OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

1985

UNIDO/ESCAP Workshop on

Accelerating Growth Through Co-operation in Selected

Industrial Sectors in the Developing Countries of the ESCAP Region

Bangkok, Thailand, 1 - 5 July 1985

Issues and problems of the development of the wood, petrochemical and chemical industries in the developing ESCAP Region

Prepared by

Prof. J. Wong

3 June 1985

This document was prepared by Prof. J. Wong as consultant to UNIDO. The views, opinions and general presentation of this document are those of the consultant, and they do not necessary reflect those of the ESCAP or UNIDO Secretariat.

CONTENTS

ISSUES AND PROBLEMS OF THE DEVELOPMENT OF THE WOOD, PETROCHEMICAL AND CHEMICAL INDUSTRIES IN THE DEVELOPING ESCAP REGION

By John Wong (Associate Professor of Economics, National University of Singapore).

INTRODUCTION

To start with, it may be useful to synthetize some common characteristics of these three industries and put them in the overall perspective of the developing ESCAP region. These three industries can be called "resource-based industries", which may be defined as industries critically linked to supplies of natural resources of a specific type or from a specific source. Thus the wood industry is clearly based on forest products, and the chemical and petroleum industries on a variety of minerals, especially petroleum and natural gas.

The role of natural resources in economic development has been controversial ever since the economist put forward the familiar triumvirate, land (a proxy for natural resources), labour and capital, as the key factors of production which determine economic progress. Today, the topic draws attention largely from economic geographers rather than from economists, as most economists come to recognize that the endowment of natural resources with a country is a valuable but no necessarily an indispensable prerequisite for its successful industrialization. The economist's contribution to the debate on the role of resources in economic development lies in the theory of comparative advantage: a country tends to specialize in the production of commodities which it can produce relatively more efficiently. The "naive" interpretation of the static concept of comparative advantage would yield an over-simplified argument that if a country were rich in forest resources its comparative advantage invariably lies in the development of wood-based industry. Extending the argument into the static Ricardian framework, this would imply that the scarcity of natural resources constitutes a major

constraint on industrialization. This also amounts to saying that if a country had no petroleum products, it should not set up a petrochemical industry.

In a dynamic context, however, the predictions of the theory of comparative advantage concerning the role of resource endowment in economic growth are much more complex. It is not just the size of the resource base of a country but the diversity and accessibility of its resources as well as a host of other crucial factors such as capital, labour, technology, price structure, institutional set-up, and government policy that all operate to condition the country's industrialization progress. Specifically, the neo-classical economic scenario, which stresses the dynamic forces of substitution by capital and technology for the lack of resources, as reflected in the Heckscher-Ohlin-Samuelson factor endowment theory, provides a better explanation as to why a country tends to specialize in certain production activities. In the real world, it is the dynamic considerations that actually shape the exact role of resource endowment in the economic development of a country. While a resource-rich country has certain "natural" advantage for developing some resource-based industries, a resource-poor country, with technical progress and an open trade policy, can also promote such resource-based industry. Initially, a "traditional" resource-based industry may be set up with the view to utilize the local raw material supply. But as the industry grows and becomes modernized, it may diversify its sources of raw material supply, with its original links with the local natural resources getting more tenuous. In fact, a "modern" resource-based industry is often set up not to gear to local or even regional, but to world-wide sources of raw material supplies. The case in point is the petroleum industry in Singapore. For the development of modern resource-based industries, there is simply no "iron law" to specifiy the possession of natural resources at home as the necessary precondition. This is clearly borne out in the actual development experience of some ESCAP countries.

The developing ESCAP region is considered to be made up of 15 countries, namely: Afghanistan, Bangladesh, Burma, the area of Hong Kong, India, Indonesia, Iran, Republic of Korea, Malaysia, Nepal, Pakistan, Philippines Singapore, Sri Lanka and Thailand. Obviously, these countries comprise an

extremely diverse group in terms of economic growth and industrial development. Diversity is equally pronounced with respect to their resource endowment, and hence the diverse pattern of development of these particular three resource-based industries.

Broadly speaking, the 15 ESCAP countries listed in this project can be put into three categories, each with a fairly distinct development typology. Thus countries like the Republic of Korea, the area of Hong Kong and Singapore (together with Taiwan Province of China), constitute the well-known Asian NICs (Newly Industrializing Countries), which have experienced near double-digit rates of growth for a sustained period, as shown in table 1. Their "dynamic" growth is based primarily on the rapid expansion of manufactured exports. These NICs are generally land-scarce and resource-poor economies. As city-states, the area of Hong Kong and Singapore have virtually no natural resources to speak of, except for their geographical location. But the Republic of Korea and Taiwan Province of China are also short of resources. However, the economic development of these NICs, as of Japan, has not been hampered by their lack of natural resources, for they have successfully overcome this constraint by intensifying the development of their human resources through cultivating higher levels of skills, enterprise, and industrial discipline.

By comparison, the ASEAN (Association of Southeast Asian Nations) countries of Indonesia, Malaysia, the Philippines and Thailand are generally regarded as resource-based economies, favourably endowed with rich natural resources, which make up the bulk of their exports. Indeed, the annual export of these primary resources has been the main spring of ASEAN's economic growth, which has been sustained at the respectable rate of around 7 per cent during the last decade. Furthermore, these ASEAN economies are open and outward-looking in orientation; and their open economic structures have also facilitated the exploitation of their natural resources and the development of their resource-based industries.

Burma and Iran are not resource-poor countries; but their economies are not so "open" as the ASEAN economies - Burma is gradually opening up its economy in recent years while Iran is increasingly drawn toward

inward-looking. The rest of the developing ESCAP countries, namely, those on the Indian subcontinent, can be regarded as land-scarce and resource-poor economies, just like the East Asian NICs. But unlike the NICs, these South Asian economies have not succeeded in developing a dynamic, export-oriented industrial sector to propel their economies into high growth. Instead, they have generally followed an inward-looking development strategy, coupled with inappropriate government intervention. Consequently, these countries have had poor economic performance with their long-term growth rate around 4 per cent. (See table 1).

The level and character of industrial development of these 15 ESCAP countries seem to have followed closely the overall pattern of their economic development. As can be seen from table 2, the more developed NICs are clearly more industrialized not only in terms of higher per-capita value-added in manufacturing and higher manufactured exports, but also a more balanced industrial structure. While the industrial structure of most of the other developing ESCAP countries is still dominated by small, labour-intensive establishments directly connected with the processing of primary products or simple fabrication, the NICs have increasingly moved away from labour-intensive industries into more capital-intensive and higher value-added activities. Another marked difference between the manufacturing sector of the NICs and that of the other ESCAP countries is that the former is export-oriented. Although some ASEAN economies are making successful transition from import substitution to export expansion, there are still many developing ESCAP countries with industries trapped in the import substitution phase and plagued by structural shortcomings. In some ways, India stands out among this group of countries. As the largest economy in the group, with the longest industrialization history spanning over three decades, India has developed a very diverse industrial base in terms of scale of operation and range of activities. Partly as a result of the prolongation of the import substitution policy and partly due to the existence of a large domestic market, most Indian industries are not fully export-oriented and internationally competitive. Suffice it to say that this simple characterization of the industrial profile of these ESCAP economies should provide a useful perspective to evaluate the conduct and performance of these three resource-based industries.

1. THE WOOD INDUSTRY

Of the three industries reviewed here, the wood industry carries profound socio-economic implications with a strong touch of humanity, as the raw materials of this industry are supposed to be universal, abundant and, in theory at least, inexhaustible. Wood-using industries are widespread in both developing and developed societies, and its products are found in every household the world over. The technology used by the industry ranges from the primitive ways of wood-gathering by hand and by axe to the highly mechanized and automatic methods of timber extraction. In the old days, there were many "hewers of wood", who occupied a special place in the rural economy. Even today, wood-using activities still provide the peasants of the rural communities in some developing ESCAP countries with important sources of additional incomes and off-season employment. The peasants are heavy users of wood products in their homes and in their place of work. In short, the wood-using industry has been well-integrated into the daily life of the peasants.

However, it would be a mistake to characterize the wood industry as purely a traditional type of resource-based industry void of "dynamic" implications. After World War II, the wood industry in many ESCAP countries has expanded rapidly and become an important foreign exchange earner. The industry has also experienced remarkable technological advance. New technology has made it possible not only for the more efficient exploitation of forest resources but also by ways of upgrading the end-use products. The case in point has been the introduction in recent years of laminates made from small pieces of wood which would not have been usable for solid wood products previously. In this way, the new technology has created new types of stronger wood panels with enhanced structural properties, thereby widening their commercial application.

1.1 Production pattern in the region

The wood industry is essentially made up of three components: (1) the forestry sector, which is concerned with the growing and harvesting of trees; (2) the mechanical processing sector; and (3) the chemcial processing sector, which is mainly involved in the production of pulp and paper. The mechanical

processing sector can be further broken down into primary processing and secondary processing. The former is concerned with processing of logs (cutting and treating of timber in the mill) into various boards and panels while the latter is responsible for turning into end-use products such as building materials, furniture, joinery, etc. There are many establishments which actually integrate the two processing stages. At each stage of production, there are by-products such as wood wastes which can be transformed into reconstituted wood panels or simply used as fuels for the processing kiln. This stage is sometimes called tertiary processing. The focus of this study is on the mechanical processing sector.

