UNITED NATIONS
ECONOMIC AND SOCIAL COUNCIL

Distr.
GENERAL

E/ECWA/XII/5/Add.5
13 February 1985

ORIGINAL: ENGLISH

ECONOMIC COMMISSION FOR WESTERN ASIA

Twelfth session
20-25 April 1985
Baghdad

Item 7(a) of the provisional agenda

PROGRESS MADE IN THE IMPLEMENTATION OF THE WORK PROGRAMME

INDUSTRIAL POLLUTION CONTROL IN THE ECWA REGION: EXPERIENCE AND PROSPECTS

85-0156

CONTENTS

Page

LIST OF FIGURES

I. OVERVIEW

1. Industrialization is the cornerstone of development strategies in the ECWA region. In oil-producing countries industrial development is predominantly oriented towards petroleum refining, petrochemicals, fertilizers and other petroleum-based industries, while in countries with diversified economies, food processing, textile, pulp and paper, and chemical industries represent over 80 per cent of total manufacturing income.

2. Pollution emanating from industry represents an emerging problem in the region. Uncontrolled emissions have destroyed fisheries, led to deteriorated water resources, impaired agricultural productivity and had a serious impact on public health and environmental quality.

3. In the past, the attitude was to down play the problem, and manufacturing operations were given a carte blanche to pollute the environment. The expectation was that gains in material well-being would exceed losses in environmental quality; expenditure on pollution control was looked upon as a cost to be borne out of financial resources which could be otherwise invested in productive development activities.

4. In the early 1960s, there was a change in attitudes as public concern about environmental deterioration led regulatory bodies to attempt to force industries to control discharges through imposing stringent regulations for end-of-pipe treatment. The concept was that basic processing practices would remain the same but treatment devices would be interposed to control pollutants' discharge into the environment. Industrialists resisted pollution control because they viewed waste treatment as costing money they could ill afford. Recently, however, new concepts began to develop regarding methods of continuing industrial development while simultaneously improving utilization of resources and alleviating pollution problems. The present approach is to continue relying on waste treatment when deemed necessary, but to give more attention to means of preventing generation of pollution which, after all, represents waste, both of the materials that are discharged into the environment and of those natural resources that deteriorate due to these discharges.

5. There is mounting evidence that pollution is a direct consequence of inefficient production practices in the region; if efficiency is improved, pollution would be simultaneously reduced. Over half the energy used in the region is wasted; this raises the temperature of water bodies and then reduces the dissolved oxygen which renders the streams less capable of sustaining aquatic organisms. Rather than investing in cooling towers which ultimately discharge the heat into the atmosphere,

attention should be directed to improving process efficiency and putting the residual heat to better uses such as heating greenhouses and industrial processes. In steel-making and agro-industries, processes are so inefficient that the waste generated does not fall far short of the processed products, which represents a drain of the finite raw material resources, a burden to the national economy and a direct financial loss to the enterprises. Reclamation of by-products from industry and domestic refuse may appreciably reduce the needs for other resources. Recycling of scrap in some ECWA countries has not only reduced the need for raw materials but also produced tangible reduction of production costs, savings in energy and water, and reduction of pollution emissions.

6. Whilst the idea of abating industrial pollution and conserving resources is now accepted in principle, industries in the region seem to be approaching the problem in a rather hesitant manner. What is needed now is to place more emphasis on the cost/benefit aspects of less waste technologies. The level of technology acquired by industry should not therefore be limited by shortage of capital, lack of qualified labour or incentives of short-term returns, but should rather reflect the need for environmentally-sound technologies which would undoubtedly result in long-term better profit margins for the industry and protection or even enhancement of environmental quality. The pursuit of Low and Non-Waste Technology (LNWT), particularly in countries with diversified economies and scarce financial resources, is a tremendous challenge which may involve the restructuring of industry, the modification of laws and, above all, changing the attitudes of government/industry towards industrial pollution.

II. ENVIRONMENTAL STRESSES OF INDUSTRIALIZATION

7. Industrial development imposes inevitable stresses in the form of health hazards, economic loss and esthetic nuisances. During the last decade, many ECWA countries accelerated their environmental concerns and passed legislation to control their environment. Unfortunately, most of that legislation was conceived theoretically and was brought about without due regard to the socio-economic conditions of the region. In addition, legislation was enacted to control "end-of-pipe" emissions without considering the environmental impacts of products when used by consumers and residues from products when released without control into the receiving environment. There are also indications that high-risk industries which face public opposition and stringent pollution control laws in the industrialized countries are moving to the region. Exportation of these high-risk industries may have long-term devastating environmental consequences, no matter how attractive the short-term economic gains seem to the community. For all these

reasons, industrial pollution cannot be regarded merely as a techno-economic problem, but should be dealt with as a priority national concern, and as such deserving of much broader in-depth consideration by all ECWA member States.

8. Health hazards of industrial emissions include exposure to high concentrations of toxic chemicals which causes poisoning and burns, or exposure to low doses for long periods which induces chronic diseases, cancers, sterility and reproductive problems. Arsenic from pesticides and glass manufacturing ties up active sites of cellular substituents and may also cause hyper-pigmentation and skin cancer. Boron is toxic for many organisms in concentrations as low as 1 part per million. Cadmium emitted from metal-finishing and ceramic industries causes serious cardiovascular diseases. Nitrate reacts with an oxygen-carrying pigment in the blood and leads to harmful physiological effects. Cyanides are extremely toxic as they inhibit the phosphorylative oxidation reactions which permit cellular respiration. Mercury and its compounds, especially methyl-mercury, have been associated with a number of poisoning episodes characterized by impaired hearing, vision and muscular co-ordination and, in some outbreaks, by high mortality. Lead, which is considered a global pollutant, can produce a variety of serious effects, including neurological disorders.

9. Particulates such as dust, smoke, and aerosols may have both acute and long-term health and environmental effects. These effects range from irritating the eyes and throat and reducing resistance to infection, to causing chronic respiratory diseases. Carbon monoxide released from incinerators and other industrial processes replaces oxygen in the blood stream and may impair vision, alertness and other mental capacities. Several crippling diseases are linked to asbestos exposure such as asbestosis and lung cancer, which has a 15 to 40 years latency. The exhaust from motor vehicles constitutes a serious health hazard as it forms photochemical oxidents responsible for smarting eyes, throat irriations and impairment of lung functions. Industrial air pollution also causes severe damage to monuments and works of art in areas close to sources of emission.

10. Uncontrolled disposal of hazardous residues from industrial complexes in the region may present serious environmental and health problems in the near future. Rain seeps through the land, carrying chemicals that contaminate underground waters and nearby streams and lakes, while toxic vapours released from evaporating liquids or uncontrolled chemical reactions cause air pollution problems. Recent vital statistics in Alexandria indicate that the infant mortality rate exceeds the average for the country, a reflection of the serious impact of environmental pollution. Typhoid, paratyphoid, infectious hepatitis and dysentery are all endemic in the city. Recent studies in Egypt have indicated that workers exposed to chemical

agents at levels lower than the internationally recognized Threshold Limits had some health impairments. This has been attributed to unfavourable climate, malnutrition, low socio-economic standards, high incidence and hypersensitivity and deteriorating public health conditions. Atmospheric chemical pollution (oxides of sulphur and particulates including heavy metals) is an emerging industrial pollution problem in Kuwait. The use of high sulphur (3.8 per cent) crude in the country was strongly objected to and will soon be replaced by one per cent gas oil. The capital investment of 339 million dollars and annual operating costs of 575 million dollars were considered cost effective based on health and envornmental considerations.

11. Measurable economic losses created by industrial pollution are estimated when they represent direct costs such as loss of materials, cost of treatment or decreased value of marketable fish. However, intangible costs such as impact on health, loss to tourism and esthetic damages are extremely difficult to quantify in monetary terms. The damage done by noise pollution, such as people moving away from noisy areas and the loss in property values, is not usually included as economic loss in the cost-benefit analysis.

12. Expanding population and industrial growth are influencing current environmental problems in the ECWA region and presenting new challenges. Rapid population growth coupled with extensive industrial development in the Gulf Co-operation Council (GCC) countries, for example, is putting severe strains on natural resources in this area. At the same time, economic constraints in other countries are hindering implementation of pollution control projects. Major industrial centres in the member States are shown in figure 1. In metropolitan centres which accommodate intensive, relatively high-technology operations, there is the potential for discharges of residual hazardous chemicals in the environment. This represents a serious problem for the existing water treatment works which are not designed to handle these persistent residues. These problems will loom larger as continued population and industrial growth will place more pressures on the limited natural resources and further limit the capacity of the environment to assimilate wastes.

