

AIR POLLUTION CONTROL AND AIR QUALITY MANAGEMENT IN MALAYSIA.

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This paper has three main sections. The first section traces the history of air pollution as a problem in Malaysia and takes an overview of air pollution sources and magnitudes. This is followed, in the second section, by a discussion of the anti-pollution measures taken by the authorities so far, and their effectiveness as instruments in air pollution abatement and air quality management. Various issues and problems connected with the enforcement of anti-pollution measures are reviewed in the last section.

Rencana ini terdiri daripada tiga bahagian. Bahagian pertama meninjau secara ringkas sejarah pencemaran udara serta punca-punca dan darjah pencemaran udara di Malaysia. Dalam bahagian kedua pula dibincangkan langkah-langkah yang telah dan sedang diambil oleh pihak berkuasa untuk menentang pencemaran udara, dan keberkesanannya dalam pengurangan pencemaran udara dan pengurusan mutu udara. Akhirnya, berbagai isu-isu dan masalah-masalah yang timbul dalam pelaksanaan langkah-langkah tersebut di atas ditelitikan.

INTRODUCTION

The 1970s witnessed a rapid rate of economic growth and expansion in Malaysian under the Second and Third Malaysian Plans (Government of Malaysia, 1971; 1976) which enshrine the New Economic Policy (NEP). Much of the material prosperity consequent upon this economic boom^{(1)*} was accompanied and accomplished by the setting up of industrial estates, free trade zones, thermal power plants, petroleum based, timber-based and agro-based industries, expansion of urban centres and transport networks, the proliferation of motor vehicles, and the emergence of a whole gamut of attendant activities and structures. This, in turn, has resulted in the impairment of the quality of the environment manifested by pollution of a varying spatial and sectoral spread.

Even larger and more ambitious development projects are either being planned or initiated for the 1980s (Fourth and Fifth Malaysia Plans) as more capital investment (both local and foreign) in the industrial sector is

¹Manufacturing sector registered growth rates of 10.9 and 12.9% respectively under the Second and Third Malaysia Plans. The present per capita income of around M\$ 4500 represents a 450% leap since 1970 (*New Straits Times*, December 2, 1983) with a growth rate of 14.4% (World Bank, 1982).

Motor vehicle population increased from 0.87 million vehicles in 1973 (Gill, 1974) to around 3 million by 1983 (*New Strait Times*, June 5, 1983.)

envisaged, particularly in petroleum refining, natural gas, petrochemicals, and basic and heavy industries. This, along with the further expansion of urban centres, the increase of motorized traffic and the intensification of economic activities in the traditional and existing development nodes and zones would add to the problem of environmental degradation if appropriate measures are not taken to protect the environment from the undesirable impact.

Air Pollution as an environmental problem in Malaysia

Generally speaking, environmental pollution in Malaysia, in common with most developing countries, is as much if not more due to underdevelopment or lack of development as to rapid, unplanned, haphazard development itself; and often these two aspects are so interwoven that it would be difficult to isolate one from the other. Deteriorating air quality, nevertheless, is one of the major manifestations of pollution which, undoubtedly, emanates from unplanned and/or improperly managed economic development in the recent past, particularly the concentration of manufacturing industries, urban sprawl, increasing motorized traffic, and high population densities in urban areas.

In most developed countries, air pollution is of industrial, commercial and domestic origin, but in Malaysia the domestic sector is a relatively insignificant source^[2] whereas motorized traffic, fuel combustion and dust pollution by industries constitute the major sources. In fact, before the advent of industries and the growth of cities the only sources of air pollution in Malaysia were quarries and sawmills (Gill, 1974), and air pollution was only a highly localized problem. By the year 1957, Malaysia had only 2 plywood factories, about 100 sawmills, and 20 quarries, but as at 1977 the number had risen to 35 plywood factories, 600 sawmills, and 340 quarries (Tan, 1982). Further in 1973 there were only about 870,000 motor vehicles in Malaysia (Gill, 1974) but with the expansion of economic activities and population the number increased to 1.7 million by 1978 (Tan, 1982), 2.6 million by 1981 (*New Sunday Times*, November 28, 1982) and around 3 million by 1983 (*New Sunday Times*, June 5, 1983).

Because of its relatively recent entry into the arena of environmental pollution, air pollution has not been perceived as a serious problem by the public, the scientific community or the decision makers in Malaysia, until recently.

²Domestic rubbish disposal through burning is, however, increasingly becoming a problem in certain localized areas. This is still a relatively minor component when compared to the very considerable pollution input from domestic sources in developed countries in mid-latitudes where, especially during winter, the use of fuel of low burning efficiency for domestic heating is the main factor.

There has been 'numerous complaints of dust falls in the environment from industries like cement factories, metal quarries, saw mills, etc... However, there are no documented studies, as yet, indicating the impairment of the health of the community arising from pollutants' (Gill, 1974). Since then, however, it has increasingly been realized that it would be prudent to incorporate various measures to prevent pollution of the atmosphere of the sort experienced by developed countries in the process of industrialization and urbanization. This realization was particularly driven home by the results of a survey by the Division of the Environment (DOE) which identified 5,000 sources of air pollution in Peninsular Malaysia (Table 1) mainly due to combustion and industrial processes besides the mobile sources (motorized traffic) (Ong, 1979. Tan, 1982)

The current policy of the Malaysian Government is 'Development without Destruction', in order that the developmental (economic) objectives and environmental (ecological) objectives are congruent. Efforts have been made during the past ten years or so to identify those areas where development has unleashed environmental degradation or are likely to do so, so that appropriate action could be taken to control or prevent any undesirable impact. Air pollution is one such aspect which has received close attention in recent years (Government of Malaysia 1974, 1979a; Ong, 1979).

The perception of air pollution as a problem has, however, not been equalled by adequate explanation of its incidence, magnitudes and consequences in scientific terms. As such the effective planning and implementation of appropriate measures have sometimes been hampered by the lack or inadequacy of quantitative information on, and in some cases the improper understanding of, some of the critical aspects related to air pollution: nature of the atmospheric environment over Malaysia and the neighbourhood; air pollution potential of different areas and different times; the sources and magnitudes of air pollution; and the possible and actual impact of air pollution on man and his biophysical and built environment. In other cases, whatever information that is available may not be used due to pure indifference of the planners or the extra costs that will have to be borne if the said information is incorporated; this is particularly true of projects oriented towards business and industrial activities where cost-effectiveness is a prime concern.

That air pollution has become a problem in certain areas in Malaysia cannot be denied, but its assessment as a problem should be based on concrete and objective information and not on speculation, emotion and quasi-scientific material. One could see the need for a balanced stance on the issues pertaining to air pollution in order that the two extremes of overreaction bordering on alarmism generated by some environmental groups, on the one hand, and the disinterested innocent-until-proven-guilty stand of some of the decision makers could be avoided.

The measures taken so far to effect air pollution abatement and the enhancement of air quality in Malaysia are based on the preliminary surveys and investigations by the Division of Environment(DOE) of the Ministry of Science, Technology and Environment, and few studies by academic groups, environmentalists, and various Government Departments which have functions related to environmental and natural resources development and use(Asmah, 1976; Che 'Man & Leong, undated; DOE, 1977, 1978a & b, 1979a; Goh & Soong, 1976; Lim, undated; Ministry of Health, 1974; Sham, 1973, 1976, 1983a; Tan, 1979).

In the following section an attempt is made to take an overview of the air pollution sources and magnitudes in Malaysia before the measures proposed or implemented to check air pollution are discussed. Due to the non-availability of information on East Malaysia much of the discussion is, in effect, confined to Peninsular Malaysia only.

AIR POLLUTION SOURCES AND MAGNITUDES

Table 2 sets out the data on air pollution magnitudes over Peninsular Malaysia based on an estimate by the DOE. This information was derived from a survey done in 1975 and, therefore, may appear outdated. But in view of the non-availability of any other general assessments of air pollution to-date and the fact that the enforcement of the anti-pollution regulations were effected only as from late 1978, and that too partially and on a limited scale, figures quoted in Table 2 could still be used as a rough index to the air pollution sources and magnitudes over Peninsular Malaysia as a whole.