The basic raw materials for the wood industry are, of course, forest resources. Broadly speaking, the forest areas of the world are classified into four regions: the conifer-softwood region, the mixed regions of softwoods and hardwoods, the temperate hardwood region, and the tropical hardwood region. The developing ESCAP region encompasses areas for the temperate hardwood forests as well as the tropical forests. In particular, Southeast Asia is known to produce a considerable amount of commercial timbers. Its forest resources are vast and varied, with forest types ranging from tropical rain and mangrove swamps to savannah and evergreen rain forests. Most forest resources in Southeast Asia are accessible and exploitable, especially in Indonesia, Malaysia and the Philippines where the forests tend to be quite homogeneous with valuable species in large quantities. Among the well-known species, the Philippines has the Lauan family; Malaysia has the Ramin and Teak; and Indonesia has the Meranti, Ramin, Kreuing and Teak. Besides, Thailand and Burma are known for their high-quality Teak; so is India for the Padauk.

Countries with abundant forest resources naturally have a favourable precondition for the development of the wood industry. On the other hand, as stressed earlier, the lack of natural resources should not deter a country from developing a particular resource-based industry. Table 3, in highlighting the trade in overall forest products for the developing ESCAP countries, brings out this point. While such resource-rich ASEAN countries as Indonesia, Malaysia and the Philippines have thrived on their forest products, the area of Hong Kong, a country with no forest resources whatsoever, also has

forest products for exports, primarily by importing the raw materials first from the resource-surplus countries and then processing them for a higher value-added.

The more intricate pattern of linking resource to processing and manufacturing is shown in table 4. Virtually all these ESCAP countries, except for the city-states of the area of Hong Kong and Singapore, produce roundwoods of both the conifer and non-conifer varieties, reflecting the "universality" of the forest resources; but only a few of them such as Indonesia, Malaysia, the Philippines and Burma have abundant roundwoods for exports in their raw form. In recent years, these countries have also processed their logs for exports in order to capture a larger share of their potential value-added at home. When it comes to secondary processing and wood-based manufacturing, however, other "dynamic" factors such as capital and technology rather than the static concept of resource supply come into play, thereby making it possible for the resource-poor countries to start their own resource-based industries on a competitive basis. Thus the area of Hong Kong, Singapore, the Republic of Korea and India can also produce plywood for exports. The rapid growth in recent years of export-oriented industries of furniture and joinery in the four Asian NICs offers another prominent example.

The best way to understand the structure of the industry is to take a cross-sectional view of the industry based on an input-output analysis. Unfortunately, comparable input-output tables are only available for 1975 for Japan, the Republic of Korea and the five ASEAN countries, which have been prepared by the Institute of Developing Economies, Tokyo. It is nevertheless quite illuminating to take an inter-industry view of the wood industry of these countries and to draw some interesting observations.

The wood industry is divided into three sectors: forestry, lumber and wooden products. Typical of being a resource-based industry, the wood industry in all these seven countries is generally characterized by the heavy uses of raw materials, with the main input for the industry being labour, energy and machinery. The lumber sector depends on the forestry sector for input; and the wooden sector, on lumber sector. In terms of output, the main purchasers are the construction industry and final demand by consumers (e.g. for furniture).

It is also interesting to compare the key direct coefficients of the three sectors for the seven countries, as compiled in table 5. For the forestry sector, Singapore, the Republic of Korea and Japan are marked by higher payments to wages and salaries (for the labour input); but Indonesia, Malaysia and the Philippines (countries with forest resources) are marked by higher value-added. Value-added in the lumber sector is generally lower than in the forestry sector. As for exports, Malaysia's lumber industry has performed better than the other countries. Finally, for the wooden sector, Malaysia, the Republic of Korea and the Philippines are shown to have gained a strong foothold in the international market, as indicated by the larger export share from their output.

1.2 Issues and problems

For those ESCAP countries endowed with abundant timber resources, their dominant concern is obviously centred not just on more efficient utilization of their existing forest resources in order to maintain the growth momentum of their wood industry but also on sustaining their future forest supplies. Forest resources are inexhaustible only to the extent that they are properly managed and maintained in a balanced demand and supply timber budget. This calls for a proper forest management policy with a realistic solution to the problems of both present and future demand for timber, and an environmental balance resulting from the rapid depletion of forest resources. The environmental issue, as a form of negative social externality, is often left out in the discussion of the growth of the wood industry in the LDCs.

According to an FAO report, of the ESCAP countries only India has made some efforts to manage its forest resources while most of the forest-surplus countries in Southeast Asia have not undertaken effective programmes to nurture and preserve their forest resources. Thus the problem of a rapid depletion and destruction of tropical forests in Southeast Asia is a real one. In the long run, the rapid exhaustion of forest resources not only can bring an end to the export earning potentials of this important sector but can also spell large-scale ecological disaster for these Southeast Asian countries. In the medium term, uncontrolled exploitation of the valuable species can render the remaining forest areas more heterogeneous and

economically less productive as primary resources. In short, the forest-surplus countries of the ESCAP regions are faced with the urgent need for the formulation of a rational forest policy at the national level. The immediate measures to be undertaken should include the setting up of a more comprehensive management framework and plans for undertaking a more accurate forest inventory.

The developing ESCAP countries with sizeable primary forest resources also have to grapple with some external challenge. The more serious is the protectionist policy taken by the forest-deficit countries against their imports of forest products. Japan, in particular, has set up high effective rates of protection against forest products from Southeast Asia, with the rates of tariff escalating according to the stages of processing. Furthermore, new technology is being developed in Japan to convert its plywood industry from its high dependence on Southeast Asian hardwoods to a softwood basis, with possible use of the cheaper American fir and Russian softwood as substitutes. Such a development will clearly reduce the demand potentials for the Southeast Asian forest products.

For the timber-deficit ESCAP countries, particularly the Asian NICs, a number of problems and issues facing their wood industry have also emerged. Although the past growth of their wood industry has amply demonstrated that such a resource-based industry does not hinge critically on the domestic availability of wood resources, it is nonetheless getting increasingly difficult for these resource-poor countries to maintain their long-term comparative advantage for this industry over the resource-rich Southeast Asian countries. In particular, the wood industry is not inherently capital-intensive, and the production technology required can be easily acquired by the less developed countries. Moreover, some timber-surplus countries have in recent years imposed restriction on the export of certain timber species. There is also the growing spectre of total prohibition of log exports on the part of the resource-rich countries in the future. Inevitably in the longer run there will a shift of wood processing activities from the resource-poor ESCAP countries to the resource-rich ones, with the former concentrating more on secondary processing facilities.

The inter-industry comparison, as shown in table 5, has provided strong indications that the wood industry in Indonesia, Malaysia and the Philippines are getting increasingly competitive, not just in the forest sector but also in the lumber and wooden sectors. Even Indonesia, the least industrialized of the ASEAN countries, had 46 plywood and veneer plants in 1982, with more in the pipeline. Both Malaysia and the Philippines have in recent years encouraged greater modernization and expansion of their existing sawmills and plywood plants, with the view of moving towards more advanced secondary processing activities.

As for the resource-poor NICs, their problems ahead seem sufficiently clear. They need to continue their efforts of restructuring and upgrading their wood industry, with a view of gradually moving away from processing of wood to manufacturing of more sophisticated wooden products such as high-quality furniture, for which technology, designs, packaging and marketing are more important than raw material supply.

Over the longer run, the demand in the developed countries for products of the wood industry of all the developing ESCAP countries may face a continuing decline due to the persistence of economic slumps or lower economic growth in the developed countries. But the more disturbing factor is the secular decline in the demand for all wood products in the industrially advanced countries on account of their demographic transition towards a permanent drop in population growth.

On the other hand, the Asia-Pacific region is slated to be the dynamic growth region by the end of this century, and this will generate greater intra-regional demand for wood products to make up for the potential shortfalls in demand from the developed countries. Finally, the opening up of China and the increasing integration of the Chinese economy with the economies of the other Asia-Pacific countries will also provide a new market potential for a wide range of wood products in future.

2. THE PETROCHEMICAL INDUSTRY

It is difficult to have a precise definition of the petrochemical industry. The category of chemicals called petrochemicals is understood differently in different countries. A narrow version of the industry is to confine it to the first-line raw materials and monomers; but a broader definition would include polymers and plastics, man-made fibers, fertilizers, pharmaceuticals and, in fact, hundreds of other chemicals. Such a broader definition clearly brings the "petrochemical industry" to overlap with the "chemical industry".

Unlike the wood industry, the petrochemical industry is characterized by scale economies, high capital investment and sophisticated technology. Naturally, this is an industry which is dominated by the developed countries. But for a variety of considerations, many LDCs have gone into this industry. The main rationale for the construction of a basic or intermediate petrochemical plant in an LDC include: (a) To save foreign exchange; (b) To provide a nucleus for the growth of other local derivative industries, the so-called upstream and downstream activities; (c) To utilize readily available starting materials; and (d) To develop a manufacturing base for high value-added activities. After all, the petrochemical industry, like other capital-intensive industry with promises for extensive economic linkages and large technological spillovers, is often the favourite choice of many development planners in the Third World as a prestige project.