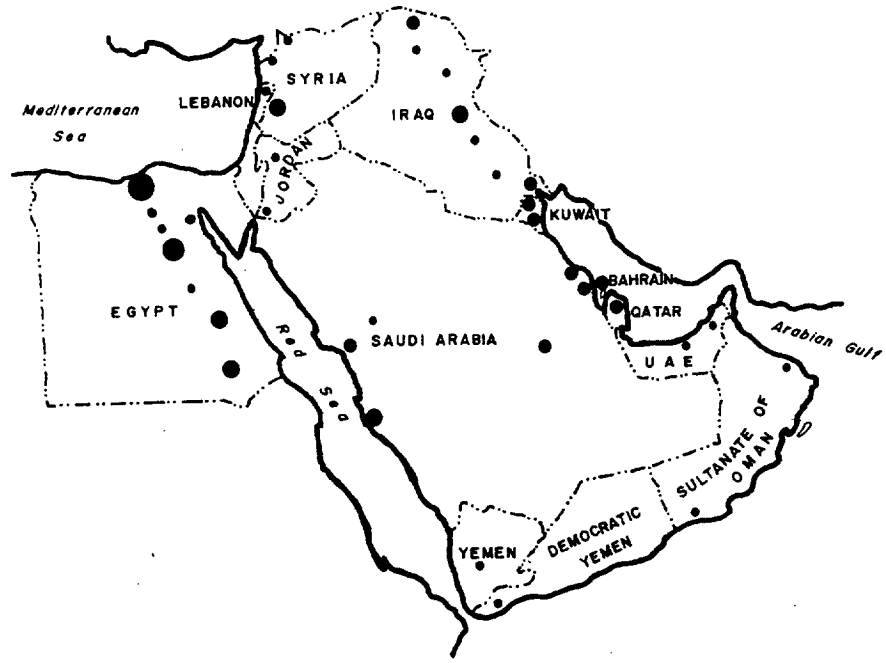

Figure 1. Major Sources of Industrial pollution in ECWA Region

III. PRACTICES OF INDUSTRIAL WASTE CONTROL IN ECWA MEMBER STATES

A. Bahrain

13. The Government realised from the outset that oil supplies were limited, and so a systematic policy of diversification into industry and switching to less energy-intensive production processes was adopted. At present, basic industries include topping refinery, primary aluminium, oil-associated gas processing, iron pelletizing, power, and shipping services for ultra-large crude carriers (ULCC); effluents from these industries are treated on-site prior to discharge into the Gulf. Future pan-Gulf heavy industrial projects to be sited in Bahrain are expected to adopt LNWT; these include heavy oil conversion, petrochemicals and an aluminium rolling mill. Most light industries are located in the capital city of Manama, where the major source of liquid pollution is agro-industry, which generates a load equivalent to 80,000 people (population equivalent). Industries within the city limits discharge their raw effluents into public sewerage for combined treatment in the Tubli wastewater purification plant.

14. The Government is pursuing a policy of siting all new industries away from existing residential areas. Bahrain's major industrial area is located close to Mina Sulman Port; it includes plastics, paper, steel-wool, wire-mesh and marine services. Aluminium assembly, block factories, cables and asphalt plants are located in another industrial area south of the primary aluminium plant. Industrial development on these entirely reclaimed areas demonstrates Government intention to reorient industrial growth in harmony with the environment.

B. Egypt

15. Industry generates about 15 per cent of the gross domestic product (GDP). The bulk of industrial exports consists of cotton-shipping, weaving and engineering products. Public sector plants dominate the output of basic industries such as textiles, food, chemical, fertilizers and heavy industries, while private industries, which account for 25 per cent of the total industrial output, tend to concentrate on light industries of relatively smaller size.

16. In general, few facilities exist for controlling water pollution and air emissions from industrial sources. Wastewater is discharged without adequate treatment into the Nile, lakes, sewers, drains or the Mediterranean. The impact of water pollution is evident in the decreased fishing catch from water bodies, deterioration of recreation areas, degradation of water resources, operational problems in sewerage networks and serious impacts on public health and amenities available for people. Air emissions from industrial sources are mostly uncontrolled. Many industrial establishments generate solid and hazardous wastes and contract out the disposal of their residues to private concerns, who dump the wastes indiscriminately in unauthorized sites or burn combustible matter in open areas.

17. Total projected industrial wastewater discharge for 1985 is 4.74 billion m3/y (cubic metre per year) of which approximately 85 per cent is cooling water for power generation (see figure 2). According to the current prices, capital cost needed to treat industrial effluents to render them suitable for agricultural pruposes is about 1.5 billion L.E. (Egyptian pounds). The total annual cost for debt service, operation, and maintenance is estimated to be L.E. 135 million. The unit treatment cost of industrial wastewater, other than power generation, ranges from L.E. 0.04/m3 to L.E. 2.05/m3; these comparatively high costs do not justify treatment for the sole purpose of agricultural reuse. However, the bulk wastewater from power generation can be treated at a low cost of about L.E. 0.004/m3 for irrigation reuse.

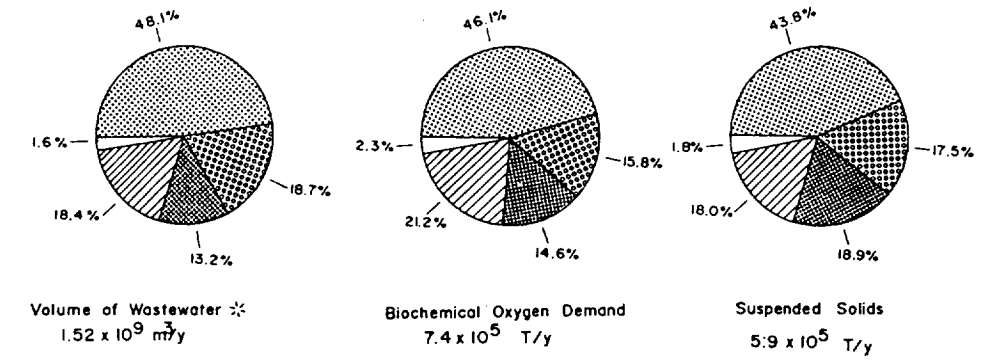

Figure 2 Industrial Liquid Pollution From E C W A Countries

18. The concentration of labour-intensive industries in densely populated metropolitan centres has led to an imbalance in ecological conditions and widespread deterioration of environmental quality. Alexandria alone has over 40 per cent of the Egyptian industry. The amount of industrial wastewater discharged to the Mediterranean is about 330 million m3/y. The pollution caused by industry has already reached an alarming level (Suspended solids ss 81,000 t/y, Biochemical Oxygen Demand BOD 60,000 t/y, Oil 15,000 t/y, Chromium 27 t/y, Mercury 10 t/y). Industrial solid wastes in Alexandria amount to 1.3 million t/y. Despite successful reclamation schemes for glass, paper, textiles and tyres, several hazardous residues are being disposed of incorrectly. Non-recyclable hazardous sludges are being dumped in open sites close to populated areas or intentionally disposed of into the sewerage system, which creates problems for the sewerage network and causes frequent disruption of the treatment works.

19. Industrial air pollution in Egypt diminishes the land value and restricts development. The Helwan area, presents a vivid example of environmental deterioration as cement, steel and chemical industries cause appreciable air pollution. Particulate emissions have caused crop decline, death of plants and serious pollution to the Nile. Other sources of air pollution

are sugar plants in Upper Egypt, the aluminium plant in Quena, coke production in Tebbin, the fertilizer plant in Talkha, and chemical and cement factories and tanneries in Alexandria. Gaseous compounds such as carbon monoxide, ammonia and partially burned hydrocarbons exceed emission standards in most industrial complexes in Egypt.

20. Undeniably, any plan for industrial pollution control should be cognizant of the economic, technical, and manpower limitations in Egypt. Because of this, waste control activities should be realistically planned to concentrate efforts on priority polluting industries. At present, the General Organization for Industralization is expected to install pollution control equipment in about 50 major plants during the next five years. The first group of priorities includes dyestuffs, food and chloralkali in Alexandria, fertilizer in Talkha, sugar in Upper Egypt and six cement production plants in various parts of the country.

C. Saudi Arabia

21. Recognizing that oil is an exhaustible resource, the Government has embarked on an extensive industrial development programme to replace the diminishing oil reserves with a permanent industrial base. Spending on the first three development plans has surged from $18 billion (1970-1975) to $150 billion (1975-1980) to an estimated $300 billion for the current plan of 1980-1985. About 37 per cent of the budgeted fund is being invested in industrial and economic development projects.

22. While pollution emanating from existing industries in Jeddah and Riyadh has an appreciable environmental impact, the Government is avoiding this situation for new industrial projects through proper siting, provision of pollution control equipment and monitoring of emissions and, most important, selection of appropriate technologies which produce minimum environmental disruptions.

23. Major plants of the Jubail Industrial Complex (JIC) are provided with on-site treatment facilities. Pre-treated effluents receive a final treatment in a conventional activated sludge plant which is followed by rapid sand filtration and ozonation. The expected flow in 1986 is 60,000 m3/d, and the ultimate flow in 1999 is estimated at 125,000 m3/d. Part of the treated effluent will be used for irrigation and the remainder will flow to the Gulf. The Yanbo Industrial Complex includes two oil refineries, a natural gas liquification plant, a lub oil plant and a petrochemical plant. Two centralized waste treatment plants with a total capacity of 36,000 m3/d will purify the combined effluent for further use in irrigation and landscaping.

24. Existing refineries in Saudi Arabia are located in Ras Tanura, Jeddah, Riyadh and Rabigh. The combined population equivalent of the refineries is 200,000. Another source of pollution is the huge amount of ballast water discharged to the Gulf (260 million m3/y), which contains about 390,000 t/y oil.