The estimate of air pollutin referred to above was based on data on the usage of gasoline and diesel by motor vehicles, use of diesel by the Malayan Railway, usage of fuel oil and diesel by power stations, estimated amount of wood burning in land clearing and as wood wastes in sawmills an plywood factories, aircraft flights from all the ariports, usage of fuel oil, diesel, and kerosene in the industrial and domestic sectors, and the amount of petroleum refined including the amount of fuel oil and gas burned in boilers and process heaters in oil refineries (Goh & Soong, 1976).

According to the above estimate, more 'han 669,000 tonnes of impurities are emitted to the air over Peninsular Malaysia alone as a result of fuel combustion. Nearly 58.3 per cent of this is carbon monoxide, 21.2 per cent sulphur dioxide, 11.3 per cent oxides of nitrogen, 5 per cent hydrocarbons, and 4.2 per cent grit, dust and other particulate matter. It is apparent from Table 2 that motor vehicles account for nearly 45 per cent of this pollution followed by wood-burning, 27.4 per cent; power stations, 13.6 per cent; industries, 11.1 per cent; and petroleum refineries, 2.9 per cent. In-

series included in the inventory are those other than cement manufacturing, quarrying, woodworking and iron and steel manufacturing. At a conservative estimate of an increase of 10 per cent annum (Ong, 1979), the pollutant load would have increased to around 1.3 million tonnes by now (1984), assuming no measures were taken to arrest it. It is hoped that as an outcome of the various measures taken in the enforcement of anti-pollution regulations under the Environmental Quality Act, the rate of emission of pollutants has gone down, but there is no information in this regard to conclude one way or the other.

It has been found that in certain areas from which numerous complaints of air pollution have been received, the suspended particulate matter deposited dust levels have exceeded the standards set by the Malaysian Environmental Quality Standards Committee (Tan, 1979). This is particularly true of densely populated industrial, urban areas such as in Kuala Lumpur, Petaling Jaya, Johore Baru and Prai. In the main industrial-urban area of Malaysia, the Klang Valley, the magnitude of air pollution is probably the highest in view of the large population of over 1.2 million clustered in several urban centres, the presence of nearly 700 point-pollution sources and nearly a million motor vehicles (Ong, 1979); *New Sunday Times*, June 5, 1983), and also, because of its relatively high 'air pollution potential' (Sham, 1979); the topographical conditions in the Klang Valley force the air layers closer to the ground to become cooler than those above, therefore, stable atmospheric conditions to occur, and this in turn would prevent any vertical dispersion of pollutants and trap and concentrate them within the lower layers ('life layer').

According to a DOE investigation in 1981 (Government of Malaysia, 1983), the mean annual suspended dust particle (i.e., those particles less than $10\mu\text{m}$ in diameter (Bach, 1972)) level was found to be around $97\mu\text{g}/\text{m}^3$ in a residential area in the Klang Valley and $196\mu\text{g}/\text{m}^3$ in industrial areas in Petaling Jaya. Dust pollution is even more in areas close to earthworks, cement works, sawmills, and quarries as, for example, in the Batu Caves area where the suspended dust levels measured over a one-month period averaged $370\mu\text{g}/\text{m}^3$ over 24 hours (Ong, 1979). These levels of suspended dust are clearly cause for concern in view of the very much lower standards proposed for Malaysia, namely, $50\mu\text{g}/\text{m}^3$ for residential areas and $100\mu\text{g}/\text{m}^3$ for industrial regions. Table 3 illustrates the suspended dust levels at selected sites.

Further, dust deposition studies have indicated that settleable dust consists of those particles normally larger than $10\mu\text{m}$ in diameter (Bach, 1972) levels around $1108\mu\text{g}/\text{m}^2/\text{day}$ in the vicinity of Batu Caves (Ministry of

Health, 1974), and is found to be more than three times the Malaysian standards (Ong, 1979). Dust fall studies at three other sites have shown high values: Ampang Quarry, 300-300 $\mu\text{g}/\text{m}^2/\text{day}$ (Government of Malaysia, 1983); Tasik Industrial area in Ipoh, around 260 $\mu\text{g}/\text{m}^2/\text{day}$ (Lim, undated); Prai industrial area in Penang, 392 $\mu\text{g}/\text{m}^2/\text{day}$ (Che 'Man & Leong, undated).

Sulphur Dioxide

The DOE has carried out investigations on the level of sulphur dioxide in industrial and residential areas. Samples obtained from six industrial areas over the country indicated averages of around 100 $\mu\text{g}/\text{m}^3$, whereas for a residential area (Damansara Utama in Petaling Jaya) it was only 5 $\mu\text{g}/\text{m}^3$. Close to fuel-burning sites, the concentration was found to be 100-170 $\mu\text{g}/\text{m}^3$. These values are, however, considered to be well below the Malaysian standards set for industrial (200 $\mu\text{g}/\text{m}^3$) and non-industrial (125 $\mu\text{g}/\text{m}^3$) areas (Government of Malaysia, 1983). Table 4 sets out some values recorded at selected sites with different land use characteristics.

Carbon Monoxide

Carbon monoxide measurements in certain areas in Kuala Lumpur have shown values around 50 ppm averaged over 30-minute periods against a proposed standard of only 5 ppm (Ong, 1979). According to another study (DOE, 1979a), the carbon monoxide levels vary from a minimum of 4 ppm to a maximum of 50 ppm depending on traffic density and presumably weather conditions in Kuala Lumpur. This state of carbon monoxide concentration is not surprising in view of the fact that Kuala Lumpur which is half the size of the city of Singapore has as many cars as Singapore (*New Straits Times*, February 12, 1982). It has, in fact, been estimated that there are over 16 motor vehicles to every 100 people and that at peak hours there are nearly 300,000 cars and trucks in Kuala Lumpur on 420 km of roads (Government of Malaysia, 1979a). According to another index (*New Straits Times*, May 20, 1983), around 1971 Kuala Lumpur had only 57 motor vehicles per km of roads whereas by 1983 this had risen to 197.

No comparable figures are available for the other urban centres in Malaysia. However, the situation in Kuala Lumpur could be taken as a typical example of what is bound to happen if appropriate measures are not taken to cut down traffic densities and traffic jams in urban centres.

¹This high rate of consumption, 0.64 grams per litre, is higher than the average in Switzerland, 0.54 g/l.

A direct result of the heavy density of motor vehicles in certain areas in Malaysia is the high levels of lead in the air. Malaysian petrol has one of the highest lead contents in the world, 0.84 grammes per litre(g/l)(*New Straits Times*, February 19, 1982)⁽³⁾. The concentration of lead in one of the busiest arteries of traffic in Kuala Lumpur, Jalan Tuanku Abdul Rahman, is $6.36\mu\text{g}/\text{m}^3$ according to a survey by the Environmental Protection Society of Malaysia and the University of Agriculture as against the proposed Malaysian standard of 0.7, which shows that the actual lead levels show a value approximately 9 times that considered safe (*New Strait Times*, February 19, 1982). The ambient lead standard is $1.5\mu\text{g}/\text{m}^3$ over three months and according to a survey reported in the *New Sunday Times* (November 28, 1983), in busy roads such as Jalan Tuanku Abdul Rahman and Pudu Road the level is almost three times that considered safe, but in other areas the levels are below the standard (see Table 5).

Although no definite link has been established, some environmentalists have suggested that the presence of a higher level of lead in the bloodstreams of a group of expectant mothers in Kuala Lumpur compared to that of rural mothers is an indication that the high lead levels in Kuala Lumpur have already had a detrimental impact on human health (*Sunday Star*, May 1983; *New Sunday Times*, November 28, 1983). However, the information is inadequate for a definite evaluation of the situation with regard to lead content in the air in Malaysian cities and the extent of its impact on the health of the urban dwellers.