In reality, most of the petrochemical projects in the developing ESCAP region were planned or constructed in the 1970s during the high tide of the world energy crisis. It was the time when prices of oil and gas, which are the feedstock of the petrochemical industry, were perceived to be on the continuous rise. The energy-deficit countries were particularly concerned over the security and the stability of supply of oil and the oil-related products. In retrospect, the world petrochemical industry, riding on the back of the two world oil crises, did experience fast growth during the 1970s, along with the petroleum industry. In recent years, as the energy scenario has sharply changed, some of the underlying assumptions for the establishment

of a large petrochemical industry in some LDCs have become irrelevant. But the historical episode of the 1970s should be borne in mind in evaluating the rational existence of any petrochemical industry today.

The world petrochemical industry, as shown in table 7, has chalked up a high rate of growth during 1965-70, with the basic petrochemical product, ethylene (produced by cracking naphtha, gas-oil, or ethane propane), having increased by 2.3 times. Furthermore, rapid growth has sustained throughout the 1970s. After having peaked in 1979, basic petrochemical production has since declined. Most of the basic petrochemical products are produced in the developed countries. The share of the developing countries for ethylene production in 1979 was only 7.2-6.0 per cent for propylene, 6.9 per cent for benzene, 7.9 per cent for butadiene, 10.8 per cent for Xylenes and 11.3 per cent for methanol.

The end-petrochemicals are usually grouped into four: plastics, synthetic fibres, synthetic rubbers and detergents. Plastics account for more than half of the world's end-petrochemicals, followed by synthetic detergents and fibres. As shown in table 8, the production of plastics (including the LDPE or low density poly-ethylene, HDPE or high density poly-ethylene, PVC or poly-vinyle chloride, PP or poly-propylene and PS or poly-styrene) has experienced the phenomenal 16 per cent growth during the 1960s, though with somewhat lower rate for 1970s. Similarly, other groups of end-petrochemicals have shown high growth during the 1960s but declined slightly during the 1970s. Furthermore, the bulk of the world's end-petrochemicals are produced in the United States, Western Europe and Japan, with the share of the developing world in 1981 at 12 per cent for plastics, 19 per cent for synthetic fibres and 8 per cent for synthetic rubber.

2.1 Petrochemical industry in the region

The petrochemical industry is a modern type of resource-based industry which clearly does not operate on domestic availability of raw materials. As can be seen from table 8, most of the ESCAP countries considered in this paper are essentially energy-deficient. The large petrochemical industry in the region for the basic petrochemicals is concentrated in the Republic of Korea,

India, Iran, Taiwan Province of China and, more recently, Singapore. But only the Iran is the petrochemical industry directly linked to its domestic resurce base, although the petrochemical industry in the resource scarce Singapore is also connected with its regionally-oriented refinery centre. The production capacities of the petrochemical plants for the basic products in India, Iran and Republic of Korea are shown in table 9. India boasts the oldest petrochemical industry in the region; but the complex in the Republic of Korea is modern and efficient and Singapore's facilities only came on stream in 1984. Iran's huge petrochemical complex, covering both basic and end products, are not yet fully operational. Beyond these four countries and Taiwan Province of China, there is no significant production capacity in the rest of the region. For the production of end-petrochemicals, however, virtually all the developing ESCAP countries have developed some capacities, especially for thermoplastics, as shown in table 10. But the major production facilities are again found in the Republic of Korea and India.

Starting from a low level, the consumption of end-petrochemicals in the developing ESCAP region has registered an extremely high rate of growth during 1965-1975: 16 per cent for plastics, 21.2 per cent for synthetic fibres and 14.3 per cent for synthetic rubber. The rates of increases became stabilized in the late 1970s. The consumption demand has been particularly high in the NICs and ASEAN which have also achieved high rates of economic growth during the same period. The country breakdown of petrochemicals consumption for the region is shown in table 11. It can be seen that the per capita level of petrochemicals consumption for the region as a whole is still low, e.g. the average per capita thermo-plastics consumption for 1980 for the whole region was only about 2 kg, as compared to 20-45 kg for the developed countries. The per capita demand for the petrochemicals products seems closely related to the per capita income level. While both India and the Republic of Korea are the industry leaders in the region, India's per capita consumption of thermo-plastics in 1980 was only 0.4 kg, as compared to 15.4 kg for the Koreans. Viewed from a different angle, the present low level of petrochemicals consumption for the region as a whole also suggests tremendous potential for the future development of the industry.

2.2 Issues and problems

Too often a large scale, capital intensive project has been set up in an LDC as a showcase, but it soon turns into an expensive white elephant for the state. Thus the most critical bottom-line to appraise the capital intensive industry is whether or not it is economically viable. And the single most important factor affecting the economic efficiency of the capital intensive industry is its capacity utilization. Despite scale economies as the major attribute of a capital intensive industry, it is often the case with many LDCs that their capital intensive projects are frequently operated with serious excess capacities due to a variety of economic and technical reasons.

In a nutshell the major problem faced by the petrochemical industry in the developing ESCAP region is precisely the low level of capacity utilization, for both basic and end products. In 1977, as by comparing table 12 with table 9, the actual production of the ethylene-propylent-butadianene line of basic - products in India and the Republic of Korea, the leading producers in the region, was only 51.4 per cent of their design capacity. In 1979, the utilization level increased to 73.5 per cent; but it dropped to 66.6 per cent in 1980. For the xylenes-benzene-methanol line of basic - products, the capacity utilization started with the high 97.6 per cent in 1977 but dropped to 70.3 per cent in 1980;

Capacity underutilization is equally serious for the end products. Take thermo-plastics, for instance. As can be seen by comparing table 13 with table 10, the total capacity utilization for the 10 ESCAP countries declined sharply from 90 per cent for 1977 to 72.3 per cent for 1979 and further to 69 per cent for 1980. Part of the excess capacity can be attributed to world wide economic recession as a result of the second world energy crisis. But not all the ESCAP countries experienced economic downturn during this period. Underutilization of capacity could sometimes happen to the industry in an LDC during the "start-up" period because of lack of trained and experienced operators or due to failure of technical backup services from its affiliated industry in a developed country. But this has not been the case for the petrochemical industry in region.

The existence of excess capacity for the petrochemical industry in the region appears even more ironical in the context of overall demand supply imbalance for both the basic and end-petrochemical products in the developing ESCAP region. As shown earlier, the average per capita consumption of petrochemical products in the region is still very low, suggesting vast demand potentials in existence. For years the region has also been a net importer of petrochemical products from the developed countries, mainly from Japan. In fact, the demand in the region for the thermo-plastics alone has been projected to be growing at the hefty 8-9 per cent for the rest of this decade while the demand in the developed world for such products have become saturated. As clearly brought out in table 14, virtually all the ESCAP countris are expected to have deficits in the domestic supply of the thermo-plastics through the rest of this decade.

Why then is there continuing underutilization of production capacity in the existing petrochemical industry of the region under such a strong demand condition? Obviously, the industry is saddled with some deep-seated structural problems form both internal and external resources.

Internally, the petrochemical industry of the region is faced with the dilemma of size and scale. For the efficient operation in order to reap the scale economies, the petrochemical industry must be set up as a large production unit. Further, the industry covers a wide range of products, though the size of facilities gets smaller and smaller as the production line moves further downstream. Thus there is an inherent tendency to scale up the main plant for the production of the basic products. This is the rationale for the establishment of an integrated petrochemical complex. Most LDCs want to set up such a large complex on the national level to turn out both basic and end products, regardless their actual market conditions. In the ESCAP region, Indonesia, the Philippines, Pakistan and Thailand have all drawn up plans for such a large, integrated petrochemical complex. Yet most of the developing ESCAP economies are either too small or their industrial structure has not been sufficiently well developed to absorb the full range of petrochemical products. Hence they are all confronted with the real problem of producing the right mix of products at the right quantity that can be fully absorbed by their downstream industries.

The problem can be solved if they can make proper use of international trade mechanism to get rid of the surplus and to make up for domestic deficiencies. Unfortunately, there has been very low level of intraregional trade in petrochemical products, as the world markets for these products are largely dominated by the developed countries. In times to come, the developing ESCAP countries can also improve the capacity utilization of their petrochemical industry by a vigorous promotion of a full range of downstream industries. But in the meanwhile, these ESCAP countries will have to live with the parodoxial situation of underutilizing their existing plant capacity on the one hand and depending on imports from the more efficient industries abroad to fill domestic deficits on the other.

The external challenge to the petrochemical industry of the region seems even more formidable. Since 1981 there has been world glut in the petrochemical products, leading to the development of the overall excess capacity for the world petrochemical industry. The glut is widely expected to continue for the rest of the decade due to sluggish economic growth of the developed countries (which remain the dominant consumers at the world level of various petrochemical products) and to the potential exhaustion of substitution opportunity in some consuming areas. Furthermore, the supply-demand imbalance will soon be aggravated by a new flood of output from the many new complexes in the OPEC countries and other parts of the developing world which come on stream before the end of the decade.