25. Through the Ministry of Industry and Electricity and the Saudi Industrial Development Fund, private industry has been encouraged particularly in industrial estates of Jeddah, Riyadh and Dammam. Industrial effluents from the Jeddah area are treated in a series of evaporation ponds, but some reach groundwater through percolation. The contents are periodically dumped into the desert. Effluents discharged from the Riyadh and Dammam industrial areas into sewage treatment works are about 30,000 and 8,000 m3/d, respectively.

26. In 1983, water produced by desalination was 2.2 m3/d. The four largest plants are located at Jubail, Al-Khobar, Jeddah and Yanbo. No information is available concerning the impact of thermal pollution on aquatic life; however, an incident of fish-kill has been reported and was attributed to overchlorination of the desalination plants' feedwater.

27. In 1980, about 60 per cent of the natural gas produced in the country was flared which resulted in an estimated emission of 2 million t/y sulphur dioxide SO2. The flaring practice caused serious air pollution in addition to wasting valuable resources; this prompted the Government to establish new industries to utilize the wasted gases for production of liquefied petroleum gas, urea, methanol, ethylene and other organic chemicals. At present, there are three operating gas plants at Berri, Uthaniyah and Shedgun which capture most of the SO2. According to 1984 estimates, the quantity of SO2 produced by flaring has been reduced to 0.4 million t/y only.

28. The information provided by the Meteorological and Environmental Protection Administration (MEPA), indicates that air pollution represents a serious problem in the Kingdom. Cement and mineral processing plants cause severe air pollution, especially in Riyadh and Jeddah, where urban growth has resulted in industrial facilities being encroached upon by residential areas. It is interesting to note that the Jeddah cement plant has been moved to a new site in Rebigh as retrofitting the old works to meet standards of air emission would not be economically feasible. The Kingdom does not enforce controls on emissions of lead, hydrocarbons, carbon monoxide and nitrogen oxides from motor vehicles which increased twentyfold during the last decade to reach 3.5 million units in 1984. Air emissions from traffic pose a potential health hazard as the gasoline used in the country contains one of the highest lead levels in the world, 840 part per million.

29. The amount of hazardous wastes generated in JIC was about 32,000 t/y in 1984 and will reach 341,000 t/y in 1996. Hazardous wastes consist mainly of inorganic sludges (brine, oily scales, desalter solids from petrochemicals, steel, copper and sulphur industries), organic liquids (oil skimming, spent monoethanolamine, hydraulic fluids and waste paints) and organic sludges (air flotation sludges, tars, heavy ends and polyethylene benzene). On-site incineration, transport or disposal of hazardous wastes outside the complex are prohibited. A new area in the general landfill of JIC has been set aside for interim storage of these wastes, while a feasibility study is underway for establishing a centralized treatment facility which encompasses an incinerator, sludge dewatering unit and landfill.

D. Kuwait

30. In the last two decades, there has been a marked acceleration of industrial development in Kuwait. The exploitation and sale of oil have resulted in the accumulation of massive revenues which in turn have stimulated and sustained rapid industrial growth. Most of the emerging industries are petroleum-based, with heavy industries being concentrated in the Shuaiba Industrial Area (SIA) south-east of the capital city.

31. SIA now accommodates 30 industrial plants (power and desalination, refining, petrochemicals, fertilizer, cement, plastics, paper, canning, asbestos, insulating materials, construction and fabricated steel). Concentration of major industries in SIA has created appreciable pollution problems within the area and in the nearby villages.

32. Several small industrial establishments are currently operating in Kuwait, mainly in the Shuwaikh Industrial Zone and the newly developed Subhan Industrial Estate. These industries include food, chemicals, paper, furniture, fish canning, metal and engineering workshops. The industrial zone is not provided with a sewerage system and effluents are discharged to the sea through a drain or trucked for further dumping in the sea, desert or the city sewer system. In addition, oilfields are spread out in various places, mostly in close proximity to the populated centres south of the capital.

33. Most industries in SIA are equipped with on-site pre-treatment facilities. However, their performance has yet to meet the stringent effluent criteria of SIA, which has been developed specifically to protect the sea-water quality required for the guaranteed operational reliability of the nearby desalination plants.

34. More than 95 per cent of the solid industrial wastes are disposed of on land, while the remaining part is discharged for draining, leached into a ground system or burned in the

desert. Spent catalysts are stored for potential sale or recovery in the future. In addition to the 2.1 million t/y sludge produced by all industrial activities in Kuwait, the Kuwait Oil Company generates 4.6 million t/y of crude oil suspension with less than 1.1 per cent oil content from its fields in Wafra and Burgan. These wastes are currently disposed of in lagoons in the desert. More oily and toxic wastes are expected to be produced in the future due to the continued industrial expansion in Kuwait.

35. A recent study by the Kuwait Institute for Scientific Research (KISR) concerning handling of hazardous wastes recommended the following:

- Neutralization of caustic and acidic wastes from power stations;
- Mixing with brine waste prior to discharge to the sea;
- Application of oily wastes to farm land;
- Incineration of organic wastes.

Wastewater renovation and reuse in Kuwait is expected to bring about the following benefits:

- Containment of pollutants;
- Conservation of the desalinated water through multiple reuse;
- Improvement of seawater quality and protection of the marine ecology.

Another study by KISR has demonstrated the amenability of the combined SIA effluent to biological treatment, and the possible reuse of the treated effluent in industrial processes or irrigation of environmental forestry.

E. Jordan

36. Rapid increases in water requirements and pollution associated with the social and technological developments of Jordan during the past decade have presented a challenge to those concerned with environmental protection and provision of adequate water supplies to meet the domestic and industrial needs of the country. The urban area of Amman - Zerqa which occupies the upper watershed of the Zerqa river is densely populated and accommodates several major industries such as phosphate mining and beneficiation, soft drinks and alcoholic beverages, tanning, pulp and paper, textiles, soap and detergent, and chemical industries. Underlying this area is the extensive Wadi Sir Aquifer which is still underexploited and, if properly managed, could provide a considerable part of the total water supply. Most industries in the area are currently disposing of their effluents without treatment into adjacent watercourses, or by direct land application. Exceptions are the

paper mill, phosphate plant and tannery, which operate earthen wastewater impoundments. Measures should be implemented to protect the Zerga river and Wadi Sir Aquifier against pollution from municipal and industrial sources. Total effluent flow from the 43 industrial establishments in the area is estimated at 2.5 million m3/y of which 21 per cent is cooling water.

37. The coastline of Jordan extends from the extreme northern end of the Gulf of Aqaba for a distance of 27 km down the southern stretch till the border town of Al-Derrah. Along this southern coast major industrial projects are being developed. The Jordan Fertilizer Plant produces diammonium phosphate, phosphoric acid and aluminium fluoride. The plant generates about 5,000 t/y of by-product gypsum, which is stockpiled in the area, while process effluents are disposed of in a nearby cooling pond. Emissions from the site also include toxic metals, residual acidity and fluorine; all are potentially harmful and would bring about environmental hazards, especially in the natural path of the valley. The Jordan Timber processing Plant emits air pollutants in the form of dust, SO2, urea and phenol formaldehyde. The Jordan Electricity Authority will commission two thermal power plants (130 MW each) in 1986, and another two (320 MW each) in 1990. These power plants are anticipated to create thermal and air pollution problems, the magnitude of which cannot be assessed at this time.

F. Iraq

38. A comprehensive industrial and economic development programme was launched in Iraq in the early 1970s. A concomitant environmental protection scheme was developed at the same time to alleviate the adverse effects of the extensive industrial and construction activities all over the country. Labour-intensive industries are mainly concentrated in Baghdad, in the north (Mosul) and south (Basra) regions. The concentration of major industries in these areas has placed a tremendous burden on water resources and aggravated environmental pollution problems. The impact of industrial pollution is evident in the deteriorated water quality in the vicinity of direct industrial discharge, problems in sewerage and sewage treatment works, and degradation of air quality, especially in areas close to oil refineries and cement plants.

39. During the period 1985-2000, the total demand for industrial, agricultural and domestic uses will increase from 39.5 billion m3/y to 59.6 billion m3/y with an average non-consumptive return of 37.6 per cent. In the year 2000, the projected return flow is 22.3 billion m3/y, about half in the form of discharge of power plants, 41 per cent from irrigation return and 9 per cent from industrial and domestic sources.

40. Industrial effluents are discharged into water bodies and, in smaller quantities, into sewerage networks. They are laden with pollutants which pose health hazards and may interfere with beneficial uses of Iraq's watercourses. Industries in Baghdad, which include an oil refinery, tanning, dairies, textile, cement, abattoirs, wool-finishing, poultry processing, power, edible oil, beverage and plastics, are disposing of their liquid effluents in the Tigris. For the most part, this practice does not conform to Iraqi limitations on liquid discharges into rivers. The estimated population equivalent of industrial and irrigation return effluents in Baghdad, based on organic loading, is about 1 million. The present population equivalent of the Mosul industries (sugar, yeast, dairies, breweries, textile, tanning and soft drinks) is 300,000.