Recently, the Minister of Science, Technology and Environment, addressing an environmental seminar in Johore Bharu, is reported to have said that the Ministry is studying the possibility of taking measures to have lead content in gasoline reduced to 0.4g/l, and that the present atmospheric lead level in Kuala Lumpur is not dangerous to health. In this connection, it may be relevant to look at the situation in Singapore with regard to the effect of adopting stringent measures in the use of lead in petrol. According to a very recent report (*New Straits Times*, May 17, 1984), since Singapore reduced the lead content in petrol from 0.84g/l before July, 1980 to 0.4g/l in 1983, the average road-side lead level in the air has gone down from $1.1\mu\text{g}/\text{m}^3$ (1980) to $1.1\mu\text{g}/\text{m}^3$ in 1983, well within the safety level of $1.5\mu\text{g}/\text{m}^3$ recommended by the United States Environmental Protection Agency. This reduction of lead level was achieved despite an increase of petrol consumption by 37 per cent between 1980 and 1983. Hence the sooner the lead content in petrol is reduced the better it would be for maintaining cleaner air.

³This high rate may be compared with the following figures for some selected countries: France, 0.64 grammes per litre(g/l); Italy, 0.4 g/l; Federal Republic of Germany, 0.15 g/l; Switzerland, 0.54 g/l; U.S.A., 0.33 g/l; Singapore, 0.4 g/l.

Haze

Another phenomenon which has lately aroused a lot of interest and worry among Malaysians is the occurrence of haze twice between September, 1982 and March, 1983. Coinciding with the intermonsoonal months of relatively stable atmospheric conditions the haze dragged on for over two months in each occasion and did cause disruption of air travel and the exacerbation of the discomfort during these relatively sultry periods. According to the DOE, the level of suspended dust levels during the haze was around $244\mu\text{g}/\text{m}^3$ whereas the normal dust levels during the past three years was only around $100\mu\text{g}/\text{m}^3$ (Friends of the Earth, Malaysia, 1983); the Meteorological Service has reportedly recorded a reading of over $300\mu\text{g}/\text{m}^3$ during the said haze occurrences.

These haze episodes were attributed to several local and regional factors in the atmospheric environment as well as the wide-spread burning of agricultural waste and vegetation during the dry weather periods, the local pollution from factories, and forest fires and volcanic eruptions in Indonesia. It has, further, been suggested that haze is a part and parcel of the urban climate of most built-up areas in Malaysia but that the stable weather conditions during the intermonsoonal periods and abnormal circumstances like the volcanic activity and forest fires in Indonesia rendered it more obvious than is usually the case.

Heat Pollution

One of the most evident effects of industrialization and urbanization is heat pollution or the formation of urban 'heat islands' as a result of changes in the thermal environment of the industrial and built-up areas. This phenomenon has been studied with special reference to Kuala Lumpur and a few other urban centres in Malaysia (Sham, 1979, 1983), and the basic pattern of the temperature field in the said areas has been shown to be suggestive of definite influence of the urban fabric and activities on the thermal gradient between cities and the surrounding rural areas. Kuala Lumpur and Petaling Jaya is found to have an average temperature $5-6^\circ\text{C}$ above the rural areas around it, whereas George Town in Penang, $3-4^\circ\text{C}$ more (Sham, 1979, 1980, 1983a). The urban and industrial areas are likely to be even warmer with the unrelenting expansion, both horizontal and vertical, of the major cities and larger towns in Malaysia as a result of increasing density of motorized traffic and the concentration of industries in the future.

Besides the discomfort resulting from the increase of sensible heat, the urban clusters may affect directly and indirectly the dispersal of pollutants. On the one hand, the heat island effect may have a beneficial effect in that the warmer, lighter and, possibly, unstable air may help transport the pollutants to the higher atmospheric layers where the natural

...sing process would take place because of greater vertical and lateral
...ing in the atmosphere. On the other hand, the narrow streets hemmed in
...ween high-rise buildings may experience 'cold-air-drainage' 'at night,
...cially under stable weather conditions thereby leading to a concentra-
...of pollutants in the lower layers.

Rain

In most industrial areas of the world and also those areas situated down
...of large industrial regions, one problem which has been a continuous
...ce of anxiety for government and environmental groups is the
...phenomenon of acid rain. This aspect was, however, not been given much
...ention in Malaysia until recently when an experiment by a group of
...ol children revealed that the rain water in a certain part of Petaling
...had a pH value of between 4 to 4.5^[4]. Subsequent to this it was reveal-
...that the rain water samples collected by the Meteorological Service at two
...ions, Petaling Jaya and Tanah Rata (in Cameron Highlands), had pH
...ings of 4.4-4.8 and 4.9-5.5 respectively (Friends of the Earth, Malaysia,
...). However, in the absence of more details and sustained studies the
...tion of acid rain as an environmental hazard in Malaysia remains very
...an open question.

Public Complaints

The expansion of industries and urban centres with little or no plann-
...in certain areas in Malaysia, before the advent of land use zoning regula-
...s, have given rise to economic activities which are potential polluters ex-
...t of the cheek by jowl with residential areas. As the public became more and
...p areas aware of the hazards of air pollution, particularly the sensory com-
...Lumpuents of air pollution such as smoke, dust and odours, and with the in-
...the bases of avenues for them to channel their grievances, more and more
...be sugple have begun to perceive air pollution as a problem affecting their
...he their health and daily lives. This is perhaps borne out by the increasing public
...umpu complaints and press exposures of air pollution

It has been shown (Ong, 1979) that public complaints to the DOE
...ut dust, grit, smoke, gases and odours have risen from 32 in 1972 to 88
...1977, 92 in 1978 and 94 for the first half of 1979 (Abu Bakar, 1976; Ong,
...). The DOE claims that it has often acted on these complants and,
...re necessary, brought the offending parties to book and required them
...conform to anti-pollution measures. In fact, in the early stages of the en-
...ement of the anti-pollution regulations the DOE had to depent a lot on
...complaints since the staff strength was not sufficient to maintain

pH is a measure of the acidity or alkalinity of a solution. Pure water has a pH of 7
...al solution); acid solutions, a pH less than 7; alkaline solutions a pH greater than 7.

surveillance over polluters. Some of the complaints may be reflective of just nuisance situations rather than of any pollution hazard. Nevertheless the preparedness of certain sectors of the public to voice their grievances and to act as 'watch dogs' is a welcome development in the direction of attaining a cleaner atmospheric environment.

ENVIRONMENTAL POLICY, LEGISLATION AND INSTITUTIONAL FRAMEWORK

At independence, in 1957, Malaysia inherited an assortment of environment - related enactments which may be described as 'hybrid legacies of traditional culture and colonial imposition' (Conway & Romm, 1973). They were mostly fragmented and non-uniform, in their enforcement, and ineffective as instruments of environmental protection let alone the enhancement of environmental quality. And, also, 'the actual contents of the enactments have been found to be inadequate to cope with the more recent and interrelated problems of the environment' (Hamzah, 1979). In the absence of legislation and organizational frameworks to deal with the new relationships among the environmental, natural resource, economic and political systems in Malaysia various environmental stresses set in.

There was, on the other hand, a parallel rise in the awareness among both the public and the decision makers of the dangers of environmental degradation; this was due partly to the intervention of mass media, environmental groups and academics. The awareness and the recognition of the environmental problems by the authorities were formalized in the 1970s in terms of several changes in policy and approaches to environmental and natural resources development and utilization in particular and economic and social development in general.

Policy

The Third Malaysia Plan (Government of Malaysia, 1976) formally enunciated the environmental policy as follows:

'Malaysia's overall environmental policy will take account of the following factors:

- (a) the impact that population growth and man's activities on resources development, industrialization and urbanization have on the environment;
- (b) the critical importance of maintaining the quality of the environment in relation to the needs of population, particularly in

regard to the productive capacity of the country's land resources in agriculture, forestry, fisheries and water;

- (c) the need to maintain a healthy environment for human habitation;
- (d) the need to preserve the country's unique and diverse natural heritage, all of which contribute to the quality of life; and
- (e) the interdependence of social, cultural, economic, biological and physical factors in determining the ecology of man.

