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DEVELOPMENT OF INTEGRATED NATIONAL AIR QUALITY MANAGEMENT STRATEGIES IN ESCWA MEMBER STATES

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Development of Integrated National Air Quality Management Strategies In ESCWA Member States

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Abstract

The rapid growth of urban/industrial areas in all ESCWA Member States, (EMS), during the past decade, increased the concentrations of air pollutants near the ground in most-if not all- of these areas. This situation has become of increasing concern at the national level. In most of EMS, environment protection laws (command instruments), have increased the powers for the local authorities (control instruments), to manage air quality and to seek assistance of a wide range of local research institutes. This paper discusses the need to develop an integrated national air quality management strategy and its relevance to the general national sustainable development approach; then it moves on to lay out the general characteristics and components of such a strategy; namely diagnostic/data collection components, setting objectives, defining policies, in addition to designing and implementing programmes to achieve these objectives. It is also imperative to include two important components to the proposed strategy in order to warrant the effectiveness and sustainability of the whole process. The first one is to carry out a cost-benefit analysis for each of the proposed programmes prior to its implementation. The second component is a reviewing mechanism capable of modifying/redesigning any programme during its implementation, when needed.
The paper will also discuss the implementation of the proposed integrated air quality management strategy in light of the current environmental management systems in some EMS, with a closer look at the legislative and institutional needs for the implementation of such a strategy in some of these countries. Recommendations regarding successful implementation of an integrated national air quality management strategy are also presented.

Introduction

This paper is designed to address policy makers and top government officials dealing with urban air pollution problems. Pollution of the atmosphere affects the lives of millions of people in urban industrial areas. Cities like Cairo (a Mega City), Damascus, and Sana'a, for example, are now suffering from high concentrations of air pollutants, such as PM_{10}, $PM_{2.5}$, SO_x, NO_x, VOCs, and Ozone. Transportation, industry, and garbage/agricultural burning are the major sources of air pollution. During the past decade, each of EMS countries responded to abate air pollution in a different way. All EMS, except Kuwait [(1)], started with the command and control approach by focusing on the command part and hence issuing laws for environment protection. While some EMS started the control part with enforcing successful vehicle emission testing programs (Jordan), others started with disseminating the implementation of pollution prevention measures among the most polluting industrial sectors (Egypt)[(2)], or creating and running urban air quality monitoring systems (Kuwait)[(1)]; to mention a few. In almost all EMS, command and control, remediation measures, and even preventive approach, were all executed in absence of a clear long term national strategy for air quality management, especially for urban areas. In the year 2000, due to the pressing situation of air quality degradation in Cairo, there was an attempt in Egypt to develop a national strategy for air quality management.

During the past decade, most of EMS adopted sustainable development as a sound approach for improving the livelihood of this generation, while protecting the rights of the coming generations to enjoy and utilize their natural resources. The major principle in sustainable development planning is to create a balance between the three interactive components, namely economic, social, and resource conservation. Urbanization and industrialization exert great pressure on urban air environment due to increasing emission loads of pollutants, which have an adverse impact on public health; which in turn is translated into consuming a sizable chunk of GNP. Therefore, designing and implementing a realistic, but effective, national urban air pollution improvement strategy became, from the author's point of view, a necessity due to the expected rapid urbanization and industrialization during the coming two decades in the EMS region. This paper is presenting a model for a national air quality management strategy (NAQMS), which should be developed as an integral part of a national environmental strategy. Needless to say, the latter should be developed, in turn, under the larger umbrella of the national sustainable development strategy. Throughout the paper, examples are presented from several experiences in the EMS. The author wants to emphasize the fact that these are mere examples and do not represent a full survey of all activities pertinent to mitigation/abatement of urban air pollution in the EMS region.

NAQMS Components and Required Instruments

In this section, strategy components and requirements are presented. In addition, examples from EMS are presented where appropriate. In addition, figure (1) represents a flow diagram for the implementation of urban air quality management strategy.

1- Diagnostic Components

As in any strategy, an analysis of the current situation is the first step to establish a base line, among other things. In order to collect enough information and data enough to describe the current status of ambient air, this component should comprise the following systems and studies:

- A Comprehensive Air Quality Monitoring System: this system provides data regarding concentrations of priority air pollutants, i.e. PM_{10}, $PM_{2.5}$, SO_x, NO_x, VOCs, and Ozone. Monitoring stations should be situated to provide data pertinent to air quality in various regions of the city where various human activities take place. For example, in Cairo, Egypt, there are six monitoring stations providing measuring and transmitting, online, hourly concentration data for PM_{10}, $PM_{2.5}$, SO_x from, NO_x, and Ozone. These stations are located so that they can measure emissions resulting from residential, industrial, industrial/residential, and traffic activities[3].