41. Treatment of complex chemical wastes in Iraq is still accomplished by "typical technology" such as precipitation and biological treatment. In view of the ineffectiveness of such treatment for removal of persistent toxic matter, it is advisable to use "tailor-made" treatments such as removal of sulphides from tanning waste by CO2 flue/gas, complexing of cyanide with ferrous compounds, extracting phenols with solvents and precipitating metals with chemicals.

42. Ordinance No. 25/67 on the protection of rivers and water resources from water pollution sets the maximum allowable pollutant concentration and it stipulates that any industrial establishment is to pre-treat its effluent prior to the discharge thereof regardless of quantity. The ordinance is not strictly enforced, and several public industries were either granted exceptions or given extended grace periods to solve their pollution problems.

G. Oman

43. Until recently, activity in the manufacturing sector was very low. Visible activities were only in the food processing, power and light industries. However, during the past five years concerted efforts have been made to increase industrial development in the country. With increased foreign exchange earnings from oil, the government has been able to finance new industries such as refining, cement and chemicals.

44. The existing industries are mostly located in the capital city of Muscat (power, dairies, grain mills, soft drinks, poultry processing and canning), while new establishments are housed in a new industrial centre 40 km west of Muscat. Some small agro-industries and a new cement plant are located in the southern province of Salalah. In general, few or no facilities exist for controlling industrial emissions; effluents are disposed of on land and air emissions are uncontrolled. However,

they pose a minor environmental impact since they are released in small amounts.

H. Qatar

45. Major industries are located in the Umm Said industrial complex (refining, petrochemicals, power, iron and steel, and fertilizer). A large cement plant is located south of Dukhan on the west coast of Qatar. Light industries are located in the capital city of Doha (soft drinks, dairy, poultry, grain mills, workshops, etc.), and their effluents are discharged to the city sewerage network for combined treatment in the Naijah wastewater purification plant. Most industries in Umm Said have end-of-pipe treatment facilities and the treated effluents are either utilized for landscaping or discharged to the Gulf. At the oil terminal, about 35,000 t/y of oily sludge is produced and incinerated in an open pit, which creates serious air pollution problems in the area.

I. United Arab Emirates

46. Several industrial plants are dispersed in major cities: Abu Dhabi (power, refining, dairies, soft drink, steel), Dubai (refining, power, cement, dairies, soft drink), Sharjah (cement, soap, beverage, dairies), Ras Al-Khaimah (cement, steel) and Al-Ain (power, cement). In addition, two major industrial complexes are being developed in Dubai (Jebel Ali, which houses aluminium and natural gas plants) and in Abu Dhabi (Kawaisin). Cement plants are generally equipped with electrostatic precipitators for dust recovery. The aluminium plant recovers most of the emitted fluoride for recycling as a catalyst. Most light industries within the major cities pretreat their effluents before discharge into the municipal system, while refineries, power and aluminium plants discharge their treated effluents directly to the Gulf. At present about 15,000 t/y of oil sludges from the inverted underwater storage vessels are released to the sea. As this practice causes serious pollution problems, sea disposal should be stopped and replaced by an appropriate disposal method.

J. Syria

47. Initiatives toward industrial development were taken at the beginning of this century, but it was not until the 1950s that the actual industrial development of the country began. Refineries are located in Homs and Baniyas while textile, fertilizer, soap, glass, cement, food processing, sugar and mechanical industries are dispersed in the major cities (Damascus, Homs, Aleppo and Hama). Industrial development aimed at satisfying domestic demands was until recently based on outdated technologies and made no provisions for emission control. As a result, large industrial centres suffered increased environ-

mental impoverishment through air and water pollution. The institutional set-up for management of industrial pollution does exist in Syria, but its capability and effectiveness is still limited. However, major sources of pollution have been identified, and serious efforts are being made to bring the situation under control by gradually introducing control measures to the existing industries and subjecting upcoming industries to more stringent controls.

48. The presence of three oil terminals and a large oil refinery and the corresponding risks of spillages from ships using the ports of Lattakia and Tartous may pose a threat to the coastline and to the local environment. Syria has not yet implemented an oil spill contingency plan although there is evidence of long-continued oil pollution of the beach and rocks of the breakwater. In meeting the rising threat to environment due to growing industrial effluents, a proposed law for the prevention of water pollution was placed before the Council of the Prime Minsiter in November 1982 which is in the process of ratification. The main features of the proposed law are as follows:

- All effluent discharges will require a licence;

- The licence will set out conditions as to volume and quality;

- Industrial discharges into sewers will require a licence from the sewerage authority (or the department of water pollution control);

- The maximum penalty for contravention of the licence conditions will be a fine (not exceeding L.S. 30,000) and/or up to one year imprisonment and payment of compensation for any damage caused by the pollutors.

K. Lebanon, Yemen Arab Republic and Democratic Republic of Yemen

49. It was difficult to assess the status of industrial pollution in Lebanon in view of the prevailing conditions in the country. It is also believed, that the level of industrial development in the Yemen Arab Republic and the Democratic Republic of Yemen does not warrant assessment of sources and impacts of industrial pollution in both countries.

IV. PERSPECTIVE ON ENVIRONMENTALLY SOUND TECHNOLOGY IN THE ECWA REGION

50. Most ECWA countries have been endeavouring to accelerate their industrial development. Considering the potential impact of this rapid industrialization and the ever increasing numbers and quantities of undesirable accumulative pollutants released into the environment, the urgent need to adopt LNWT becomes apparent.

51. Some countries in the region, especially those with long industrial experience, still rely on conventional, mostly outdated, technologies which utilize large amounts of raw materials, consume considerable energy, generate large quantities of waste and usually yield inferior end-products. Modernization of existing processes and introduction of LNWT could lead to overcoming the above-mentioned deficiencies at one step.

52. Recognizing the importance of LNWT, a report by UNEP/FAO on residue utilization (1977), recommended that "each country and industry should establish definite feasible residue utilization strategies that reflect realistic social, economic and technical goals. The strategy must be compatible with environmentally sound decisions that reflect existing physical, human and other resources."

53. Analysis of the situation in the region indicates that major constraints to adoption of LNWT arise from the following: lack of complementarity in production; inadequacy of industrial infrastructure; domination of less developed technologies; lack of knowledge of environmentally sound processes coupled with a reluctance to adopt processes which have not been previously tried; and prevalence of a climate in which investment in industrial modification and research is limited. In order to overcome some of these constraints, concerted government and industrial efforts should be aimed at encouraging recycling of used feedstocks, purification on by-products to be used in other processes, provision of grants for investment in cleaner technologies and linking up of various industrial, agricultural and urban activities in an integrated system so as to permit reuse of waste from one process as input into another. Governments can also promote LNWT through taxation of wastes and removal of subsidies to production inputs. Taxation of wastes may play a decisive role in encouraging pollutors to invest in LNWT to reduce generation of wastes. Present government policies which ensure a continuous supply of cheap energy, water and raw materials implicitly encourage wastage of resources and continued reliance on polluting technologies.

54. Pollution is created by wasting raw materials, energy, water, intermediates and finished products. It reflects the low level of production efficiency, inappropriate housekeeping, unskilled labour and inefficient management. Dealing with the effects instead of causes leads to costly curative rather than preventive approaches. Apart from the immense advantages of LNWT for conserving resources and alleviating pollution problems, it also minimizes the dependence on conventional waste treatment technologies which are subject to frequent operational failures, drops in efficiency and improper functioning.

55. Although the main concern of industry is development of new products rather than the introduction of new production systems, evidence indicates a growing interest in improving productivity and cutting production costs; this trust, by and large, is consistent with the aims of LNWT. However, LNWT should be extended to all phases of the manufacturing chain, which encompasses production and transportation of raw materials, processing of primary and final products, and recovery/recycling of used products. The concept of cleaner technology should be applied also to the manufacturing process itself through process design modifications, loss control, recovery and utilization of spent chemicals, operation control and good housekeeping.

56. In the comparatively industrialized countries of the ECWA region, the concept of LNWT is emerging particularly in the following areas: processes which require lower raw material inputs; technologies with less energy and water requirements; systems which reduce generation of wastes and processes which depend on waste from other production processes, either as raw materials or as energy source. The following examples are presented to demonstrate the accomplishments of LNWT in the region.

- An industrial-scale multiple water reuse system was implemented in a poultry processing plant in Egypt. The system involved chlorination of cooling water from compressors and its successive reuse as feed water for the chiller, pre-chiller, washer and finally for makeup in the scalder. Process water was purified alternatively by a pressure leaf filter. The bacterial quality of the processed poultry by the multiple reuse system was superior to the quality of the once-through system which utilizes prodigious quantities of potable water. The system offered reduction of water consumption of up to 60 per cent and substantial savings in energy, in addition to reducing the amount of effluent discharged into the waste treatment unit.

- Several dairy plants in the region convert whey and protein residues into industrial products through coagulation and ultrafiltration. Production of lactose is accomplished by microbial decomposition; the product is used for production of pharmaceuticals and ethyl alcohol.

- Increasing emphasis is being placed on sludge handling from petroleum refining. Landfilling has been subject to restrictions and criticism on environmental grounds. Refineries in Bahrain and Saudi Arabia are currently assessing "sludge farming" of oily refinery sludge which encompasses spreading sludge on soil and mixing followed by repeating the mixing at suitable intervals to ensure adequate aeration of the soil/sludge layer.

