may surface first in Brazil, where such schemes are well advanced. Despite the possibility that energy crops could be produced in addition to, and not instead of, food crops, the volume of fuel required for Brazilian automobiles indicates that energy cropping might require up to one-fifth of Brazil's existing cropland, in addition to agricultural investment capital, water, fertilizer, and other inputs. Brazil may well become self sufficient in fuels, but in the process become more dependent than ever on food imports. Brazil is already the largest grain importer in the Western Hemisphere. Diversion of cropland to energy crops is likely to drive food prices up, thereby further pricing the urban poor out of the market.

Indeed, even crop and animal wastes are the object of conflicting demands. Traditionally, agricultural wastes are used for fertilizer. In heavily deforested areas, however, people may turn to burning crop wastes or animal dung instead of all-too-scarce firewood. Diversion of this resource from fertilizer to fuel use results in a loss of agricultural productivity. A generally accepted estimate holds that each metric ton of cattle dung that is burned rather than used as fertilizer means a loss of around 50 kilograms of potential grain output. Since some 400 million metric tons of dung are

annually burned in Asia, the Near East, and Africa, annual losses in potential food output total 20 million metric tons, or very roughly 15 kilograms of grain for each person in these regions.

According to a World Bank analysis, in Nepal alone the amount of dung which may be burned in the year 2000 will reduce grain production by about one million tons, or one quarter of Nepal's total annual grain production. Radical boosts in tree planting are needed to offset the deforestation which forces rural people to burn dung.

The food producing capacity of a region is lowered if land suitable for growing food is used instead for the production of firewood or other energy crops. However, both energy and food production are vital to development efforts. People must be able to cook most of the food they grow. Conversely, all the firewood in the world cannot help those who have no food to cook. Balancing conflicting demands for scarce, finite resources is a continuing challenge for sustainable development. Expanded efforts to control population growth can minimize such difficult tradeoffs as these. (END BOX).

III. Summary: Population Growth and Sustainable Development

When human populations are kept in balance with the natural resources that support them, sustainable development is possible. When human populations grow too quickly, or become too large, they damage their essential natural resource base, thereby making sustainable development impossible. In many regions, environmental stresses now indicate that the human population may be too large or growing too quickly.

Natural resources, whether renewable or nonrenewable, are inescapably finite. Thus, for developed and developing countries alike, the question is not whether there are ultimate limits to population growth. The question is which of these limits a region will encounter first, and when. If population

growth is not limited by conscious human control, it is likely to be limited by factors related to natural resource constraints.

Populations cannot be sustained beyond the carrying capacities of their regions. To develop sustainably, countries have only two viable choices. First, they can act to lower their population growth rates, through measures such as family planning. Second, they can seek to expand sustainably their carrying capacities. While both options are necessary for most developing countries to bring their populations into a sustainable balance with their natural resource base, the former option has often received insufficient attention, relative to the latter. Moreover, because carrying capacity cannot be increased forever, pursuing the second policy at best only delays the need to adopt the first.

There is also a third option--one which is not viable. That is to liquidate the capital of the natural resource base for one-time use, thereby temporarily supporting a population larger than the carrying capacity. In many areas of the world, this third option is being pursued because, in the short term, it is less costly and requires less social cooperation than either of the others. The environmental stresses and natural resource degradation described in this paper are products of this third course of action. The third option ultimately destroys a society's chances for successful, sustainable development. To be sustainable, a society must "live within its means" in terms of natural, as well as human and financial, resources.

Because of the very long "lag" periods inherent in population planning (1-2 human generations), considerable foresight capability is needed to assess possible future carrying capacity limitations and resulting environmental stresses. The existing evidence strongly suggests that many developing countries are already suffering severe problems related to environmental and natural resource degradation. Even those countries that

still have favorable population-natural resource balances are well advised to undertake vigorous population policies, because such favorable balances can easily become unfavorable within the long period required for the full effect of population policies to be felt. Aside from the question of stabilizing population size because of on carrying capacity limitations, the negative environmental consequences merely associated with a high rate of population growth provide a compelling case for urgent efforts to reduce such growth.

LITERATURE CITED

Brown, L. 1978. The twenty-ninth day. (FILL IN)

CEQ, 1980. Global 2000 Report to the President. Washington, D.C.: U.S. Council on Environmental Quality.

Clay, J., 1982. Deforestion: the human costs. Cultural Survival Quarterly 6(2):3-7.

Deevey, E. S., et al. 1979. Mayan urbanism: impact on a tropical karst environment. Science 206 (Oct. 19, 1979): 298-306.

Ehrlich, P.R. and Ehrlich, A.H., 1981. Extinction: the causes and consequences of the disappearance of species. New York: Random House, 305 p.