Growing international competition certainly presents a very serious challenge to the petrochemical industry of the developing ESCAP countries. Many of them find their industry still trapped in the import substitution phrase plagued by structural shortcomings. Worse still, the established producers from Western Europe and Japan have in recent years started to unload, in large quantities, their petrochemicals on the region's market at prices significantly lower than those of the region's domestic producers, partly because the former are more efficient than the latter and partly the former have lower fixed cost from their old plants and equipment. Meanwhile, some centrally planned economies, in their earnest pursuit of foreign exchange, have also dumped their petrochemical products on the Third World markets at low prices.

But greater challenge to the region's petrochemical producers comes from the emerging petrochemical industry in the Middle East. Many oil rich countries there have planned or in the process of setting up ultra-modern, large-scale petrochemical complexes, with full technological back-up from the multinationals in the developed countries. These new production facilities are planned to be purely export oriented as their domestic markets are too small, and they are expected to turn out a wide range of petrochemical products at low cost because of the availability of cheap feedstock from their petroleum industry. In fact, these plants can even make use of wasted raw materials like flared gas with almost zero cost. Without doubt, the new petrochemical industry of the OPECs will bring about a disruptive impact on the existing petrochemical industry of the developing ESCAP countries, particularly those which are net oil importers.

Faced with enormous international uncertainty and serious internal structural problems, the petrochemical industry of the region is clearly going through a difficult period of adjustment. In most of these countries, the industry has been set up under strong government patronage, with heavy protection. The immediate survival of the industry in these countries may not be called into question; but their long-term existence nonetheless entails high cost to their respective economies. There is therefore the urgent need for the indutry to restructure and rationalize itself through technical upgrading and diversification.

Some countries (e.g. Indonesia) have taken a decision to shelf their plans for the construction of a big petrochemical complex. This is an economically justified moeve. Apart from the unfavourable international economic environment, there is actually not much real economic raison d'etre for a small to medium developing country to go into such a large project, which involves huge capital outlays but generate only modest employment. It would also be difficult for these small LDCs to realize many of the hypothetical benefits associated with a large integrated petrochemical plant such as downstream linkages and technological spillovers. The opportunity cost of setting up such a large complex is simply too high for many LDCs.

Another lesson to be drawn is concerned with the resource base of the industry. As asserted from the outset, under dynamic condition the growth of a modern resource based industry may not necessarily be constrained by the domestic availability of resources. However, under static conditions, with shrinking markets and over-production, domestic resource supply at low cost coes provide the industry with a great advantage. Specifically for the petrochemcial industry, cheap local crude oil and gas means low-cost feedstocks for low-cost petrochemicals. For this kind of resource based industry, operating during the world recession, the resource rich countries will reassert their natural comparative advantage.

3. THE CHEMICAL INDUSTRY

The chemical industry - once known as the "Alkali Industry", has, starting with the polymers revolution, begun to overlap with the petrochemical industry. The traditional chemical industry with its manufacturing of such basic chemicals as sulphuric acid and alkali is unmistakable. But confusion with the petrochemical industry begins with the chemical industry moving towards the production of modern chemicals such as synthetic polymers by using hydrocarbon minerals, which are also the feedstocks for the petrochemical industry.

The chemical industry has been conveniently but broadly defined on the basis of the section 5 of the SITC (UN Standard Interntional Trade Classification), which include a diverse range of chemical elements and compounds: mineral tar and crude chemicals from coal, petroleum and natural gas; dyeing, tanning and colouring materials, medical and pharmaceuticals products; essential oils and perfume materials; polishing and cleansing preparations; manufactured fertilizers; explosives and pyrotechnic products; plastic materials, regenerated cellulose and artificial resins; and chemical materials and products not elsewhere classified. Broadly speaking, this classification corresponds to that implied by sections 6 and 7 of the BNT (Brussels Nomenclature for the Classification of Goods in Customs Tariffs).

For the purpose of this exercise, it seems possible to distinguish the chemical industry from the petrochemical industry in that the former is not so severely restricted by the scale economies as the latter, which has to operate as a large, integrated unit. While both the wood industry and the chemical industry affect almost every phase of our daily life, whereas the former has products visible in every household, the latter, with products numbering in thousands, are for most part absorbed by other branches of industry. A wide range of organic solvents, common acids or inorganic salts, which form inputs for numerous industrial processes, are not directly used as final consumer goods by the public. Essentially, the chemical industry in every economy is interlocked with the other industries of the manufacturing sector and subject to the growth and fluctuation of the whole manufacturing sector.

Although some segments of the chemical industry, e.g. the synthetic polymers and the pharmaceuticals, are characterized by rapid technological change and scale economies, the technology employed in production for considerable sections of the chemical industry is mature and can therefore be easily transferred to or acquired by LDCs. The structure of the chemical industry on the whole is marked by lesser concentration, with a lot of activities undertaken in basically small to medium-sized firms. Thus all LDCs have their chemical industry, albeit of traditional kind.

Over 90 per cent of world production of chemicals is centred in the developed market economies, which also account for 70 per cent of world's exports of chemical products. In general, the developing countries produce only some 30 per cent of the chemicals they annually consume.

3.1 Industry features in the region

The chemical industry in the developing ESCAP region can be said to be quite widespread. Though the modern component of the industry is closely linked to the growth of the manufacturing sector, the production of many traditional basic chemicals can be undertaken outside the modern sector by smaller establishments. Table 15 is purported to provide an overall view of the chemical industry in the region. In 1981, the total value-added of the chemical industry in 10 ESCAP countries amounted to $US 5.1 billion at 1975

prices, with India and the Republic of Korea responsible for 66 per cent of the total. The share of chemicals in the total manufacturing value added for these 10 countries is averaged 9.3 per cent, which is slightly lower than the average for the developed countries. In per capita terms, however, the average for these 10 ESCAP countries yields only $US 11, as compared with $US 233 for the United States and $US 172 for Japan. India can boast the largest chemical industry in the region in terms of total value added; but the per capita value added for India at $US 3.3 is very low, as compared with $US 42.6 for Singapore and $US 29.7 for the Republic of Korea. In general, the per capita value added of chemicals is closely related to the level of per capita GNP.

A more detailed picture of the structure of the chemical industry in the region is shown in table 16, which contains the five sub-sectors of the chemical industry, namely, industrial chemicals, other chemicals, petroleum refineries, miscellaneous petroleum and coal products, and plastic products. These sub-sectors are listed in terms of value added and their total employment as well as the mean size of establishments. It can be seen that the industry in South Asia tends to employ more workers as the average size of the establishment tends to be bigger in terms of employment. But there are no data available on capitalization to show that whether or not the industry in South Asia is actually operated on a larger scale.

Productivity, i.e. value added per worker, of the main branches of the chemical industry of the developing ESCAP countries is worked out in table 17. Productivity of the petroleum refinery, which is usually capital intensive and operated with joint venture arrangements with some multinational oil firms, is typically higher than that in the other sectors, while productivity of the plastics sector generally tends to belower due to its more labour intensive nature. A more interesting pattern on the productivity performance that emerges from table 17 is that on the whole the NICs and ASEAN tend to score higher productivity than the countries in South Asia. One obvious explanation is that the South-East Asia economies are more inward looking generally with a less efficient industrial structure.

No comprehensive information is available for a more detailed analysis of the conduct and performance of the chemical industry of the developing ESCAP region in a comparative perspective.

3.2 Issues and problems

The traditional component of the chemical industry in the developing ESCAP region, as elsewhere in the Third World, is made up of a large number of smaler import substitution type of establishments, which produce a variety of basic chemicals as inputs for the local industries making various daily consumer goods from soap and detergents to house paints. Many of these small chemical factories, especially those found in South Asia and some ASEAN countries, are structurally inefficient. Thus appropriate government policies should be formulated to assist these industries for their modernization and technical upgrading.

It should be added that small industries are not inherently inefficient. The plastic industry in the area of Hong Kong, Taiwan Province of China and the Republic of Korea comprises many small, export oriented firms, which are frightfully dynamic. This lesson should not be lost. For the industrially more underdeveloped parts of the ESCAP region, there are good prospects for the further growth of the traditional lines of chemical products, which are not technology intensive nor very capital intensive. These are also the activities which are regardes as sunset industries in the developed countries and will soon be given up for their lack of comparative advantage in these fields. On the other hand, these are the same industries which can play a catalystic role for the development of a more balanced industrial structure in the LDCs. Countries in South Asia may find it worthwhile to concentrate more efforts on upgrading the traditional component of the chemical industry.

The more developed part of the ESCAP region, namely, the NICs, is more preoccupied with the growth of the modern component of the chemical industry, which tends to be highly skill intensive and capital intensive. Some of the issues connected with the petrochemical industry have already been discussed in the previous sector. One branch of the chemical industry which has the scope for fast growth in all the developing ESCAP countries is the

pharmaceuticals industry. This is an industry characterized by high unit cost, advanced technology, and high R&D expenditures. Naturally, the world pharmaceuticals industry is dominated by the developed countries.