- A project is underway in Kuwait for recovery of urea from the effluent of the urea plant by means of desorption and hydrolysation. Ammonia will be recovered from purge gases and scrubbed in wash towers; diluted ammoniacal solution will be concentrated and reused in the process.

- There are large numbers of automotive batteries scrapped in the region each year. According to estimates from the GCC countries and Egypt, about 25,000 t/y of lead can be recovered at present. The refined lead of the scrapped batteries is being used as a substitute for imported lead in some battery factories in the region. This practice will undoubtly receive more attention in the future due to the escalating price of the imported lead.

- The Egyptian copper works in Alexandria depend mainly on imported scrap for production of 100,000 t/y of Steel, 20,000 t/y of Copper and 15,000 t/y of Aluminium. The number of vehicles in use in the region now is over 5 million cars. Despite the unreliability of data concerning scrapped vehicles, it is assumed that the average rate of scrapping is on the order of 5 per cent annually. Based on 75 per cent recovery, the amount of iron and steel scrap is about 200,000 t/y. These scrapped vehicles could be used efficiently as input to the steel plants in the region, provided that schemes for collection, recovery and transportation of pressed scrapped vehicles are economically justifiable.

- The recovery of chemicals from rice-straw black liquor was not possible in the past due to the high silica content which causes difficulties in the recovery process. Recent field studies in Egypt have demonstrated the feasibility of 95 per cent desilication of the black liquor using quick lime and plant flue gases as precipitating agents; this pre-treatment is expected to permit caustic recovery and recycling in the pulping plants.

57. The potential amount of industrial residues that could be recovered within the ECWA region cannot be accurately quantified because of lack of information concerning the total volume and characteristics of the generated residues. Estimated amounts of industrial solid wastes are shown in figure 3. Despite the above-mentioned limited recovery experiences, it is believed that significant amounts of waste material are still not recycled, reused or salvaged. Their disposal has been haphazard and unregulated in most member States. Since significant portions of these residues are toxic and hazardous, their improper disposal represents a serious environmental problem.

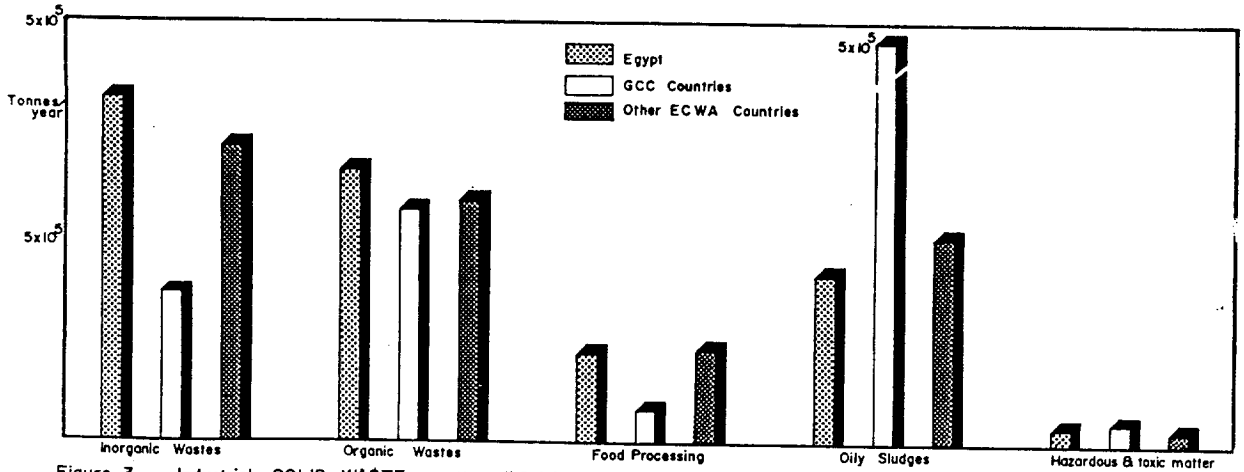

Figure 3. Industrial SOLID WASTE the ECWA Region.

58. There is considerable scope for material recovery and reuse if a mechanism for waste exchange can be developed in the region. Rising prices of raw materials, concerns about energy conservation and increased awareness of environmental pollution have made it attractive for industries to search for further uses for the recyclable components of their waste material. As local waste generators and users are not usually in a position to achieve effective exchanges among themselves, it seems possible that their requirements can be met through wider schemes of waste exchange. Two distinct types of waste exchange are in operation in the industrialized countries. These are "Information Exchange" and "Materials Exchange". The information exchange or clearing-house serves a specific function of linking interested trading parties without becoming involved in the transaction. Clearing-houses can be established in the region and sponsored by governments, trade associations or concerned

industries. By contrast, the materials exchange enterprises actually receive the waste, identify potential uses, reprocess waste as needed and resell them at profit. As materials exchange depends on highly competent technical and marketing skills they should preferably be sponsored by private entrepreneurs to ensure their effectiveness and efficiency in the long run. It is anticipated that widespread application of waste exchange in the region, in addition to eliminating major sources of pollution, will result in important savings in disposal costs, conservation of feed stocks and reuse of energy-rich materials such as oil and combustible residues.

59. When waste exchange institutions are established in the region, attention should be given to limiting their activities to management of scrap, waste chemicals, and leftover materials, and to avoid dealing with regular by-products with recognized economic value which are commonly handled through brokerages or commercial institutions. Some examples of wastes that can be readily exchanged in the region include waste lubricating oils, solvents, pickling liquor, spent catalysts from refineries, metal-rich slags, and waste phosphoric acid for use in the manufacture of fertilizers. Many of the wastes are substantially organics such as resins, oils, solvents, carbon filters and off-specification organic chemicals. In view of current fuel shortages and mounting energy costs in the non-oil producing countries, it seems opportune for waste exchange to explore the use of these combustibles in waste-to-energy facilities.

V. INSTITUTIONAL ORGANIZATION FOR INDUSTRIAL POLLUTION CONTROL IN THE REGION

60. Some ECWA countries have already incorporated management of industrial pollution within the framework of the existing environmental protection institutions, while others are giving serious thought to such organizational mechanisms. Unfortunately, considerable attention is given to passing strict standards and instituting elaborate regulations, while little has been done for control of industrial wastes and enforcement of anti-pollution laws.

61. Management of industrial pollution is a complex undertaking in the ECWA region, but in a real sense the issue does not become truly complicated until it gets down to the local level. And here is where the challenge regarding implementation lies. Complications often arise from various local constraints including organization, finance, legal jurisidiction, politics and socio-economic factors. It is therefore obvious that a working familiarity with and due consideration for the unique problems of the individual areas are necessary for development and implementation of a realistic pollution management

programme. The existing organizational set-up and measures taken by the member States for management of industrial pollution are highlighted below.

A. Bahrain

62. The Environmental Protection Committee (EPC) has been assigned the responsibility of integrating environmental considerations in development projects and instituting monitoring mechanisms for environmental quality. A technical secretariat is attached to EPC to implement its activities. The secretariat has just embarked on a programme for monitoring effluents from light industries in the country. Major industries (refining, aluminium, and iron pelletizing) are responsible for monitoring and control of their effluents, while the Public Health Directorate is involved in a limited programme for monitoring the impact of industrial pollution on air and water resources. It is hoped that EPC can co-ordinate these fragmentary efforts and put together a comprehensive scheme for management of industrial wastes in the country.

B. Egypt

63. The Ministerial Committee for Environmental Affairs has been recently replaced by the Agency for Environmental Affairs (AEA) which will function outside the purview of the existing ministries as it is linked directly to the Council of Ministers. AEA is entrusted with development of policy for environmental protection and conservation in Egypt.

At present, by law, all industrial emissions should be subjected to pretreatment before discharge. However, most plants still discharge their effluents without treatment, and the sewerage network has to bear the brunt of these excessive loads.

64. Control of industrial pollution is generally non-existent and, if present, it is only enforced on newly established industries. Problems hampering enforcement on existing industries include, *inter alia*, shortage of professionals and operators, lack of machinery and responsibility of residue control, shortage of financial resources, technical problems and inadequate legislation. To overcome these drawbacks, AEA will undertake the following actions:

- Development of a master policy to promote interim and long-term programmes for abatement of industrial pollution;

- Financing or offering of subsidies for research and development in areas related to industrial pollution control;

- Requesting environmental impact statements for all major industries as a prerequisite to granting permits;

- Proposing remedies for deficiencies in the existing management system;

- Development of manpower.

C. Iraq

65. The tasks of assessing impacts of industrial development projects and proposing measures to be incorporated in the implementation plans are vested in the Environmental Protection Council (EPC). In the meantime, the General Directorate of Preventive and Environmental Services (GDPES) is engaged in a nationwide programme to survey industrial activities with emphasis on pollution sources, in-plant controls and pre-treatment. Monitoring of industrial effluents is currently limited to the Baghdad area, with occasional interventions in problems in other provinces. A new strategy has been formulated in Iraq for industrial pollution control which has been based on three principles:

- Directing industrial growth towards new development centres in which environmental impacts are controlled through proper planning;

- Orientation of new industries to LNWT and more rational use of natrual resources;

- Strict enforcement of legislation to alleviate pollution and ensure environmental protection.