Environmental Quality Act (EQA) and the Division of Environment (DOE)

The most fundamental of the package of measures pursuant to this environmental policy was the passage of enabling legislation in the form of the Environmental Quality Act of 1974, 'an act relating to the prevention, abatement, control of pollution and enhancement of environment' (Government of Malaysia, 1974). This was followed by the establishment of the Division of Environment (DOE), 'to be responsible for and coordinate all activities relating to the discharge of waste into the environment and for preventing or controlling pollution and protecting and enhancing the quality of the environment' (Government of Malaysia, 1974). At first, the responsibilities of the DOE were mainly concerning pollution control and later these were expanded to incorporate environmental planning and management as well.

The DOE thus became the administrator of the Environmental Quality Act, and, in order to perform its functions, a 'three-pronged' strategy was adopted:

short-term measures (statutory) aimed at pollution control and taking remedial action;

medium-term measures (non-statutory) aimed at providing guidelines for planners and developers in incorporating environmental considerations into the developmental activities;

long-term measures by way of instituting procedures for Environmental Impact Assessment in order to anticipate and provide for possible undesirable consequences of any economic planning and project decisions and in the long run to ensure that the environment is managed to maximize the benefits to man and minimize the detrimental impact unleashed on the environment in the process.

The DOE has within it separate units for handling water and air pollution problems. The air pollution unit comprises two sections: Enforcement and Control Section and Air Quality, Noise and Radiation Section. Within these sections are different 'cells' with distinct functions. The Enforcement and Control Section is divided into cells for mobile pollution sources, pre-siting evaluation, Northern Region Southern Region, Eastern Region, Central Region, Sabah Region, Sarawak Region,⁵ and the cells in various Regional Development Authorities.⁶ Air Quality Section, on the other hand, has three main cells with special functions for source emission inventory, monitoring, data processing and evaluation, and control technology and air quality criteria and standards.

These cells are later to evolve into a three-level administrative set up: central agency, regional agencies and local agencies. The central agency is concerned mainly with policy matters, air quality and emission standards, designating air quality control regions, central laboratory facilities, supporting, coordinating and carrying out research, and coordinating public information campaigns. At the regional level the emphasis will be more on the control of air pollution: plans for regional air quality management; controlling and inspecting relatively large and complex air pollution sources; carrying out source emission inventories; establishing air quality measuring networks, works, warning systems and monitoring; studying regional master plans for the region for transportation, energy supply, waste disposal, land use, provision of open space etc. for the purpose of coordinating these plans with air pollution control work; and providing technical assistance, guidance and advice to State and Local Government authorities. Local level functions are related to the control of minor pollution sources, carrying out routine surveillance of pollution sources and air quality monitoring, investigation of public complaints and the detection of violations of air quality regulations (Goh, 1979b).

The nature and the main features of the various measures that were taken are discussed below as a preliminary to an examination of their implementation and effectiveness.

Air pollution control Regulations

The Environmental Quality Act enables the Director-General of Environment to formulate regulations as and when required to protect the environment.

⁵Northern Region (Penang, Kedah, Perlis Perak); Southern Region (Johore, Malacca); Central Region (Selangor, Negeri Sembilan); Eastern Region (Kelantan, Trengganu, Pahang); Sabah Region; and Sarawak Region

⁶For example, KETENGAH and KESEDAR.

ment against actual or potential pollution. For controlling air pollution, two sets of regulations were gazetted: Motor Vehicle (Control of Smoke and Gas Emission) Rules, 1977 and Environmental Quality (Clean Air) Regulations, 1978.

Motor Vehicle (Control of Smoke and Gas Emission) Rules, 1977.

Preliminary surveys conducted by the DOE have shown that motorized vehicles are one of the most serious sources of air pollution, particularly in urban areas (Table 2) (Tan, 1982). As such the provisions of the Road Traffic Ordinance of 1958 were invoked to formulate the Motor Vehicle (Control of Smoke and Gas Emission) Rules of 1977. These regulations were enforced with effect from March, 1978 with the cooperation of the Road Transport Department and the Police.

Under these regulations it is an offence for motor vehicles to emit dark smoke of a density exceeding 50 units in the Hartridge Smoke Meter; this is particularly directed at diesel powered vehicles such as lorries, buses and trucks which operate in large numbers in urban areas. In the case of petrol-powered vehicles, 'every motor vehicle powered by a four-stroke petrol engine (other than a motor cycle) first registered for use on or after the coming into force of these Rules shall be so constructed or equipped with such devices as to prevent the escape of gas from the crankcase of such motor vehicles into the atmosphere'. This would mean that petrol-driven motor vehicles are required to ensure that the emission of noxious gases from the exhausts is prevented by the installation of suitable equipment.

The penalty for a violation of the above Rules is a maximum fine of M\$ 1,000/- or two week's imprisonment for a first offence and a maximum fine of M\$ 1,000/- or one month's imprisonment for a second or a subsequent offence. However, the Section 5 of the Rules say that 'the Director General of Road Transport may, with the prior agreement in writing from the Director General of Environmental Quality, exempt any person or class or type of vehicle from the full compliance with any or all of those Rules'. (Motor Vehicles (Control of Smoke and Gas Emission) Rules, 1977).

However, due to the delay in the formulation of standards to be enforced, the regulations against petrol-driven vehicles which emit noxious fumes and gases have been in cold storage for some time now, so that the said regulations are as good as non-existing.

Environmental Quality (Clean Air) Regulations, 1978

Environmental Quality (Clean Air) Regulation were enforced from October, 1978. These regulations have detailed specifications on burning of

waste, emission of dark smoke by factories, and the emission of air impurities both particulate and gaseous, and is accompanied by a set of explanatory notes entitled 'Clean Air Regulations And You' (DOE, 1978d) for the benefit of relevant parties involved. These regulations are designed to:

- (a) control the location of new industrial facilities (which are potentially polluting) with respect to residential areas;
- (b) control the burning of wastes;
- (c) control the emission of dark smoke from Chimney stacks;
- (d) control the emission of air impurities (Goh, 1979 a).

Licensing and authorization procedures are spelled out as guidelines in the siting of industries and burning of wastes - industrial, trade or agricultural - so as to control the addition of noxious impurities into the air. Burning of industrial and commercial wastes should, according to the regulations, be done only in an incinerator. The installation, resiting and alteration of any fuel-burning equipment should be approved by the Director-General of the Environment. All open burning of combustible material and refuse before 6 pm is prohibited, the exception being the burning of wastes arising out of agricultural activities and necessities.

As from October 1978 it was made mandatory for new industrial and trade premises ('prescribed premisses')⁷ to ensure that smoke emissions are not darker than shade number 1 on the Ringlemann Chart, for those using liquid fuel, and shade number 2 for those using solid fuel. For existing premises, the smoke emitted should not be darker than shade 2 of the Ringlemann chart.

As for air impurities, 3 standards of emission (A, B & C) were prescribed, the level of stringency increasing from A through C. Standard C was enforced for all new industries as from October, 1978 (Table 6). Existing industries, on the other hand, were given time up to 2 years to comply with standard A and a further year to achieve standard B. In taking steps to conform to the above emission standards, the industries were to follow the 'best practicable means' to prevent the emission of noxious or offensive

⁷ Prescribed premises are those used for activities connected with the following: cement; chemicals; asbestos; stone-quarrying and processing; basic metallurgical; scrap metal recovery; ferrous and non-ferrous metals; petroleum; earthenware, pottery, ceramics and china; sawmills, wood mills and wood products; crushing, grinding and milling; concrete; gas; charcoal and coke; premises with fuel burning equipment; fish manure; palm oil processing; and rubber processing (DOE, 1978d).

substances and to render harmless and inoffensive those substances unnecessarily discharged' (Section 32 (1) of the Regulations). Where technological and economic considerations do not permit the employment of pollution control measures, the operators can 'apply to the Director-General of Environment for a licence to contravene specified acceptable conditions' (Section 10, Clean Air Regulations and You).