The more populous ESCAP countries in South Asia have set a high priority for promoting the pharmaceuticals industry, initially for the manufacturing of some common ethical drugs as an import substitution measure. Apart from its foreign exchange saving function, such an industry will facilitate the fulfilment of the long-term development goals of these countries in terms of greater satisfaction of basic needs. But the more developed ESCAP countries are aiming at developing a more ambitious pharmaceuticals industry for the production of sophisticated modern drugs, not just for domestic consumption but also for exports. In both cases, joint venture arrangements with some large Western pharmaceutical multinationals are necessary. It is indeed imperative to work out technological co-operation with these multinationals, which in many cases control the patent rights of certain key drugs. This brings to the fore the controversial role of multinationals in the development of chemical industry in the region. The recent Bhapol tragedy in India has added more fuel to this continuing debate.

A total of 25 leading chemical multinationals, which have a large share of foreign sales or are heavily involved in foreign operations, can be identified. This number includes some of the familiar oil multinationals such as Shell and Exxon, for petrochemicals: Du Pont, Union Carbide. Dow Chemicals, ICI, Hoechst, BASF, Mitsubishi Chemicals, Sumitomo Chemicals and Rhone-Poulenc, for basic chemicals; and Roche, Pfizer, American Cyanamid and Sandoz, for pharmaceuticals. Most of these multinationals have branches or joint venture arrangement in the ESCAP region.

Generally, the ASEAN countries are more well disposed towards direct foreign investment than countries in South Asia and the Republic of Korea. In ASEAN, the issue of multinationals does not provoke the same degree of emotion as it does in other parts of the region, largely because the ASEAN countries have been, by and large, able to harness foreign economic forces to meet their industrial development objectives. Indeed, the performance records of foreign investment in ASEAN, though varying in the individual ASEAN countries, do not

conform with the negative image often presented by its critics. On the whole, foreign investment played a useful catalystic role in ASEAN's industrialization progress. It should be remembered that the standard of performance of multinationals is not independent of the types of policies pursued by host governments nor independent of the effectiveness of their implementation devices. It is actually up to the individual ESCAP countries to design policies to capture the benefits of foreign investment while minimize its negative externalities. In the modern component of the chemical industry, it is simply not possible for the developing ESCAP countries to avoid the involvement of multinationals which are often the main source of technology and expertise in a particular field.

Finally, chemical fertilizers are likely to form another growth industry in the chemical fields, especially in the more strongly agrarian-based ESCAP countries. From various FAO studies, it is clear that the share of the developing ESCAP region in the world production and consumption of fertilizers is still low. Increasing application of fertilizers is the key element in bringing about the technological transformation of agriculture, the so-called Green Revolution, in these countries. With the exception of the Republic of Korea, virtually all these ESCAP countries are net importers of manufactured fertilizers, as evident in table 18. The FAO projection has also indicated that deficits in the demand and supply of fertilizers in these countries are likely to continue to the next decade. Hence high priority for the development of this branch of chemical industry in the region. Technically, many of the industry related problems for the fertilizer industry are essentially similar to those concerning other chemical industries.

4. CONCLUSIONS

In an overall conclusion, it may be pertinent to single out the issue of international co-operation. The three industries under review have been categorized as resource based industry from the outset. It has been noted that the region as a whole has adequate resources for the development of these three industries. However, the resources required by these industries are not evenly endowed with the ESCAP countries concerned. This is a good starting point for intraregional co-operation involving the resource rich and resource

poor countries, for the purpose of better utilization of the region's resources. The advantage for greater regional co-operation for the development of the wood industry is quite apparent.

The developing ESCAP countries also differ considerably in respect of their stages of economic growth, skills level and industrialization progress. Such differences, viewed from a different angle, are also sources of their complementarity, providing more leeway for regional industrial co-operation.

In any case, a general scheme of regional co-operation for sharing industrial development experience, training and research, exchange of industry information, and the like should always work to the benefit of both the more developed and the less developed ESCAP countries. Where possible, more specific inter-industry co-operation such as arrangements for the surplus basic petrochemical products in one ESCAP country to be used as input by the petrochemical industry producing end products in another ESCAP country would be even more beneficial.

Regional co-operation can be extended to extra-regional activities. As emphasized earlier, the multinationals will continue to play a significant role in the region's petrochemical and chemical industries. Clearly it would be to the advantage of all the ESCAP countries with substantial multinational involvement to work together for some measures which will raise the level of performance of the multinationals in terms of technology transfer, environmental protection and the like. Regionally co-ordinated pressures would also be effective in dealing with rising protectionism in some developed countries against the resource based manufacturers from the region.

TABLES

Table 1. ECONOMIC PROFILE OF THE DEVELOPING ESCAP COUNTRIES

	Area	Population		G N P		Distrubution of G D P (%)						Average Annual Growth 1970-1982(%)		
						Agriculture		manufacturing		Services				
	(1000 Km^2)	(million 1982)	growth rate 1970 -82 (%)	Per-Capita 1982 US $	Averaqe Annual growth of GDP 1970 - 82 (%)	1960	1982	1960	1982	1960	1982	Agriculture	Manufacturing	services
Afghanistan	648	16.8	2.5	195	3.9	-	-	-	-	-	-	-	-	-
Bangladesh	144	92.9	2.6	190	4.1	57	47	5	7	36	39	2.3	10.4	5.5
Burma	677	34.9	2.2	169	5.0	33	48	12	13	55	39	5.0	4.7	5.6
Hong Kong	1	5.2	2.4	5340	9.9	4	-	26	-	57	-	-	-	-
India	3288	717.0	2.3	260	3.6	50	33	14	16	30	41	1.8	4.5	5.5
Indonesia	1919	152.6	2.3	580	7.7	54	26	8	13	32	35	3.8	13.4	9.3
Iran	1648	41.2	3.1	-	-	29	-	11	-	38	-	-	-	-
South Korea	98	39.3	1.7	1910	8.6	37	16	14	28	43	45	2.9	14.5	7.8
Malaysia	330	14.5	2.5	1860	7.7	36	23	9	18	46	47	5.1	10.6	8.4
Nepal	141	15.4	2.7	170	2.7	-	-	-	-	-	-	-	-	-
Pakistan	804	87.1	3.0	380	5.0	46	31	12	17	38	44	2.7	5.0	6.2
Philippines	300	50.7	2.7	820	6.0	26	22	20	24	46	42	4.8	6.6	5.2
Singapore	1	2.5	1.5	5910	8.5	4	1	12	26	78	62	1.6	9.3	8.6
Sri Lanka	66	15.2	1.7	320	4.5	32	27	15	15	48	46	3.2	2.4	5.2
Thailand	514	48.5	2.4	790	7.1	40	22	13	19	41	50	4.4	9.9	7.4

Source: World Bank, World Development Report 1984

Table 2. THE DEVELOPING ESCAP COUNTRIES

DISTRIBUTION OF MANUFACTURING VALUE ADDED AS AT 75 PRICES

	Ford and Agriculture	Textile & Clothing	Machinery & Transport Equipment	Chemicals	Other Manufacturing	Value-added in Manufacturing million of 1975 dollars 1970	1981	Per-Capita Value-added in 1981 (US $)	Manufactured Exports - (US $ million) 1962	1981
Afghanistan	-	-	-	-	-	25	37	2	9	-
Bangladesh	30	38	4	16	12	647	1290	14	-	448
Burma	31	14	1	4	50	287	456	13	3	1
Hong Kong	-	-	-	-	-	1620	4996	980	3	20076
India	13	18	20	14	35	10232	16190	24	642	4424
Indonesia	28	8	7	12	45	1517	5998	40	2	733
Iran	14	20	10	-	56	2601	-	-	44	-
South Korea	16	23	18	11	32	2346	10542	270	10	19188
Malaysia	21	8	18	6	47	941	2918	200	58	2359
Nepal	-	-	-	-	-	-	-	-	-	29
Pakistan	46	14	7	16	17	1492	2496	30	97	1439
Philippines	40	11	10	7	32	2816	5706	110	26	2552
Singapore	5	3	55	4	33	827	2556	1100	328	11712
Sri Lanka	46	10	-	-	44	556	714	50	6	218
Thailand	31	26	15	3	25	1676	4639	96	21	1869

Source: World Development Report 1982

Table 3. TRADE IN FOREST PRODUCTS OF DEVELOPING ESCAP COUNTRIES
(US $ million)

	Exports		Imports		Balance	
	1970	1981	1970	1981	1970	1981
Afghanistan	-	-	-	-	-	-
Bangladesh	*	7.4	*	26.6	-	-19.2
Burma	23.9	111.0	2.0	44.3	21.9	66.7
Hong Kong	8.3	64.0	7.4	10.7	0.9	53.3
India	14.7	26.6	85.0	571.5	-70.3	-544.9
Indonesia	88.0	1020.3	29.0	170.3	59.0	850.0
Iran	1.6	0.3	49.5	291.0	-47.9	-290.7
Korea	103.0	550.5	163.2	933.5	-60.2	-383.0
Malaysia	302.6	1713.0	31.2	226.5	271.4	1486.5
Nepal	2.4	11.0	-	-	-	-
Pakistan	0.1	-	16.4	79.8	-16.3	-
Philippines	290.5	421.5	31.5	73.3	259.0	348.2
Singapore	56.3	441.4	77.2	535.7	-20.9	-94.3
Sri Lanka	*	*	9.5	39.0	-	-
Thailand	11.0	27.8	26.9	264.2	-15.9	-236.4