FAO, 1977a. World Food Survey, 1977, Appendix B. Rome: United Nations Food and Agriculture Organization.

FAO, 1977b. World Food Survey, 1977, Appendices C and M. Rome: United Nations Food and Agriculture Organization.

FAO, 1978. Forestry for Local Community Development. Rome: United Nations Food and Agriculture Organization.

Farnsworth, N., 1982. The potential consequences of plant extinction in the United States on the current and future availability of prescription drugs. Washington, D.C.: Symposium on Estimating the value of Endangered Species--Responsibilities and Role of the Scientific Community, annual meeting of the American Association for the Advancement of Science.

Gilland, B. 1982 (or 1983). Thoughts on world population. Environmental conservation.

Goodland, R.J.A., 1981. Indonesia's environmental progress in economic development in Sutlive, V.H., et al. (eds.), Deforestation in the Third World. Williamsburg, Virginia: College of William and Mary, Stud. Third World Socs., 278 p.

Grainger, A., 1982. Desertification. London: International Institute for Environment and Development, 94 p.

Greene, H. 1966. Irrigation in arid lands in Hills, E. S. (ed.), Arid Lands: A Geographical Appraisal. Paris: United Nations Educational Scientific, and Cultural Organization.

Harrison, P., 1983. Land and people--the growing pressure. Earthwatch 13.

Hoskins, M. 1979. Women in forestry for local community development: a programming guide. Washington, D.C.: U.S. Agency for International Development.

IUCN, 1980a. Averting a major setback to development. IUCN Bulletin 11(5): 22-26.

IUCN, 1980b. World conservation strategy. Gland, Switzerland: International Union for Conservation of Nature and Natural Resources.

Kahn, H. 1982. The coming boom. New York: Simon and Schuster.

Kovda, V.A. 1980. Land aridization and drought control. Boulder, Colorado: Westview Press, 277 p.

Ledec, G., 1983. The political economy of tropical deforestation in Leonard, H.J. (ed.), The Politics of Environment and Development. New York: Holmes and Meier (in press).

Leonard, H.J., 1983. Environment and economic development in the Third World in Leonard, H.J. (ed.) The Politics of Environment and Development. New York: Holmes and Meier (in press).

Mann, D.W., 1981. Fewer people for a bettter world: a plea for negative population growth. Environmental Conservation 8(4):260-261.

Moris, J. and K. Openshaw, 1979. The socio-economics of agro-forestry. Morogoro, Tanzania.

Myers, N., 1979. The sinking ark. New York: Pergamon Press.

NAS, 1980a. Conversion of tropical moist forests. Washington, D.C.: U.S. National Academy of Sciences.

NAS, 1980b. Research priorities in tropical biology. Washington, D.C.: U.S. National Academy of Sciences.

NRDC, 1980. Aiding the environment: a study of the environmental policies, procedures, and performance of the U.S. Agency for International Development. Washington, D.C.: Natural Resources Defense Council.

Pereira, H. C., 1973. Land use and water resources in temperate and tropical climates. Cambridge, U.K.: Cambridge University Press.

Poore, D., 1983. Deforestation and the population factor. IUCN Bulletin 14 (1/2/3):26.

Revelle, R. 1976. The resources available for agriculture. Scientific American, September. 1976.

Simon, J.L., 1981. The ultimate resource. Princeton, New Jersey: Princeton University Press.

Smil, V., 1983. The Bad Earth: environmental degradation in China. Arnouk, N.Y.: M.E. Sharpe.

Tillman, R.E., 1981. Environmental guidelines for irrigation. Washington, D.C.: U.S. Agency for International Development.

UNEP, 1980. Overview document: experts meeting on tropical forests. Nairobi: United Nations Environment Program.

USAID, 1979. Environmental and natural resources management in developing countries: a report to Congress, Vol. 1. Washington, D.C.: U.S. Agency for International Development.

USDS, 1978. Proceedings of the U.S. Strategy Conference on Tropical Deforestation. Washington, D.C.: U.S. Department of State.

USDS, 1982. Procedings of the U.S. Strategy Conference of Biological Diversity. Washington, D.C.: U.S. Department of State, Publication No. 9262.

U.S. Fish and Wildlife Service, 1982. 1980 national survey of fishing, hunting, and wildlife associated recreation. Washington, D.C.: U.S. Fish and Wildlife Service.

Westing, A.H., 1981. A world in balance. Environmental Conservation 8(3):177-183

World Environment Report, March 16, 1981.

World Bank, 1978. Forestry sector policy paper. Washington, D.C. : World Bank.

World Bank, 1981. Accelerated development in sub-Saharan Africa: an agenda for action. Washington, D.C.: World Bank, 198 p.