Under section 22 (2) of the Regulations, there is a presumption that a person emits or discharges wastes into the atmosphere if he (a) places any matter in a place where it may be released into the atmosphere, (b) causes or permits the discharge of odours which by virtue of its nature, concentration, volume, or extent are noxious or offensive, (c) burns any wastes of trade, process or industry and (d) uses any fuel burning equipment not equipped with any device or control equipment required to be fitted for such equipment (Low, 1979).

The penalties imposed on those contravening the regulations without a licence are a maximum fine of M\$ 10,000/- or imprisonment up to 2 years or both and to an additional fine of not exceeding M\$1,000/- a day for every day that the offence is continued.

Guidelines for the Siting and Zoning of Industries

The above short-term measures are mostly of a remedial and corrective nature. In order to prevent those activities which are potentially polluting and to minimize the magnitude of pollution, certain guidelines have been introduced (DOE 1979 b). This called for the incorporation of the environmental component as an integral element in the medium term development planning process itself, and taking positive measures in bringing about a harmonious relationship between development and environment. These guidelines are meant to prevent the location of certain types of industries in or close proximity to residential or built-up areas.

Under these guidelines, 'light industries' (i.e., those not classified as 'Scheduled Premises' and which are non-polluting or only of very small possibilities of resulting in pollution) may be located in industrial lots near housing estates or in built-up areas. As the likelihood of pollution increases, the distance from the residential areas has to be increased accordingly - 500-1,000 m for certain types of industries collectively called 'general industries', and 1500-3000 m for 'special industries'. These 'special industries' are 'those that will give rise to air, water and noise and solid waste disposal problems', and must be sited only in designated industrial estates. Furthermore, industries to be located in any particular area should be compatible in terms of their products (DOE, 1979c).

The guidelines also encourage the development of 'buffer zones' between different industries and residential areas as well as between different industrial areas/estates. These buffer zones may be developed as green belts, agricultural areas or as commercial areas, parks and for recreational purposes.

Environmental Impact Assessment -

The above short and medium-term measures have the objective of ensuring that the existing industries and other air pollution sources are subject of direct controls or 'add-on' technologies and that the land use patterns give rise to desirable and pollution-free environmental conditions; this alone is, however, thought to be insufficient. As such, to complement these measures, procedures were suggested in the overall strategy to foresee and forestall potential damage from future air pollution sources by having Environmental Impact Assessment (E.I.A.) as an integral aspect of environmental planning. This particular long-term strategy as a general planning constraint was emphasized in the Third Malaysia Plan.

It was proposed that the EIA procedure would provide for a Project Screening phase, an Environmental Screening phase and a Detailed Assessment phase (O'Brien, 1979). EIA is essentially a preventive rather than a remedial measure in environmental management. In order to step up the efficiency of EIA in preventing air pollution it is essential that five factors should be present: a thorough knowledge of the project concerned, a deep knowledge and understanding of the environment, the availability of technical know how and technological capabilities, financial feasibility and cost effectiveness of the available measures, and the quality of the implementation decisions. In short, the efficiency of the EIA would depend on the ability to predict and estimate the impact and the ability to place a value on environmental loss.

The status of the implementation of EIA in Malaysia will be dealt with in a later section. However, it may be mentioned here that in evaluating the need for EIA as a routine procedure in environmental management in Malaysia one should be conscious of the many problems that the authorities and the prospective investors have to contend with, especially those pertaining to cost, expertise, time factor, and the lack of baseline data.

The DOE had the services of an expert from Australia for assisting in formulating EIA procedure and staff training. It was expected that the EIA would be formally adopted under the Fourth Malaysia Plan as a tool for the environmental management and that it will be fully implemented during the Fifth Malaysia Plan period.

Ambient Air

The DOE survey of dust order to ascertain order to ascertain respectively, and Malaysia 1972 until the was instituted WHO/UNEP programme; this dust particulate in response to Butterworth Johore Bahru Besi, Taman pollution level

Until the stations mean monitoring stations for carbon monoxide Federal Territory stations mean soot, dust, and carbon monoxide

Whilst the population and order to obtain stations are known continuous basis national deficiencies

Air Quality S

A National Air Quality Standard was formulated a list of the Environmental perspective of mostly in the been operating

*Air Quality measurement station

Ambient Air Quality Assessment

The DOE started its air quality monitoring programme in 1977 with the survey of dust pollution in two sites in Batu Caves and Rawang areas in order to ascertain the extent of dust pollution in those two sites having, respectively, quarrying and cement works. Before that, however, the Factory and Machinery Department had conducted air quality surveys since 1972 until the DOE took over. In 1978, a long-term monitoring programme was instituted for two areas in Petaling Jaya in conjunction with the WHO/UNEP Global Environmental Monitoring System (GEMS) programme; this was particularly to measure sulphur dioxide and suspended dust particulates. Further, special monitoring programmes were carried out in response to air pollution complaints in the vicinity of tin ore smelters in Butterworth and Penang Island, and in the industrial estates in Larkin, Johore Bharu; *ad hoc* surveys were also conducted in Kepong, Sungai Besi, Taman Cheras, and Pudu areas in Kuala Lumpur to ascertain air pollution levels (Tan, 1979).

Until the end of 1981, the DOE had set up 316 air quality monitoring stations measure seven major pollutants: suspended particles (including monitoring suspended dust particles, 79 for estimating sulphur dioxide, 2 for carbon monoxide, 2 for ozone (Government of Malaysia, 1983). In the Federal Territory of Kuala Lumpur and in the Selangor State, 125 sampling stations measure seven major pollutants: suspended particles (including soot, dust, aerosols and fumes); sulphur dioxide and oxides of sulphur; carbon monoxide; oxides of nitrogen; hydrocarbons; oxidants; and lead.

Whilst most of the monitoring sites are located in the areas of dense population and intense industrial activity, a few stations are in rural areas in order to obtain information on the background air quality. Most of these stations are known to operate only at intervals and only a few are on a continuous basis. This may partly be due to staff shortages as well as organizational deficiencies.

Air Quality Standards^(a)

A National Environmental Quality Committee set up in 1974 formulated a list of air quality standards in accordance with the requirements of the Environmental Quality Act. The standards so proposed were in the perspective of the air quality standards and criteria used by other countries, mostly in the extra-tropical regions, where anti-pollution measures have been operating for quite some time, and, also, the limited information

^a*Air Quality Standard*: 'The concentration of a pollution in the atmosphere at the point of measurement shall not be greater than some specified amount'. (World Bank, 1974).

available on the present and potential air pollution sources and magnitudes in Malaysia (Tan, 1979). Table 7 sets out of the Malaysia Air Quality Standards according to the type of effluent and nature of land use or economic activities. It is understood that the DOE is not using these standards probably because the basis of their derivation is rather unsatisfactory. The WHO standards are certainly preferable but should be used with the full knowledge of the context under which they are formulated which may not be applicable to the Malaysian context. Hence the air quality standards to be used for local purposes is still a matter for careful consideration.

Emission Standards⁽⁹⁾

In the light of the above data and the experience of other countries, certain emission standards were prescribed for industries (Tables 6 & 7). There are three standards for most effluents which have to comply with according to the requirements stated in the Environmental Quality (Clean Air) Regulations, 1978.

ENFORCEMENT OF ANTI-POLLUTION REGULATIONS

The two main sets of regulations, Motor Vehicles (Control of Smoke and Gas Immission) Rules and the Environmental Quality (Clean Air) Regulations were enforced with effect from March and October, 1978 respectively; petrol-driven vehicles were, however, not covered due to lack of local standards. Since then, industrial premises and motor vehicles were checked from time to time and action taken against the erring parties. Much of the action on industrial premises, quarries, and earthworks was at first based on investigations following public complaints because the DOE monitoring network was not dense enough and the organizational set-up was not well established at the formative stages for more effective 'policing'.