Source: FAO Yearbook of Forest Products 1981

Table 4. PRODUCTION AND TRADE OF SELECTED FOREST PRODUCTS IN THE DEVELOPING ESCAP COUNTRIES

	Round Wood (million c.u.m.)				Sawlogs and Veneer-logs (million c.u.m.)				Ply Wood (million c.u.m.)			
	Production		Exports		Production		Exports		Production		Exports	
	1971	1981	1971	1981	1971	1981	1971	1981	1971	1981	1971	1981
Afghanistan	6.5	8.4	-	-	0.8	0.9	-	-	-	-	-	-
Bangladesh	8.6	10.9	-	-	0.9	0.6	-	-	*	*	-	-
Burma	21.1	27.2	0.1	0.1	1.7	36.0	*	*	*	*	-	-
Hong Kong	0.1	0.1	*	*	-	-	*	*	*	*	*	*
India	173.5	230.0	*	*	9.1	14.6	*	*	0.1	0.2	*	*
Indonesia	117.5	151.5	8.0	7.9	10.8	13.9	7.8	6.5	*	1.6	-	0.5
Iran	7.2	6.7	*	*	0.5	*	-	-	*	*	-	-
Korea	56.3	69.2	-	-	0.8	1.7	-	-	0.8	1.6	0.8	1.1
Mallaysia	28.1	43.5	12.1	16.3	18.7	31.5	11.4	15.9	0.2	0.5	0.1	0.5
Nepal	11.0	13.9	*	*	0.5	0.3	*	0.1	-	-	-	-
Pakistan	13.9	19.5	-	-	0.3	5.4	-	-	-	-	-	-
Philippines	31.2	34.8	9.9	1.6	10.7	5.4	9.6	1.4	0.6	0.5	0.3	0.4
Singapore	-	-	*	*	-	-	*	*	0.2	0.5	0.1	0.6
Sri Lanka	6.5	7.9	-	-	*	*	-	-	*	*	-	-
Thailand	29.1	38.1	0.1	0.3	2.7	1.8	*	*	*	0.1	*	*

* Quantity Small

Source: FAO Yearbook of Forest Products 1981

Table 5. INTER-INDUSTRY COMPARISON OF THE WOOD INDUSTRY IN SELECTED ESCAP COUNTRIES, 1975

(Direct Input - Output Coefficient)

	Forestary Sector			Number Sector			Wooden Products		
	Wages & Salaries	Value-added	Exports	Wages & Salaries	Value-added	Exports	Wages & Salaries	Value-added	Exports
Indonesia	0.166	0.879	0.081	0.091	0.461	0.061	0.177	0.351	0.001
Malaysia	0.184	0.870	0.001	0.160	0.515	0.444	0.126	0.436	0.302
Philippines	0.186	0.843	0.112	0.067	0.227	0	0.154	0.421	0.150
Singapore	0.411	0.411	0.128	0.241	0.241	0.076	0.170	0.170	0.049
Thailand	0.665	0.890	0.015	0.097	0.406	0.086	0.096	0.391	0.089
Korea	0.225	0.783	0.004	0.081	0.217	0.002	0.094	0.191	0.181
Japan	0.276	0.542	0.004	0.127	0.141	0.002	0.223	0.361	0.004

Source: Based on the Input - Output Tables prepared by the Institute of Developing Economies, Tokyo.

Table 6. A PROFILE OF FUEL ENERGY IN THE DEVELOPING ESCAP REGION

	Fuel Energy Reserves and Potential (proven reserves)			Commercial Fuel Energy Production, 1980 (1000 Ton)		
	Crude Oil (million barrels)	Natural Gas (billion cubic ft)	Coal (million toe)	liquid fuels	Solid fuels	Natural gas
Afghanistan	n.a	n.a	n.a	n.a	n.a	n.a
Bangladesh	-	7,000	519	-	-	1,164
Burma	n.a	n.a	n.a	n.a	n.a	n.a
Hong Kong	-	-	-	-	-	-
India	3,416	14,508	33,700	8,960	53,680	1,000
Indonesia	9,550	29,600	1,430	78,680	200	14,000
Iran	55,308	482,600	193	72,283	620	7,000
Korea	-	-	386	-	8,630	-
Malaysia	3,325	34,000	-	13,940	-	1,000
Nepal	-	-	-	-	-	-
Pakistan	196	18,540	-	500	620	5,000
Philippines	36	16	-	500	140	-
Singapore	-	-	-	-	-	-
Sri Lanka	-	-	-	-	-	-
Thailand	103	11,000	-	10	210	4

n.a -- Not Available

Source: The World Bank, The Energy Transition in Developing Countries (1983)

Table 7. WORLD PETROCHEMICALS PRODUCTION

BASIC PRODUCTS

(MILLION METRIC TONS)

	1965 (a)	1970 (a)	1975 (b)	1979 (b)	1981 (c)&(d)
- Ethylene	8.000	18.500	24.400	37.630	35.253
- Propylene	4.400	9.530	12.590	19.720	18.445
- Butadiene	1.900	3.130	3.445	5.060	8.201
- Benzene	4.780	8.820	11.310	17.180	16.501
- Xylenes	N.A.	N.A.	3.770	6.110	9.512
- Methanol	N.A.	N.A.	7.540	11.720	N.A.

Sources: a) First World-wide Study on the Petrochemical Industry 1975-2000 UNIDO/ICIS.83 12 December, 1978.

b) Second World-wide Study on Petrochemicl Industry: Process of Restructuring ID/WG.336/3 19th May, 1981 and Annex. Ref. ID/WG.336/3/Add.1 20th May, 1981.

c) The Development of Petrochemical Industries in the Developing Countries, Paper presented by UNIDO Secretariat at Joint UNIDO/OPEC/OPEC FUND Seminar on Petrochemicals Vienna 7-9 March 1983.

d) Hydrocarbon Processing, Gulf Publishing Co. USA, August 1983.

Table 8. WORLD PETROCHEMICALS PRODUCTION
END-PRODUCTS

(MILLION METRIC TONS)

	1960 (a)	1970 (a)	1975 (a)	1979 (b)	1981 (c)
- Plastics	7.000	30.200	38.500	41.165	37.436
- Synthetic fibres	0.700	5.100	7.500	10.040	12.069
- Synthetic Rubbers	2.000	5.900	7.400	6.390	8.494
- Detergents	3.500	9.000	10.800	N.A.	N.A.

Sources: a) First World-wide Study on Petrochemical Industry 1975-2000 UNIDO/ICIS 83 12 December, 1978. The individual product groups include all categories of products.

b) Annexes to Second World-wide Study on Petrochemical Industry: Process of Restructuring UNIDO ID/WG.336 3/Add.1 20 May 1981. The individual product group cover major products e.g. in case of plastics only thermoplastics are included.

c) The Development of Petrochemical Industries in the Developing Countries. Paper presented by UNIDO Secretariat at Joint UNIDO/OPEC/OPEC FUND Seminar on Petrochemicals Vienna 7-9 March 1983. The individual product group cover major products e.g. in case of plastics only thermoplastics are include

DEVELOPING ESCAP REGION

Table 9. PETROCHEMICALS EXISTING PRODUCTION CAPACITIES (BASIC PRODUCT)

(THOUSAND METRIC TONS)

COUNTRY	ETHYLENE			PROPYLENE			BUTADIENE			TOTAL		
	1977	1979	1980	1977	1979	1980	1977	1979	1980	1977	1979	1980
India	180	240	240	100	120	120	36	50	50	316	410	410
Iran	12	30	30	***	15	15	***	***	***	12	45	45
S.Korea	100	150	505	60	80	268	20	25	25	180	255	798
TOTAL:	292	420	775	160	215	403	56	75	75	508	710	1253

	XYLENES			BENZENE			METHANOL			TOTAL		
	1977	1979	1980	1977	1979	1980	1977	1979	1980	1977	1979	1980
India	17	40	40	69	150	150	33	33	33	119	223	223
S.Korea	***	50	50	100	110	155	390	390	390	490	550	595
Pakistan	***	12	12	***	5	5	***	***	***	***	17	17
TOTAL:	17	102	102	169	265	310	423	423	423	609	790	835

SOURCE: - First World-wide Study on the Petrochemical INdustry 1975-2000 UNIDO/ICIS.83 12 December,1978.
- Second World-wide Study on Petrochemicl Industry: Process of Restructuring ID/WG.336/3 dated 19 May,1981.
- The Development of Petrochemical INdustries in the Developing Countries, Paper presented by UNIDO Secretariat at Joint UNIDO/OPEC/OPEC FUND Seminar on Petrochemicals Vienna 7-9 Marach,1983.