D. Jordan

66. There is no national institution responsible for formulating environmental policy. The Environment Department (ED) of the Ministry of Municipal and Rural Affairs is embarking on a programme for control of industrial emissions; the supporting legilsation has been finalized and submitted to the National Assembly. The existing programme for monitoring of industrial emissions is inadequate and provides inconclusive evidence concerning the status of industrial pollution in the country.

E. Kuwait

67. Decree Law 62/80 relating to the environment sets up an Environmental Protection Council (EPC), which is entrusted with setting scientific and health standards compatible with lifestyles and the industrial and urban environment. The strategy of EPC includes setting ambient standards for air, water and soil which can be used as a basis for establishing emission standards from various sources, limiting anticipated pollution problems by conducting environmental impact studies for the pro-

posed industrial and urban projects, and promoting comprehensive research on the use of industrial effluents and treated sewage for irrigation or other uses. It is probably in Kuwait that one finds an appropriate decentralized system for industrial waste management. While the Ministry of Public Health through its Environmental Protection Department (EPD) has been responsible for monitoring and control of industrial emissions from enterprises within the city of Kuwait, another comprehensive programme of industrial waste management has been undertaken by the Pollution Control Centre of the Shuaiba Area Authority. Both bodies have acquired over the course of several years considerable experience in monitoring and control of industrial pollution. Through their versatile expertise and monitoring capabilities they can offer invaluable advice on programme implementation in other ECWA countries.

F. Saudi Arabia

68. In accordance with its charter, MEPA has issued ambient standards for protection of environmental quality by limiting pollution emissions to air and water. Another set of standards will be issued in the near future for control of groundwater quality, noise and hazardous wastes. MEPA regulations require that major new industries and expansion of existing ones must be designed and operated in compliance with ambient and emission standards and stipulate incorporation of the best available pollution control technologies in the new industries. Also, MEPA can grant exceptions under special circumstances to non-complying sources, provided that such exceptions do not violate environmental quality criteria or pose a threat to public health.

69. As in Kuwait, the Kingdom is pursuing a decentralized approach for industrial waste management, with the Royal Commission for Jubail and Yanbo overseeing environmental protection according to specially developed environmental criteria for both industrial centres. The municipalities of large cities like Jeddah, Riyadh and Dammam exercise certain powers for enforcing local guidelines and regulations, and for granting discharge permits to industry. While these entities are not subject to detailed supervision by MEPA, they have to obtain MEPA consent for major administrative actions.

G. Oman

70. The Council for Environmental Conservation and Prevention of Pollution (CECPP) has the authority to review and propose emission standards, approve industrial projects and monitor pollution. Comprehensive legislation establishing environmental criteria and pollution prevention regulations is now being drafted. The technical secretariat for CECPP is responsible for executing monitoring and inspection programmes for all

sources of pollution as well as the protection of water resources, wildlife and marine environment. In view of the infancy of industrialization in Oman, and the limited emissions from industrial sources, development of a comprehensive monitoring scheme is not yet warranted.

H. Qatar

71. A Committee for Environmental Protection (CEP) was established in 1981 and empowered by law to formulate and implement an integrated environmental policy for the country. The Industry Technology and Development Centre (ITDC) is involved in a wide range of activities, including assessment of environmental impacts of new industrial projects, implementation of control measures in existing establishments and development of guidelines for pollution control. Industrial activities in Qatar are still relatively limited and emissions are viewed as a lesser environmental problem. However, it appears desirable that CEP should introduce and enforce specific pollution control measures to be duly incorporated in the industrialization plan in order to prevent the introduction of pollution-intensive processes and avoid potential detrimental environmental effects in the future.

I. United Arab Emirates

72. The Higher Committee for Environment is entrusted with co-ordination of environmental protection activities between the concerned government agencies and issuing the necessary guidance for protection of water resources and the marine environment. The Committee plays an advisory role, as local authorities can overrule its decisions and grant permits for industry. At present, management of industrial pollution is faced with a shortage of manpower, absence of legislation and emission criteria, lack of national institutions for policy formulation and absence of local entities for pollution management in major industrial complexes (Jebel Ali in Dubai and Rawaisin in Abu Dhabi).

J. Syria

73. There are fragmented legislative acts dealing with industrial pollution in the country. The limited information concerning emissions from industrial sources indicates that the problem is mainly confined to large cities and ports where major industries exist. The newly formed Ministry of Environment recognizes that the concentration of traditional industries in urban areas coupled with ineffective control of their generated wastes has become a major problem and is expected to result in increased environmental degradation. Several policy instruments are being devised to deal with industrial pollution, among which are emission standards, licences and permits, incentives to pro-

mote pollution control and direct charges on industrial effluents.

K. Regional Strategies

74. Evidence from the region indicates that management of pollution in major industrial centres of Saudi Arabia and Kuwait by independent entities has led to increased co-ordination among concerned industries and implementation of concerted actions for amelioration of pollution caused by their emissions. Similar experiences of the industrialized countries suggest that giving sufficient autonomy and power to specialized waste management organizations in industrial localities would ensure incorporation of appropriate environmental elements in the industrialization process and better handling of pollution problems.

75. When planning strategies for industrial pollution control in the region, decisions should be based on national commitment with due consideration to the people's needs. Industrial development should be non-destructive, and people should be party to the decisions affecting their quality of life and their vital interests. It is therefore recommended to establish Environmental Management Boards (EMB) in major industrial areas in the region. EMBs would comprise representatives of muncipalities, local councils and the concerned industries. The environmental policy of EMB may involve actions in four major directions:

- Corrective policies for on-site and/or centralized treatment of industrial emissions;

- Preventive policies directed towards upgrading maintenance practices, introducing in-plant controls, switching to non-polluting feedstocks, modifying equipment and product design, etc.;

- Protective policies such as increasing environmental awareness and adoption of incentives for pollution control;

- Resources conserving policies to streamline energy-intensive process loops, close water use cycles, countercurrent use of chemicals and regeneration of catalysts.

76. EMB should be empowered to impose charges, issue bonds, or take other necessary measures to cover the cost of administration, surveys, engineering designs, construction and operation of centralized waste treatment works. EMB will be of particular value in large cities and new industrial zones for the following reasons:

- A single authority is entrusted with the tasks of monitoring and control of pollution, as well as protecting the quality of the receiving environment;

- Local authorities will deal with one organization concerning environmental issues in the area, making possible the adoption of an integrated system for wastewater renovation and reuse, and a central facility for handling industrial residues and hazardous waste (such centralized schemes are illustrated in figure 4).

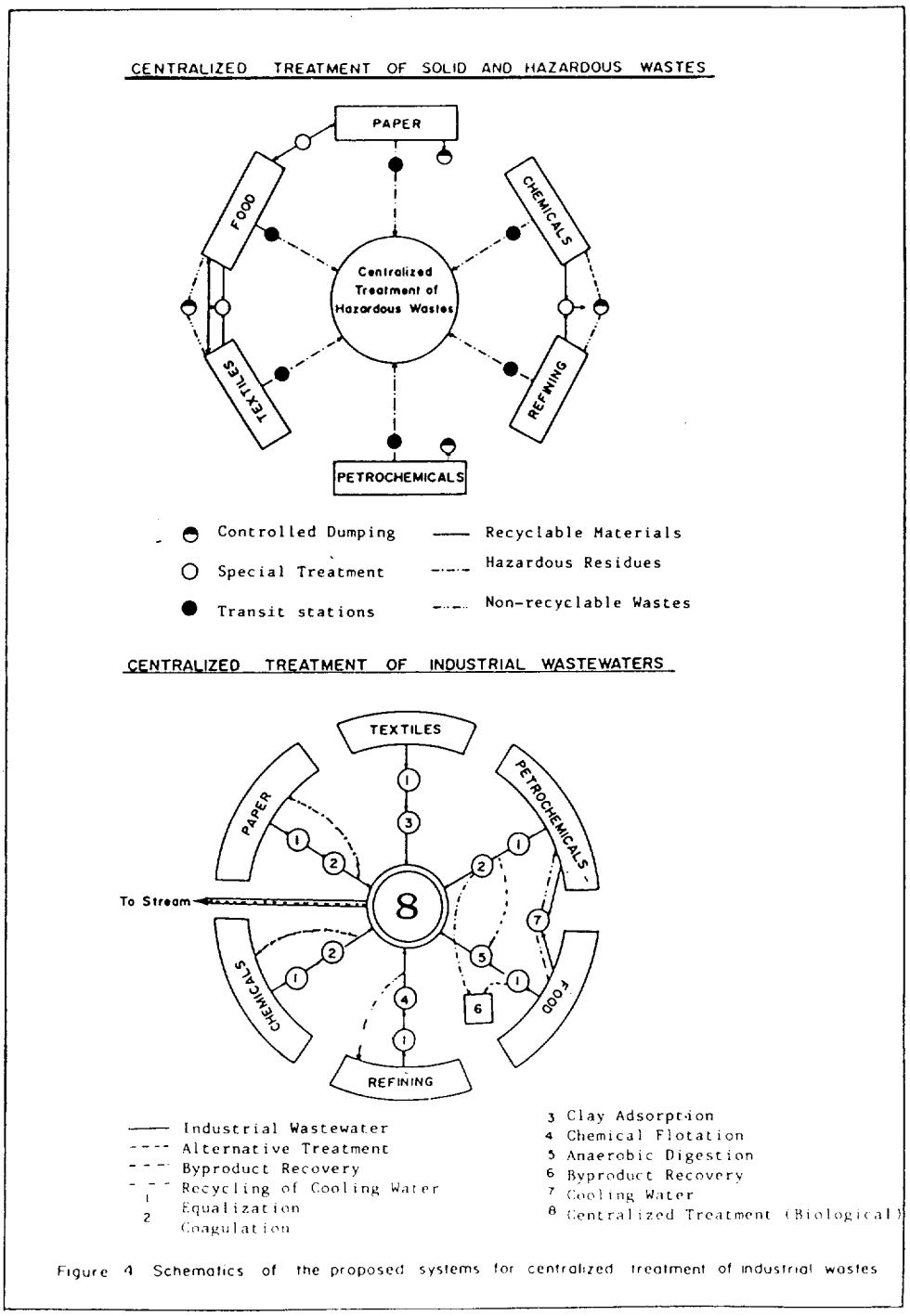

Figure 4 Schematics of the proposed systems for centralized treatment of industrial wastes