The extent of the impact and the effectiveness of these regulations in bringing about changes in the air pollution scene for the better is rather difficult to evaluate primarily because of the dearth of information, particularly published, authoritative material. The following comments are, therefore, mostly based on bits and pieces of reports appearing in the media and occasional statements by decision makers and administrators.

Immediately after the regulations were enforced in 1978, the officers of the DOE with the cooperation, in relevant cases, of the Police and the Road

⁽⁹⁾*Emission Standard*: 'The amount of a pollutant emitted from a specified source shall not be greater than some specified amount' (World Bank, 1974).

transport Department did carry out investigations at several factories and roadside checks on motor vehicles. As a follow up, by mid-1979, 37 mills and factories were issued 'show-cause' notices for violating the clean air regulations; they were required to show why they should not be prosecuted and, also, what measures they have taken or are taking to prevent the recurrence of violations (*New Straits Times*, Malaysia, 31.5.1979 and 2.6.1979).

In 1981, 38 commercial premises and factories found to violate the provisions of the clean air regulations were issued written warnings at first, and were fined a total of M\$ 19,200 for various offences. Further, six factories were charged in court for repetitive offences and fined M\$ 5,500 and other premises were also issued written directives to conform to appropriate measures for air pollution abatement (Government of Malaysia, 1983).

The enforcement of the Motor Vehicles Rules was at first mostly against vehicles emitting dark smoke, mainly heavy vehicles and taxis using diesel, sources 'which are fairly easy to monitor and tackle as emission of excessive smoke, soot and gases is attributable to negligence in operation and maintenance' (Friends of the Earth, Malaysia, 1983). By mid-1979, roadside checks on nearly 2,000 vehicles were made; of this, 1,200 were objected to tests by Hartridge Smoke Meters to ascertain the level of dark smoke and 370 were issued written warnings and 469 others were issued summons (Ong, 1979). In 1981, summons were issued to 1516 vehicles for smoke emission offences and a total of M\$ 70,000 was collected as compound fees (Government of Malaysia, 1983).

Action on petrol-driven motor vehicles seems to have been deferred until a proper *modus operandi* for checking them for pollution and, also, emission standards are worked out. It must be realized, however, that although not so evident as in the case of diesel-powered vehicles, petrol-driven vehicles are the main sources of carbon monoxide and lead pollution and hence the enforcement of regulations pertaining to these vehicles is a matter of extreme urgency. This is particularly so because of the fast increasing number of private cars in the urban and residential areas in Malaysia.

SOME ISSUES AND PROBLEMS

In the implementation of the three-pronged strategy in controlling pollution and enhancing the quality of the atmospheric environment several problems have been experienced. Some of them are related to the nature of

the political and economic set-up in Malaysia whereas others stem from the institutional and organizational deficiencies. One may argue that most of these are teething problems which could and would be straightened out in the near future.

The system of administration in Malaysia is three-tiered: Federal, State and Local Governments. The DOE which is the watchdog of the environmental policy is only a coordinating body and has to contend with the reality of the existence of many other agencies (8 Federal and 18 State agencies) having functions related to the development and the utilization of the natural resources and the environment. Hence many problems have arisen in the process of coordination of work involving a multiplicity of agencies whose functions have led to a lot of duplication and conflicts of objectives; the situation is further compounded by the Federal-State conflicts. It appears that the crux of the matter is that the DOE has no authority to require the various government bodies to comply with the spirit and the specifications of the national environmental policy nor the various regulations. In most matters, the DOE has only an advisory role and the decisions are left to the respective agencies themselves.

The State Governments, in particular can be quite stubborn at times in the pursuit of their economic goals. A case in point was the problem of dust pollution created by the quarries in the Batu Caves, close to Kuala Lumpur. The Selangor State Government in whose territory the said area lies did not act promptly to stop the quarrying operations although the evidence was overwhelming that they posed a pollution hazard. The Federal Government while being quite concerned, could not step in directly. The question dragged on for a long time before it was brought to a satisfactory solution due partly to the very aggressive campaigning by various environmental groups and the public.

The DOE has apparently been not successful in effectively getting across to the planners and decision makers the message that creating various material conveniences *per se* would not guarantee an improved quality of life for the people if their environment is polluted. It is, however, expected that in the implementation of the various control, planning and management measures under the three-pronged strategy stated earlier, continuous monitoring and coordination would be effected so as not to let possible conflicts impair the efficiency and effectiveness of those measures.

At the moment, the DOE is only a small division in the Ministry of Science, Technology and Environment. Some observers feel that it should be elevated to the status of a fully-fledged Department if not a Ministry so that its air pollution unit can play a more meaningful and effective role, presumably by virtue of being at a higher level in the administrative hierar-

with a larger organizational and logistical backing, particularly in view of its multifarious functions: air pollution control; environmental surveys; establishing air quality criteria, air quality standards and emission standards; research on specific problems in coordination with other research agencies; land use planning and zoning supervision; and the institution EIA procedure. But unless the basic problem of the Federal-State disagreements is resolved even the change of status will turn out to be only a 'cosmetic' change at best.

It is little wonder that the DOE's resources are stretched and strained considering its multiplicity of functions and the nationwide nature of its coverage. Much of the manpower resources at its disposal are tied down to routine administrative and desk jobs or are channelled to immediate tasks tackling air pollution control often at the expense of other functions which, in the long run, may be as important. As a result, in response to public inquiries and complaints regarding problems such as acid rain, haze episodes, carbon monoxide, lead and dust content in the air and the extent of other pollutants, the DOE has had to, on many occasions, claim ignorance or provide only vague explanations or else admit to being understaffed and underequipped. The lack of adequately trained staff and non-availability of appropriate equipment has led to lax enforcement especially where the sources of pollution are located over a large area.

As at 1980, the air pollution unit of the DOE had 17 professional staff and 42 sub-professional staff, many of whom were inexperienced but supposed to monitor air pollution and administer the enforcement of the regulations all over the country involving nearly $2\frac{1}{2}$ million motor vehicles and 5,000 point sources of pollution. Further, until the end of 1979 there were only 2 Hartridge Smoke Meters for use in kerb-side checks on diesel-powered vehicles. However, under the Midterm Review of the Third Malaysia Plan M\$ 7 million was allocated for the purchase of air quality monitoring equipment and instruments (Ong, 1979). The staff strength was expected to be increased and the regional centres were to be fully functional under the Fourth Malaysia Plan. With these developments a country-wide enforcement of the anti-pollution regulations and planning for the prevention of air pollution were expected to be launched. However, under the present austerity drive and stringent financial management required from all public sector establishments, the allocations for all departments are understood to have been drastically curtailed. Therefore, it is unlikely that the projected expansion programmes of the DOE will be realized for some time to come.

The efforts at incorporating the environmental component in the planning and project evaluation processes has also run into delays and problems. In order to sustain the rapid pace of economic growth of the last

three decades, Malaysia continues to depend on increased foreign investment, particularly in industries. Most of these are in the nature of joint ventures between foreign interests and Federal or State Governments or state-assisted agencies. Although, at first, it looked as if the Environmental Impact Assessment procedure would be applied to all future development projects whether in the public or the private sector as form the Fourth Malaysia Plan period (O'Brien, 1979), surprisingly enough, in the Fourth Malaysia Plan there is no mention at all of the Government's intentions in this regard. Speculation is that strong lobbying by investors has been able to persuade the authorities to postpone if not to drop altogether the requirements of the EIA.

It is learnt that some projects do submit their EIA reports but under the existing institutional and legal set-up it is not obligatory on the part of the respective developers to conform to the suggestions or counter-proposals by the DOE evaluation committees. In certain cases where the DOE did require certain prospective investors to undertake EIA exercises, the reaction is reported to be total indifference or non-compliance or only very slow compliance (Friends of the Earth, Malaysia, 1983).