*** Denotes data not available.

DEVELOPING ESCAP REGION

Table 10. PETROCHEMICALS EXISTING PRODUCTION CAPACITIES (END PRODUCTS)

THERMO-PLASTICS

(THOUSAND METRIC TONS)

COUNTRIES	P.V.C.			POLYSTYRENE			LDPE			HDPE			POLY PROPYLENE			TOTAL		
	1977	1979	1980	1977	1979	1980	1977	1979	1980	1977	1979	1980	1977	1979	1980	1977	1979	1980
Hong Kong	***	***	***	68	68	68	***	***	***	***	***	***	***	***	***	68	68	68
India	80	132	132	24	24	24	50	112	112	30	30	30		30	30	184	328	328
Indonesia	12	40	40	***	***	***	***	***	***	***	***	***	20	37	37	32	77	77
Iran	60	60	60	***	***	***	***	***	***	***	***	***	***	***	***	60	60	60
S.Korea	50	200	300	3	50	117	50	70	150		70	140	105	125	185	208	515	892
Malaysia	***	25	25	7	7	7	***	***	***	***	***	***	***	***	***	7	32	32
Pakistan	5	5	5	***	***	***	5	***	***	***	***	***	***	***	***	10	5	5
Phillipines	29	50	50	13	13	13	***	***	***	***	***	***	***	***	***	42	63	63
Singapore	10	10	10	***	***	***	***	***	***	***	***	***	***	***	***	10	10	10
Thailand	20	20	20	***	15	15	***	***	***	***	***	***	***	***	***	20	35	35
TOTAL:	266	542	642	115	177	244	105	182	262	30	100	170	125	192	252	641	1193	1570

SOURCE: - First World-wide Study on the Petrochemical Industry 1975-2000 UNIDO/ICIS.83 12 December, 1978.

- Second World-wide Study on Petrochemical Industry: Process of Restructuring ID/WG.336/3 dated 19 May, 1981.
- The Development of Petrochemical Industry in the Developing Countries, Paper presented by UNIDO Secretariat at Joint NIDO/OPEC/OPEC FUND Seminar on Petrochemicals Vienna 7-9 March, 1983.

*** Denotes data not available.

DEVELOPING ESCAP REGION

Table 11. PETROCHEMICALS CONSUMPTION (END-PRODUCTS)

PLASTICS

(THOUSAND METRIC TONS)

COUNTRIES	1965	1970	1975	1980*	INCREASE IN CONSUMPTION % ANNUM 1965-75	% ANNUM 1975-80
Bangla Desh	***	***	***	14	***	***
Hong Kong	75	150	165	193	8.2	3.2
India	55	110	150	252	10.6	10.9
Indonesia	11	65	145	295	29.5	15.2
Iran	50	100	200	141	15.0	-5.9
S.Korea	25	100	284	577	27.8	15.2
Malaysia	***	***	***	108	***	***
Pakistan	6	20	60	55	26.0	-1.7
Phillipines	37	100	125	93	13.0	-5.1
Singapore	10	25	60	75	19.8	4.6
Srilanka	***	***	***	8	***	***
Thailand	20	95	90	98	16.2	1.6
TOTAL:	289	765	1279	1909	16.1	8.3

NOTE : * 1980 Figures pertain to Thermo-plastics (PE, PVC, PS and PP)

SOURCE: - First World-wide Study on the Petrochemical Industry 1975-2000 UNIDO/ICIS.83 12 December, 1978.

- Second World-wide Study on Petrochemical Industry: Process of Restructuring ID/WG.336/3 19 May, 1981 & Annex. ID/WG.336/3/Add.1 20th May, 1981.
- The Development of Petrochemical Industries in the Developing Countries, Paper presented by UNIDO Secretariat at Joint UNIDO/OPEC/OPEC FUND Seminar on Petrochemicals-Vienna 7-9 March, 1983.
- World Petrochemical SRI International
- Market Study of Petrochemicals, ENAR Petrotech Services Limited (1980) Karachi Pakistan.

*** Denotes data not available.

DEVELOPING ESCAP REGION

Table 12. ACTUAL PETROCHEMICALS PRODUCTION

BASIC PRODUCTS

(THOUSAND METRIC TONS)

	ETHYLENE				PROPYLENE				BUTADIENE				T O T A L			
	1975	1977	1979	1980	1975	1977	1979	1980	1975	1977	1979	1980	1975	1977	1979	1980
India	47	57	102	102	33	37	58	58	5	6	7	7	85	100	167	167
S.Korea	96	87	185	373	59	56	111	208	15	13	26	57	170	156	322	638
TOTAL:	143	144	287	475	92	93	169	266	20	19	33	64	255	256	489	805

	XYLENES				BENZENE				METHANOL				T O T A L			
	1975	1977	1979	1980	1975	1977	1979	1980	1975	1977	1979	1980	1975	1977	1979	1980
India	15	15	30	30	56	64	75	75	25	30	30	30	96	109	135	135
S.Korea	51	86	99	120	36	56	65	103	59	175	317	212	146	317	481	435
Pakistan	****	****	****	-7	****	****	****	2	****	****	****	****	****	****	****	9
TOTAL:	66	101	129	157	92	120	140	180	84	205	347	242	242	624	616	579

SOURCE: - First World-wide Study on the Petrochemical Industry 1975-2000 UNIDO/ICIS.83 12 December,1978.

- Second World-wide Study on Petrochemical Industry: Process of Restructuring ID/WG.336/3 19May,1981 & Annex.Ref:ID/WG.336/3/Add.1 20th May,1981.
- The Development of Petrochemical Industries in the Developing Countries, Paper presented by UNIDO Secretariat at Joint UNIDO/OPEC/OPEC FUND Seminar on Petrochemicals Vienna 7-9 March,1983.
- World Petrochemical SRI International.
- Market Study of Petrochemicals,ENAR Petrochemical Ltd.(1980) Karachi Pakistan.

**** Denotes data not available.

DEVELOPING ESCAP REGION

ANNEXURE-VII-B

Table 13. ACTUAL PETROCHEMICALS PRODUCTION (END-PRODUCTS)

THERMO-PLASTICS

(THOUSAND METRIC TONS)

COUNTRY	P V C				P S				L D P E				P P				T O T A L			
	1975	1977	1979	1980	1975	1977	1979	1980	1975	1977	1979	1980	1975	1977	1979	1980	1977	1977	1977	1980
Hong Kong	***	***	***	***	***	40	50	60	***	***	***	***	***	***	***	***	***	40	50	60
India	42	57	59	100	9	15	14	11	51	47	100	98	***	***	20	25	102	119	193	234
Indonesia	8	10	25	25	***	***	***	***	***	***	***	***	***	***	***	***	8	10	25	25
Iran	15	15	20	20	***	***	***	***	***	***	***	***	10	15	20	20	25	30	40	40
S.Korea	68	124	225	237	13	33	38	47	64	64	112	201	60	108	100	146	205	329	475	631
Malaysia	***	***	10	15	3	4	5	5	***	***	***	***	***	***	***	***	3	4	15	20
Pakistan	2	3	4	4	***	***	***	***	***	***	***	***	***	***	***	***	2	3	4	4
Phillipines	8	12	20	25	7	8	10	11	***	***	***	***	***	***	***	***	15	20	30	36
Singapore	***	8	8	8	***	***	***	***	***	***	***	***	***	***	***	***	***	8	8	8
Thailand	10	15	15	15	***	***	8	10	***	***	***	***	***	***	***	***	10	15	23	25
TOTAL:	15	244	386	449	32	100	125	144	115	111	212	299	70	123	140	191	370	578	863	1053

SOURCE: - First World-wide Study on the Petrochemical Inudstry 1975-2000 UNIDO/ICIS.83 12 December, 1978.
- Second World-wide Study on Petrochemical Industry: Process of Restructuring ID/WG.336/3 19 May, 1981 & Annex. ID/WG.336/3. Add.1 20th May, 1981.
- The Development of Petrochemical Industries in the Developing Countries, Paper presented by UNIDO Secretariat at Joint UNIDO/OPEC/OPEC FUND Seminar on Petrochemicals Vienna 7- [illegible]rch, 1983.
World Petrochemical SRI International.
- Market Study of Petrochemicals, ENAR Petrotech Service Ltd. (1980) Karachi Pakistan.