- Savings in capital and operating costs of centralized waste treatment works due to economy of scale;

- Ability to carry out comprehensive surveys and work out solutions to serve the best interest of the area;

- Ability to engage competent talents for programme implementation as pay schedules are usually better;

- Setting up practical guidelines for discharge of emissions from local industries;

- Better monitoring of the environmental quality in the district.

77. It is worth noting that handling effluents in EMB centralized treatment works may generate large amounts of produced gas to operate gas-driven generators; the effluent can be utilized in large irrigation projects and the sludge may be used as a basic fertilizer ingredient. The functions and duties of EMB can be implemented in two ways:

- Setting limits and regulations for discharge and dealing with violators through administrative actions (warning, permit modification or revocation) or judicial sanctions (injunctive relief or fines for incarceration). It should be noted, however, that resorting to court actions in the region rarely occurs and administrative measures did not play a significant role as effective deterrents.

- Another appropriate approach involves offering economic incentives or disincentives to industries within its jursidiction. Economic incentives encompass grants, loans or subsidies to promote development and implementation of new techniques for conservation of resources, control of pollution and improving product durability and recyclability. Most ECWA countries are now promoting this trend through offering industry long-term low-interest loans, subisidies, waiving taxes on imported pollution control equipment, and in a few cases offering direct incentives to plant managers to introduce waste control system in their operations. Economic disincentives involve taxing raw materials and energy inputs, deposits on recyclable goods, and fines for non-compliance with regulations which would eventually encourage improving production efficiency in order to minimize the economic burden of taxation. Economic disincentives serve another important purpose of internalizing the external costs created by polluting industries, and creating revenue sources for EMBs to enable them to carry out their functions and duties without reliance on governments' financial support.

VI. INDUSTRIAL POLLUTION CONTROL: REGULATORY POLICY AND ENFORCEMENT

78. Environmental legislation passed in recent years in the region has had an increasing impact on industry. Standards and limitations governing the release of pollutants into the environment are imposing new restrictions on manufacturing operations. Through its interdisciplinary technical teams, industry is expected to direct part of its capital and technological resources to identify and resolve environmental challenges. The solution of the myriad complex emission problems requires a change in methods of operation, development of new waste control technology, and substantial capital and operating costs. Some Governements in the ECWA region are cognizant of these costs and have already developed programmes to assist public sector industries in adopting new technologies and in financing capital facilities required to meet the stringent effluent standards. The intent of these Government programmes is twofold: to accelerate the compliance with emission standards and to minimize the short-term impact these costs might have on production economics.

79. Industrial air and water pollution problems have their unique approances and solutions. Restrictive standards necessitate high performance for emission control equipment. Ready-made solutions, which were applicable in the past, no longer suffice to meet the specific needs of present complex industries. Liquid wastes can be generally treated by chemical and physical methods with the expectation that the majority of the treated effluent can be recycled. Gaseous emissions can be removed by scrubbing, filtration, absorption and adsorption and the clean gas discharged into the atmosphere.

80. The objective of any operational system of effluent standards is to induce reductions in discharges so that environmental quality will be maintained. Standards are either direct and specify maximum limitations of pollutants' discharge or indirect and control pollution in terms of required production processes, limting types and/or quantities of inputs, and specifying final product outputs. Factors which should be considered in establishing discharge standards include, inter alia, ambient water quality criteria, assimilative capacity of the receiving environment, level of production technologies, variaiblity in generation of residuals, cost of pollution and its effect on profitability, potential for utilizing LNWT and the state of the national economy.

81. Pollution control legislation currently enacted in several member States does not give the necessary power for the enforcement agencies to control emission sources. The legislation does not specify practical and adequate penalties for violators and the procedures for issuing permits for discharge of industrial emissions are not properly followed in most instances. Industry expects that administration of standards will be reasonable, equitable, consistent and persistent. If there are any doubts concerning enforcement or evidence of favoritism, the ground rules for compliance will not be respected by the industrial management.

82. A review of industrial emission standards and the related control regulations currently enacted in the member States reveals the following facts:

- Standards are generally developed along the lines of those enacted in the industrialized nations, and as such they are not geared to the environmental conditions and technoeconomic capabilities of the region. There is a growing trend towards dissension as the standards are unreasonable, inconsistent, and economically unattainable.

- Effluent standards are based solely on pollutants' concentrations without appropriate reference to amount of discharge. This can lead to overload of the ecosystem as it basically responds to the total pollution load imposed on it.

- Industrial discharges into underground water bodies are, in general, not regulated. Standards should be devised for underground discharges, especially from leaching of industrial landfills and mine tailing sites.

- In many, if not most, cases unified standards are imposed on new as well as existing industrial activities. However, it is less costly for new activities to control pollution, compared with existing ones which should meet less stringent standards. This decentralized pragmatic approach is recommended provided that it will not lead to a status quo for pollution control in existing industries.

- Legislation does not encourage industry to design, build and operate LNWT. This trend can be promoted through implementation of a comprehensive permit system which specifies consent conditions for emission control and risks emanating from production processes. Penalties should be imposed to deter default on consent conditions without forcing concerns to go out of business. The challenge of the regulatory machinery is to set and implement standards high enough to enforce a moderate amount of coercion, while at the same time devising feasible ways to cushion the impact upon industry.

- Some regulations are outdated and do not fit new environmental changes in the region. Tightening or relaxing emission limits should be regarded as a dynamic process to meet new developments. As production continue to grow, as it typically occurring now in major industrial centres in the region, the reliance on the assimilative capacity reflected in standards developed in the past should be revised to reflect the rise in pollution loads. Enterprises must recognize that emission standards and pollution control regulations will very likely continue to be tightened in the future to match the accelerated industrial growth.

VII. POLLUTION CHARGE: INCENTIVE FOR ABATEMENT OF INDUSTRIAL WASTES

83. While it is difficult to assess the effectiveness and achievements of environmental legislation in the ECWA region at present, it is abundantly clear that lack of effective monitoring and enforcement mechanisms, the slowness of legal proceedings, the trivial penalties imposed on violators, the technical difficulties of introducing control measures and the practice of granting exceptions to public industries have all led to limiting the role of regulations in stemming the tide of pollution.

84. Pollution charges, which represent a payment by industry for use of the assimilative capacity of the environment, are currently being thought of as a viable option in reducing industrial wastes. Evidence in the region suggests that pollution charges and emission standards can adequately complement each other for effective control of industrial pollution.

85. A pollution charge is conceived as an economic incentive to promote waste control. However, its deterrent effect will diminish if the rates are not set high enough to encourage introduction of LNWT and reduction of discharges. If the charge is less than the marginal costs of abating pollution, there will be little or no incentive for industry to abate pollution and the charge simply becomes a tool of raising revenue to supplement governmental budgets.

86. A pollution charge depends on effluent flow and pollutants' content which generally includes BOD, SS, and possibly nitrogen, phosphorus, grease and toxic constituents. Once costs are apportioned among the waste-loading parameters, they can be allocated to individuals or groups of users according to waste loads. Methods of cost allocation and recovery include:

- <u>Users charge</u>. The system is based on the use of or benefit from the public waste treatment works where municipal and industrial wastes are combined and treated together. The

unit-user charge is expressed as cost/unit waste. The total charge for a given contributor is the sum of the unit-user charges multiplied by their corresponding loads.

- Negotiated contracts. In cases where there are few major industrial contributors to the municipal system, the sewerage authority can negotiate individual contracts taking into account the special nature of each effluent. Contracts are particularly useful in planning of a new industry, as it may be charged the capital costs for that portion of the design capacity allocated to its use. Also an industry anticipating expansion can easily contract for the excess capacity.

- Property taxes. Though this system of taxation is convenient and commonly applied in the region for other purposes, it is considered inefficient and inequitable for paying pollution charges. The system encourages excessive generation of waste loads as there is no incentive for industry to reduce pollution. Inequities would occur as non-pollutors are forced to bear a share of the total cost which should be paid by the polluting industries only.