Nevertheless, the DOE in a recent statement says that the procedure for EIA has been formulated and will be implemented under the Fifth Malaysia Plan given Cabinet clearance (*New Straits Times*, April 2, 1984). It is to be made applicable to all types of development projects industrial or otherwise initiated by the public or private sectors. Should it finally get implemented the EIA procedure may be taken seriously by prospective investors as something which will benefit all parties concerned. Until such time, it is unlikely that advanced planning as a measure for air pollution prevention (or, for that matter, environmental pollution prevention in general) will assume a high place in the order of priorities of the Malaysian development policies and strategies.

AIR RESOURCE MANAGEMENT: SUMMARY AND CONCLUSION

In Malaysia, air pollution is recognized as a problem which requires serious attention. This is evident in the various policy documents and the statements by decision makers during the last decade. The passage of the Environmental Quality Act and the establishment within the DOE of a separate unit entrusted with controlling air pollution and enhancing air quality are reflective of the reaction of the decision makers to this problem. These fundamental phases were followed by various organizational and action programmes instituted with the intention of achieving the objectives of the Environmental Policy: 'Development without Destruction'.

Whereas in most other countries the organizational and implementation phases have had a sequential order, in Malaysia the enforcement

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inery was set in motion close on the heels of the passage of enabling legislation and the setting up of the DOE with only a rudimentary organizational framework. As the instruments of enforcement were being finalized, they were made operational without a gestation period. The thinking in Malaysia appears to be that under the circumstances and context obtaining in Malaysia this is the most realistic and pragmatic approach.

Until now, the efforts and pace of air quality management can at best be considered slow due, maybe, to practical difficulties and the simultaneous launching of the organizational and action programmes which should ideally evolve in their correct sequence. It also appears that the Malaysian authorities are treading the path of environmental protection with a lot of circumspection perhaps in view of the local political and economic realities.

In most treatments on air pollution problems and their control it has been explicitly or implicitly been stated that air pollution is a direct or indirect result of urbanization and industrialization and that a total systems approach geared towards environmental management is required to protect and enhance the quality of the atmospheric environment in particular and the quality of the environment in general. Towards this end, besides the various regulatory and management measures undertaken by the DOE, various government authorities (Federal, State, Local) are taking measures towards better urban planning, zoning of economic activities, traffic planning and creation of more greenery and plant cover in urban areas. The improvement of the road networks in the Federal Territory and in such major cities as Penang, Johor Bharu and Ipoh has definitely smoothened traffic circulation considerably and thereby helped reduce pollution from motorized traf-

In certain individual cases such as dust pollution at Batu Caves quarry, Rawang Cement Work, and chemical pollution at Malayan Acid Works, the problems have more or less been contained; at Batu Caves, for instance, the dustfall levels are found to have decreased by 28 per cent since quarrying operations ceased in 1981 (Sham, 1983b). Also, most of the other cases of pollution by factories seem to have been dealt with, though it cannot be said for sure if the DOE has any continual monitoring measure that the offending parties do not repeat contravening the regula-

CONCLUSION

Motor vehicles being one of the major sources of air pollution, one should have expected the DOE to concentrate a great deal of effort in that direction. However, apart from occasional kerb-side checks reported in the media there does not seem to exist any organized and sustained effort to control heavy vehicles and taxis spewing out black, malodorous smoke in massive quantities in busy arteries of traffic in most cities in Malaysia.

The non-implementation in full of the Environmental Impact Assessment as a routine procedure in the project appraisal and planning stages is a setback in achieving the objectives of the environmental policy especially in view of the faster tempo of economic development in general and industrial development in particular envisaged for the coming years.

Most of the air quality and emission standards adopted in Malaysia are based on the experience of other countries and not necessarily in the perspective of local environmental and socio-economic conditions. This may be due to the relatively short history of air pollution as a problem in Malaysia as well as the short experience in anti - pollution measures.

For the purpose of practical air pollution control, 'air pollution is restricted to those conditions in which the general atmosphere contains substances in concentrations which are harmful or likely to be harmful to man and his environment' (Parker, 1977). Therefore, emission rates must be treated with caution because it is the amount of pollution to which the public is actually exposed and the time of exposure (the 'pollution dosage' if you will) which is germane and the quantification of emissions does not supply the answer. Much of the efforts in air pollution control in Malaysia is directed towards action based on air quality standards and emission standards but there is a distinct inadequacy of attention to air quality criteria¹⁰). Moreover, the air quality standards and emission standards, as mentioned earlier, are not soundly based, much of it being borrowed from foreign experiences without local confirmation. Reliable information on all the above aspects is required to make rational decisions on the basis of facts.

The vital role that the public and environmental groups can play in air pollution abatement in Malaysia cannot be over-emphasized. However, the environmental groups should do well to be wary of making emotion-packed statements which can never be substitutes for solid, hard facts based on scientific studies and no-nonsense approaches..

Formulation of policy, passage of enabling legislation, framing of rules and regulations and the setting up of various instruments for enforcement of the rules and regulations are simpler compared to their actual implementation and enforcement. For, it is at the enforcement phase, interaction with complex political, economic and social institutions is involved. This is perhaps the reason why judicious management of human activities to alleviate air pollution in particular and environmental problems in general has barely begun to evolve in Malaysia.

¹⁰*Air Quality Criteria*: Compilation of effects associated with various concentrations and durations of exposure of pollutants plus other factors such as costs and technological feasibility of emission control and social questions' (World Bank, 1974).

is basically the habits and practices of various strata of society conditioned by their perceptions, thinking and attitudes which are at the root of air pollution and other environmental problems. Therefore, action programmes for environmental protection and enhancement should be initiated by new thinking, new perceptions and change attitudes. In short, Malaysia should think of new approaches to growth and development so that the extremes of no-growth and unbridled growth can be avoided and development could be achieved without environmental destruction.

TABLE I
AIR POLLUTION SOURCES IN PENINSULAR MALAYSIA 1977

Source	Number
Therma Power Plants	13
Boilers	1550
Cement Plants	17
Quarries	341
Timber based industries	1598
Brick and clay works	184
Glass works	23
Metallurgical works	112
Chemical works	371
Oil Palm mills	136
Petroleum refineries	2
Tin smelters	2
Asbestos works	5
Lead-related producers	7
Feed mills	186
Rubber smoke houses	698
Rice and grain mills	1258
Incinerators	350

(Sources: Ong, 1979; Tan, 1982)

TABLE III
SUSPENDED PARTICULATE LEVELS FOR SELECTED
SITES PENINSULAR MALAYSIA 1977-78

Site	Type of area	Monitoring Period	Sample number	Level obtained ($\mu\text{g}/\text{m}^3$)		
				mean.	max.	min.
Petaling Jaya						
Section 51	industrial	Jan-Dec 1978	135	157	275	77
Damansara Utama	residential	Jan-Dec 1978	131	90	203	32
Kepong						
Taman Petaling	residential	Mar-Apr 1978	23	143	183	103
Kepong Baru	residential	Mar-Apr 1978	24	147	240	107
Ipoh						
PPC Bus/Complex	commercial	Apr-May 1978	12		113	49
Chartered Bank District	commercial mixed	May 1978	13	95	164	72
		May 1978	14	76	144	45
Georgetown						
Sekolah	commercial	May-Jun 1978	16	107	133	78
Kampung Jawa						
Balai Polis	commercial	May-Jun 1978	15	93	110	82
Jalan Petani						
Lam Soon	commercial	Jun 1978	9	95	131	68
Cannery						
Malacca Industrial Estate						
Yardley	industrial	Oct-Dec 1978	59	84	156	41
Factory						
FIAT Factory	industrial	Oct-Dec 1978	56	77	179	38
Malacca Caves						
Kg. Batu Caves	residential	Mar 1977	5	255	—	—
Kg. Melayu Selatan	residential	Mar-Apr 1977	7	182	—	—
Kg. Nakhoda	residential	Mar 1977	14	144	—	—
Rawang						
Balai Polis	residential	Aug 1977	6	106	—	—
Rawang						
Kg. Baru	residential	Sept 1977	9	96	—	—
Rawang						

10 suggested criteria is $50 \mu\text{m}^3$ (annual)

Source: Divison of Environment, Ministry of Science, Technology & Environment).