*** Denotes data not available.

DEVELOPING ESCAP REGION

ANNEXURE-XXV-A

Table 14. PROJECTED PETROCHEMICALS DEMAND/SUPPLY (END-PRODUCTS)

(THERMOPLASTICS - 1990)

(THOUSAND METRIC TONS)

COUNTRY	P V C			H D P E			L D P E			P P			P S		
	SUPPLY	DEMAND	SURPLUS/ (DEFICITS)	SUPPLY	DEMAND	SURPLUS/ (DEFICITS)	SUPPLY	DEMAND	SURPLUS/ (DEFICITS)	SUPPLY	DEMAND	SURPLUS/ (DEFICITS)	SUPPLY	DEMAND	SURPLUS/ (DEFICITS)
Afghanistan	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***
Bangladesh	***	17.29	(17.29)	***	0.98	(0.98)	***	8.15	(8.15)	***	***	***	***	***	***
Burma	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***
Hong Kong	***	77.80	(77.80)	***	36.71	(36.71)	***	81.45	(81.45)	***	31.44	(31.44)	60.00	227.07	(167.07)
India	168.30	232.74	(64.44)	27.00	142.30	(115.30)	100.80	175.10	(74.30)	27.00	54.24	(27.24)	21.60	36.91	(15.31)
Indonesia	135.00	217.71	(82.71)	54.00	151.46	(97.46)	162.00	166.22	(4.22)	33.30	141.91	(108.61)	***	34.08	(34.08)
Iran	135.00	173.01	(38.01)	54.00	61.55	(7.55)	90.00	90.72	(0.72)	45.00	28.40	16.60	***	28.91	(28.91)
S.Korea	270.00	351.97	(81.97)	126.00	175.79	(49.79)	288.00	368.78	(80.78)	184.50	350.37	(165.87)	180.00	101.75	78.25
Malaysia	22.50	52.06	(29.56)	***	49.71	(49.71)	***	64.76	(64.76)	***	68.12	(68.12)	6.00	31.24	(25.24)
Nepal	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***
Pakistan	4.00	47.06	(43.06)	***	10.64	(10.64)	***	54.29	(54.29)	***	32.41	(32.41)	***	7.11	(7.11)
Phillipines	45.00	59.17	(14.17)	***	23.65	(23.65)	***	43.19	(43.19)	***	70.95	(70.95)	11.70	36.91	(25.21)
Singapore	***	37.86	(37.86)	72.00	18.92	53.07	103.00	30.23	77.77	90.00	70.95	19.05	***	34.08	(34.08)
Srilanka	***	10.78	(10.78)	***	***	***	***	4.88	(4.88)	***	***	***	***	***	***
Thailand	45.00	42.62	2.38	***	47.34	(47.34)	66.60	64.76	1.84	***	42.58	(42.58)	20.70	42.58	(21.88)
TOTAL:	824.80	1320.07	(495.27)	333.00	719.06	(386.06)	815.40	1152.53	(337.13)	379.80	891.37	(511.57)	300.00	580.64	(280.64)

*** Denotes data not available.

Table 15. The Chemical Industry in the Developing ESCAP Region :
(Value-added in 1981, at 1975 prices)

	Total Value-added in Manufacturing (US$ Million)	Value-added in Chemicals (US$ Million)	Chemicals as % of Total (%)	Per-capita Value-added in Chemicals (US$)	Per-Capita GNP (US$)
Afghanistan	N.A.	N.A.	—	—	—
Bangladesh	1,290	206	16	2.3	144
Burma	456	18	4	0.5	190
Hong Kong	4,966	N.A.	—	—	5,100
India	16,190	2,267	14	3.3	260
Indonesia	5,998	719	12	4.8	530
Iran	N.A.	N.A.	—	—	—
South Korea	10,542	1,160	11	29.7	1,700
Malaysia	2,918	175	6	12.5	1,840
Nepal	N.A.	N.A.	—	—	150
Pakistan	2,496	399	16	4.7	350
Philippines	5,706	399	7	8.0	790
Singapore	2,556	102	4	42.6	5,240
Sri Lanka	714	N.A.	—	—	300
Thailand	4,636	139	3	3.0	770
Total/Average	—	5,185	9.3	11.1	—
For Comparison					
U.S.A.	446,760	53,611	12	233.0	12,820
Japan	252,581	20,206	8	171.8	10,080

N.A. — Not Available

Source : Computed from data contained in World Development Report 1984

Table 16. Developing ESCAP region characteristics of petrochemical industry

Countries	Year	Value added '000 US$	Number of employees	Mean size of establishment
AFGHANISTAN				
Industrial chemicals	1980	-	3,830	3,830
Other chemicals	1980	-	402	80
Petroleum refineries	1980	-	-	-
Misc. petr. & coal products	-	-	-	-
Plastic products	1980	-	771	25
BANGLADESH				
Industrial chemicals	1979	44,673	5,300	279
Other chemicals	1979	55,166	23,750	67
Petroleum refineries	1979	1,609	450	450
Misc. petr. & coal products	1979	-	-	-
Plastic products	1979	386	640	23
HONG KONG				
Industrial chemicals	1979	34,476	1,500	12
Other chemicals	1979	62,298	5,400	12
Petroleum refineries	-	-	-	-
Misc. petr. & coal products	-	-	-	-
Plastic products	1979	416,532	87,900	19
INDIA				
Industrial chemicals	1978	736,109	165,000	106
Other chemicals	1978	849,799	262,000	79
Petroleum refineries	1978	138,967	10,000	303
Misc. petr. & coal products	1978	103,065	30,000	102
Plastic products	1978	736,109	165,000	106
INDONESIA				
Industrial chemicals	1979	129,760	12,700	128
Other chemicals	1979	95,840	38,100	132
Petroleum refineries	-	-	-	-
Misc. petr. & coal products	-	-	-	-
Plastic products	1979	22,240	16,500	76
IRAN				
Industrial chemicals	1979	34,340	2,240	172
Other chemicals	1979	186,883	13,970	155
Petroleum refineries	1979	577,251	18,400	1,314
Misc. petr. & coal products	1979	1,135	360	120
Plastic products	1979	112,669	11,710	94
REP. OF KOREA				
Industrial chemicals	1979	809,666	40,600	57
Other chemicals	1979	913,999	49,400	84
Petroleum refineries	1979	334,279	3,600	82
Misc. petr. & coal products	1979	188,419	12,300	42
Plastic products	1979	435,306	52,300	53

Table 16. continued

Countries	year	Value added '000 US$	Number of employees	Mean size of establishment
MALAYSIA, WEST				
Industrial chemicals	1978	57,476	3,700	46
Other chemicals	1978	73,034	8,600	63
Petroleum refineries	1978	75,627	500	100
Misc. petr. & coal products	1978	864	100	17
Plastic products	1978	41,487	11,500	73
PAKISTAN				
Industrial chemicals	1976	54,343	11,400	190
Other chemicals	1976	55,556	40,596	188
Petroleum refineries	1976	171,344	1,000	250
Misc. petr. & coal products	1976	303	125	125
Plastic products	1976	2,222	1,150	44
PHILLIPINES				
Industrial chemicals	1977	49,413	9,400	57
Other chemicals	1977	148,778	23,300	76
Petroleum refineries	1976	171,344	1,000	250
Misc. petr. & coal products	1976	4,834	100	11
Plastic products	1977	31,052	19,200	67
SINGAPORE				
Industrial chemicals	1980	50,935	2,140	48
Other chemicals	1980	142,056	4,270	48
Petroleum refineries	1980	686,916	3,340	334
Misc. petr. & coal products	1980	686,916	3,340	334
Plastic products	1980	81,308	9,150	47
SRI LANKA				
Industrial chemicals	1979	2,377	769	48
Other chemicals	1979	16,058	4,469	26
Petroleum refineries	1979	18,884	4,729	4,729
Misc. petr. & coal products	1979	193	291	291
Plastic products	1979	3,661	1,543	23
THAILAND				
Industrial chemicals	1975	119,237	7,979	80
Other chemicals	1975	126,593	25,951	108
Petroleum refineries	1975	352,193	2,266	453
Misc. petr. & coal products	1975	1,415	440	88
Plastic products	1975	23,462	3,821	41

Source: ASIAN INDUSTRY IN FIGURES
Statistical profile of key sectors in selected ESCAP countries.
UNIDO/IS.390, 15 June 1983.

Table 17. PRODUCTIVITY PERFORMANCE OF THE CHEMICAL INDUSTRY OF THE DEVELOPING ESCAP REGION: VALUE-ADDED PER WORKER

(US$ million)

		Industrial Chemicals	Other Chemical	Petroleum Refineries	Plastic Products
Bangladesh	(1976 - 77)	8,430	2,330	3,576	603
Hong Kong	(1979)	23,000	11,537	-	4,739
India	(1978)	4,460	3,244	13,897	4,461
Indonesia	(1979)	10,220	2,515	-	1,348
Iran	(1979)	15,330	13,377	31,372	962
Korea	(1979)	19,925	18,502	92,855	8,323
Malaysia	(1978)	15,534	8,492	151,254	3,607
Pakistan	(1976)	4,767	1,369	171,344	1,932
Philippines	(1977)	5,257	6,385	171,344	1,617
Singapore	(1980)	23,801	33,268	205,664	8,886
Sri Lanka	(1979)	3,091	3,593	3,993	2,374
Thailand	(1975)	14,944	4,878	155,424	6,140

Source: Based on Table 16.

Table 18. TRADE IN MANUFACTURED FERTILIZERS FOR THE DEVELOPING ESCAP REGION

(US$ million)

	Imports		Exports	
	1976	1981	1976	1981
Afghanistan	11.6	2.3	2.0	9.9
Bangladesh	63.1	108.9	-	8.1
Burma	1.1	58.2	-	*
Hong Kong	2.6	6.7	*	3.1
India	163.3	774.7	-	-
Indonesia	24.0	263.1	-	4.1
Iran	15.0	294.9	-	-
Korea	23.4	41.2	11.5	187.1
Malaysia	54.9	146.9	*	2.6
Nepal	3.7	13.9	-	-
Pakistan	74.6	356.1	-	-
Philippines	11.0	104.4	-	*
Singapore	23.4	92.5	24.0	89.2
Sri Lanka	9.0	62.1	-	-
Thailand	69.1	166.3	*	*

* Insignificant

Source: FAO Trade Yearbook 1982