87. It is of paramount importance in view of the current economic constraints in the region to consider the impact of a pollution charge on the total production costs. Conceptually the imposition of a pollution charge will have two different effects on the cost of production: a general rise in product price to absorb this new cost and a change in the relative prices of both products and resources inputs. The increase in particular final product prices will not be only related to the pollution charge embodied in the product, but any pollution charges imposed on the primary and intermediate materials used in processing of the final product. It is expected that such charges will not be easily absorbed by industry, especially in countries which apply restrictive pricing policies for the locally produced essential goods. However, the change in relative resources prices may induce substitution of these resources inputs because of the pollution charge and may ultimately lead to introduction of LNWT and other control measures.

VIII. RECOMMENDATIONS FOR A PROGRAMME OF ACTION

88. Evolving concern over environmental pollution stems from the awareness of the threats to health and welfare posed by the increased emissions of industrial wastes in the region. However, the efforts to preserve the envirionment have to date been rather slow.

89. In most member States, the concept behind environmental legislation has been that the establishment of environmental quality criteria will in itself protect the environment.

It has been found that this approach, largely administered by national environmental protection agencies, is not effective. A more recently advanced concept is that environmental protection can be better achieved through control of pollution at the source. The pollutant liability that industry has built up over the course of many years now should be paid up. The challenge to industry is to accomplish this task practically and economically, without an excessive burden to itself.

90. Evidence indicates that in spite of efforts to preserve the environment to date, the contamination of the atmosphere, pollution of rivers and lakes and deterioration of other natural resources are increasing at an alarming rate in several member States. There are very few national standards or regulations dealing with solid and hazardous industrial wastes. This is particularly unfortunate, as secondary products hold the greatest potential for recovery and utilization of resources. A concerted effort towards recovering the secondary materials would not only alleviate the problems of solid waste but could reduce the overall need for the raw materials. New impetus should be given to the prospect of regional exchange of waste through a "clearing-house" enterprise which links waste generators with potential users.

91. In most ECWA countries, the major difficulty of recycling waste materials lies in the fact that recovery cost does not generally secure a reasonable profit margin for private investors. However, municipalities are considering recycling ventures as if they are capital investments which need to break even or make a profit. The economic viability of recycling should be compared with the lowest cost disposal alternative. In some member States, the inaccessibility of landfill or incinerator sites is such that recycling is likely to be an economically attractive option.

92. The prima facie assumption that effective management of industrial wastes can be achieved through central organization has been proved invalid. Evidence suggests that local initiatives can do more than just abate pollution; they can stimulate industry when properly motivated to improve efficiency and minimize production losses. Within a framework appropriate to its unique situation, the local board for management of industrial waste may ascertain the nature of pollution problems in a specific area and implement "tailor-made" action programmes to alleviate these problems. The board must conduct its work openly and with adequate representation of the community, industry, government and other concerns.

93. International funding agencies must observe high environmental standards when financing industrial projects in the region. They should promote incorporation of LNWT in all new

industrial projects, and withdraw their support to environmentally unsound projects.

94. It is irrational to suppose that ECWA countries need follow the path already pursued by the industrialized countries. In that context, moving of polluting and hazardous industries into the region has to be deplored.

95. There are very few reliable estimates on the expenses of cleaning up the environment in Western Asia, and even fewer on the costs of inaction. However, it is evident that pollution costs much more than does its control. In order that external costs of pollution be properly reflected in the allocation of resources, Governments must consider the framework of policy instruments needed to control industrial wastes. In this context, Governments may impose indirect measures such as disincentives (taxes, effluent charges) and incentives (subsidies, tax rebates), or resort to administrative actions such as enforcing statutory regulations, curtailment of toxic releases and control of industrial locations. Since most of industrial investment in the member States is under direct Government control, and as a wide range of fiscal incentives is already offered to promote private industries, it appears that these control measures may be effectively used to restrain the tide of industrial pollution in the region.

96. The environmental impact assessment (EIA) should be integrated in the process of industrial development. This would ensure proper identification of mitigative measures which could be used in the planning, construction or operation of industrial projects to minimize undesirable effects on the environment. Mitigating measures may include avoiding the impact by not taking a certain action or part of an action, minimizing impacts by limiting the degree and magnitude of emissions, or diffusing the impact through rehabilitating or restoring the affected environment. EIA should be required as a prerequisite to issuing permits for new and existing industrial establishments.

97. Compliance with new anti-pollution norms will inevitably raise production costs. In countries with long industrial experience such as Egypt, the cost of pollution control is influenced by the age-structure of the existing industrial plants. Costs are generally higher in the older plants, since older units are usually less productive and the cost of pollution control is higher as equipment is likely to be less suitable for installation in outdated plants. Governments should encourage the upgrading of existing technologies, the employment of a labour-intensive processes, and most important, the search for ways of decentralization down to rural areas to ease the burden on the overloaded urban centres. Where industrialization is relatively new, such as in the GCC countries, the annual investments are large and introduction of LNWT can be

easily accommodated financially in the normal process of industrial development.

98. In order to pursue an environmentally sound industrial development policy, ECWA countries require a lot more information than they currently possess. While the lack of information may be particularly acute in the least developed member States, it also exists by and large in all countries of Western Asia. Governments should promote the establishment of regional network for "Pollution Control Information EXchange". The proposed network is illustrated in figure 5. The compiling of information concerning legislation, policy instruments, resource conservation, LNWT and control technology, and its dissemination to the member States will help them to get a clearer perspective on the priority pollution problems and to select the appropriate corrective courses of action. Transfer of "Show-how" among member States will complement the transfer of "Know-how" from the developed countries to the ECWA region.

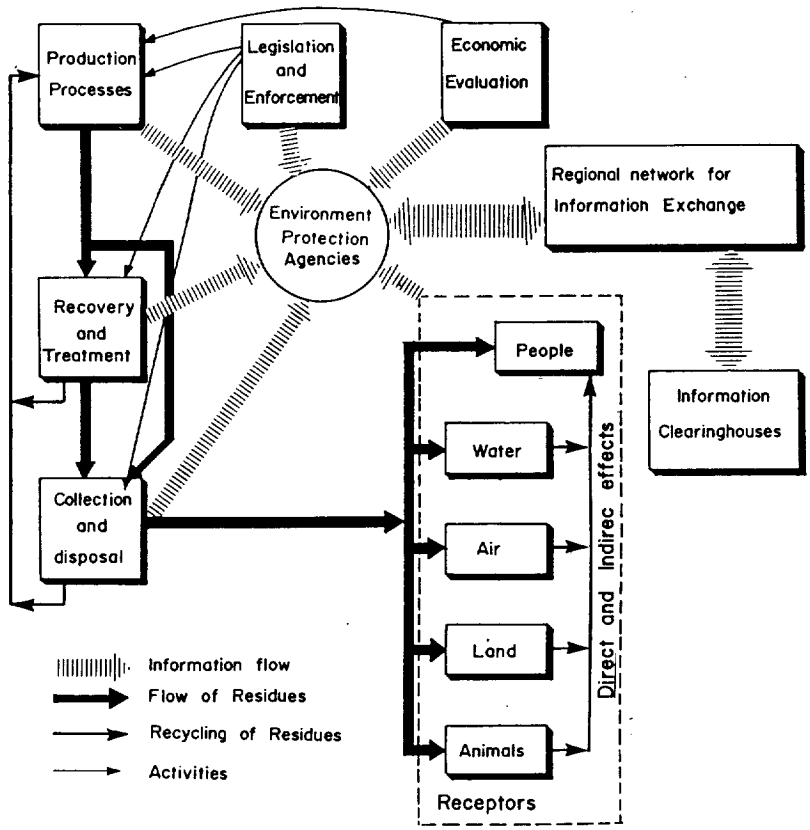

Figure 5 Schematic of the proposed network for Industrial Waste Intomation Exchang.

99. Although well intentioned, some environmental standards are so idealistic that they are in most instances non-enforceable. Stringent effluent standards require substantial capital and operating budgets which might cause serious cash flow problems to the industrial enterprises. Industrial pollution control in the region should be viewed as an ipso facto struggle for striking a balance between expenditures and level of environmental improvement. In that regard, industry should accept a long-term scheme for gradual tightening of emission standards to permit absorption of control costs. In major industries a policy of "bubble control" may be pursued, to control emissions from the enterprise as a whole rather than controlling individual sources. This policy permits achieving pollution abatement goals at affordable costs.

100. In most ECWA countries, enforcement of environmental legislation is not yet sufficient. Court action takes so long and fines are frequently so small that pollution levies can be shrugged off by corporations as a cost of doing business. As of yet, although signs of strict enforcement are limied, they are defintely emerging. The slow progress is attributed to shortage of manpower, vagueness of regulations and socio-economic constraints. Violations of the pollution laws are so widespread in the ECWA region that law enforcement alone would be ineffective; however, relying on enforcement as a component of a serious national commitment can lead to viable control of industrial pollution.

101. Government and industry expenditures on research and development for waste control have been practically nil. Funding for research related to LNWT, recovery of materials, water recycling, energy conservation and practical treatment technology should be increased substantially to achieve proper abatement in the light of indigenous experience.