TABLE IV
SULPHUR DIOXIDE LEVELS FOR SELECTED SITES
PENINSULAR MALAYSIA, 1978

Site	Type of area	Monitoring Period	Sample number	Level obtained ($\mu\text{g}/\text{m}^3$)		
				mean.	max.	min.
Petaling Jaya						
1. Section 51	industrial	Jan-Dec 1978	139	43	101	2
2. Damansara Utama	residential	Jan-Dec 1978	142	4	20	*
Butterworth						
1. PPC Bus Complex	commercial	Apr-Mar 1978	11	99	178	50
2. Chartered Bank	commercial	May 1978	7	39	49	16
3. District Hospital	mixed	May 1978	12	49	147	16
Pulau Pinang						
1. Sekolah Kampung Jawa	commercial	May-June 1978	25	34	96	16
2. Balai Polis Jalan Petani	commercial	May-June 1978	15	53	116	17
3. Lam Soon Cannery	commercial	June 1978	13	41	71	18
Larkin Industrial Estate						
1. Yardley Factory	industrial	Oct-Dec 1978	53	31	126	*
2. FIAT Factory	industrial	Oct-Dec 1978	59	39	350	*
3. Cheshire Home	residential	Oct-Dec 1978 (monthly sample)	2	0.49	ppm	
4. Balai Raya Jalan Unku Mohsein	residential	Oct-Dec 1978 (monthly sample)	2	0.23	ppm	

*negligible

WHO suggested criteria is 0.02 ppm or 60 $\mu\text{g}/\text{m}^3$ (annual). This applies only when related to particulate concentration.

(Source: Division of Environment, Ministry of Science, Technology and Environment)

TABLE V
LEAD CONCENTRATION AT SELECTED
SITES IN KUALA LUMPUR,
SELANGOR AND PULAU PINANG.

Pudu Road, Kuala Lumpur

	Length of Survey	Range in Reading	Mean
1979	3 months	4.5 - 8.2 mg/m ³	3.7 mg/m ³
1980	9 months	0.2 - 8.65 mg/m	4.5 mg/m ³
1981	9 months	0.1 - 7.5 mg/m ³	4.5 mg/m ³

Daily Readings at selected sites (October 14-22, 1981)

Place	Range in Readings	Mean	Nature of activities
Amansara Utama	0.44 - 0.74 mg/m ³	0.52 mg/m ³	Residential
Merajaya Jaya (Old Town)	0.44 - 1.00 mg/m ³	0.58 mg/m ³	Residential/ retail business
Alam Tunku Abdul Rahman, K.L.	4.10 - 5.60 mg/m ³	4.80 mg/m ³	City centre
Alam Pudu, K.L.	4.10 - 6.40 mg/m ³	4.50 mg/m ³	City centre

Daily Readings at Selected sites in Penang (September, 1982)

Place	Range in Readings	Mean	Nature of activities
Penang Road	1.10 - 3.10 mg/m ³	1.30 mg/m ³	busy thoroughfare business centre
Seti Road	0.40 - 0.70 mg/m ³	0.60 mg/m ³	low traffic
Waterworth	0.80 - 1.20 mg/m ³	1.00 mg/m ³	residential/ industrial

Source: *New Sunday Times*, Nov. 28, 1983

TABLE VI
SUMMARY OF EMISSION LIMITS AND STANDARDS
PRESCRIBED UNDER ENVIRONMENTAL QUALITY
(CLEAN AIR) REGULATIONS 1978.

I. DARK SMOKE FROM FUEL BURNING EQUIPMENT

Type of Fuel used	Existing or New Equipment	Dark Smoke Limit
Solid fuel	Existing and New	Ringelmann 2
Liquid fuel	Existing	Ringelmann 2
Liquid fuel	New	Ringelmann 1

II. EMISSION STANDARDS FOR AIR PURITIES

Substance emitted	Sources of Emission.	Standards		
Solid particles Concentration in the heating of metals		Standard A: 0.3 gm/Nm ³ Standard B: 0.25 gm/Nm ³ Standard C: 0.2 gm/Nm ³		
Solid particles Concentration in other operations		Standard A: 0.6 gm/Nm ³ Standard B: 0.5 gm/Nm ³ Standard C: 0.4 gm/Nm ³		
Metals and metallic Compounds.		Std. A	Std. B	Std. C
Mercury		gm/Nm ³	gm/Nm ³	gm/Nm ³
Cadmium		0.02	0.01	0.01
Lead		0.025	0.015	0.015
Antimony		0.04	0.025	0.025
Arsenic		0.04	0.025	0.025
Zinc		0.15	0.1	0.1
Copper		0.15	0.1	0.1
Acid Gases	Manufacture of Sulphuric acid	1. Equivalent of: Standard A: 7.5 Standard B: 6.0 Standard C: 3.5 gramme of sulphur trioxide/ Nm ³ of effluent gas,		
		2. Effluent gas free from persistent mist.		
Sulphuric acid mist or sulphur trioxide or both	Any source other than combustion process and plant for manufacture of sulphuric acid as in (a) above.	1. Equivalent of: Standard A: 0.3 Standard B: 0.25 Standard C: 0.2 gramme of sulphur trioxide/Nm ³ of effluent gas.		
		2. Effluent gas free from persistent mist.		

**TABLE VII
MALAYSIA AIR QUALITY STANDARDS**

Pollutant	Averaging Time*	Concen.	Applicable to
Suspended Particulates	1 year	0.02 ppm	All zones
	24 hours	0.05	Res/common zone
	24 hours	0.08	Industrial zone
	1 year	0.04 mg/m ³	Res/Common zone
	1 year	0.08	Industrial zone
Carbon Monoxide	24 hours	0.05 mg/m ³	Res/common zone
	24 hours	0.1	Industrial zone
	30 min	0.1 mg/m ³	Res/common zone
	30 min	0.2	Industrial zone
	1 hour	35	All zones
Sulfuric Acid	24 hours	3 ppm	All zones
	8 hours	9	All zones
	1 hour	35	All zones
Hydrogen Sulfide	30 min	3	Residential zone
	24 hours	0.1 ppm	Com./Industrial zones
	20 min	0.3	Industrial zone
Hydrogen Fluoride	24 hours	0.01 ppm	All zones
	30 min	0.03	Residential zone
	30 min	0.1	Com/Industrial zones
Deposited Particulates (µg/m ² - month)	24 hours	0.001 ppm	Residential zone
	24 hours	0.04	Industrial zone
	30 min	0.01	Industrial zone
Deposited Particulates (µg/m ² - month)		30 tons	Industrial zone
		10	Residential zone
		8	Specially protected areas

100% of time not allowed

Continue Table VII

Pollutant	Averaging Time*	Concen.	Applicable to
Ammonia	30 min	5 ppm	Industrial zone
	30 min	1	Res./Com. zones
Carbon Disulfide	30 min	0.15 ppm	Industrial zone
	30 min	0.01	Res./Com. zones
Chlorine	30 min	0.1 ppm	Industrial zone
	30 min	0.01	Res./Com. zones
Ethylene	1 hour	0.01 ppm	All zones
Nitrogen Dioxide	24 hours	0.05 ppm	All zones
	1 hours	0.2	All zones
Beryllium	30 days	0.01 $\mu\text{g}/\text{m}^3$	—
	24 hours	0.01	—
Calcium Oxide	—	0.02 mg/m^3	—
Lead	24 hours	0.0007 mg/m^3	All zones
	30 min	0.02	All zones
Sulfates	1 year	0.004 mg/m^3	All zones
(as H_2SO_4)	30 days	0.01	All zones
	24 hours	0.03	All zones

(Source: Tan, 1979)

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