- Emission Inventory Studies: these studies, when conducted, reveal a true picture about the amount and type of pollutants emitted every year from major polluters (point source) individually, and the same for a cluster of polluters; e.g. a cluster of brick kilns (area source).
  This type of study was conducted in Egypt, during 2002-2003[4], for the Southern Greater Cairo Region; and provided the following consequent and inter-related outputs:

  a) Emission Inventory the industrial point sources
  b) Dispersion modeling of PM_{10} and SO_x emissions
  c) Health Risk assessment of PM_{10} emissions
  d) Pollution abatement measures and associated costs

  It is also important to indicate that the study contributed to the efforts for amending the Executive Regulations of Law 4/1994. In other words, the study provided key information that revealed the need for enforcing the self-monitoring activities as well as introducing the concept of emission loads[5]. This would

provide a sound basis for establishing a system for continually improving emission inventory as well as the consequent studies to improve the environmental quality.

- Health Risk Assessment Studies: these studies provide the decision makers with a powerful tool since it translates the impact of air pollution into its actual health risk; which in turn can be translated into actual adverse impact on GDP.
  In 1999, Mike Smith et al[6], revealed that an estimated annual loss of USD 1-1.5 Billion can be attributed to health damage cost attributed to air pollution in Cairo. It was also estimated that mitigation measures with a cost estimate of about USD 1 Billion over a three year period can dramatically take off 70 - 80 % of this annual loss.

- Source Attribution Studies: these studies are aimed at estimating the contributions of major sources of pollution to the concentrations of each priority pollutant in ambient air through sampling at various seasons to obtain source signatures. Then with the knowledge from air quality monitoring data, coupled with a sophisticated modeling process, percentages of attribution of each source to each priority pollutant are estimated. During 1999, a source attribution study was conducted in Cairo[7]. The study focused on source of PM_{10} and $PM_{2.5}$ pollutants. Results of this study identified major polluters, and hence were instrumental in developing policies, programmes, and mitigating measures.

- Air Quality Index (AQI): this index is utilized to inform officials and the public at large of the air quality status in urban areas on daily basis. It is worth noting that the information from AQI of each of New Delhi, Mombay, Calcutta, and Madras are broadcasted on daily basis on TV on Watch Channel, presenting levels of pollution of all priority pollutants. In year 2000, an AQI was designed particularly for Cairo, and was approved by the Board of Directors of the Egyptian Environmental Affairs Agency (EEAA) at the end of that year[8]. However, it did not get the approval of the Prime Minister for reasons unknown.

- Early Warning System (EWS): this system aims at providing a "forecast" for one or more priority pollutants for the coming three days. It is an important tool in preventing the risk of major public exposure to unhealthy, and may be hazardous, concentrations of major pollutants. It functions through combining hourly concentration data of air pollutants from monitoring stations along with the meteorological data (temperature changes, wind speed and direction changes, etc) and its forecast, and then blends the mix in an advanced computer model. The output is a forecast for the pollutant concentrations for the coming three days, with decreasing accuracy as you go farther. In its best performance, it can work with 75% accuracy, according to experts of the Early Warning System for Ozone Episodes in the Los Angeles Basin, USA[7].
  An Early Warning System has been up and running in EEAA for PM_{10} in Cairo since September 2000, and it was able to predict Air Pollution Episodes with reasonable accuracy, where the sources of pollution were from within Cairo Region. The Cairo EWS could not predict the famous (Black Cloud) air pollution episodes which plague Cairo every fall because they occur mainly due to the nightly burning of thousands of tons of rice straw in various areas of the Delta region. On the other hand, it was able to predict the Spring episodes, which occurred due to the southern slow winds that carried Heavy loads of PM_{10} from heavy industries, mainly Iron and Steel, when the filters of the main sintering unit were not functioning (Spring 2000)[8].

2- Required Instruments

This is the most important component in the command and control approach since it comprises both the legislative and institutional instruments;

- Legislative Instruments: with regard to the legislative instruments, one could notice that, in most EMS, there are good and sound Laws, Executive Regulations, Ministerial Decrees, ...etc that govern a wide range of environment protection actions. Moreover, one has to note a trend for improvement, especially in the area of urban air quality controls. For example, EPA/Yemen is embarking since 2006 on developing a new Bill for environment protection to replace the 1995 Law[1]. One of the important improvements in the new Bill is the introduction of a new chapter entitled "Protection of Air Environment" which did not exist in the original Law. Another example is when the Executive Regulations of Law 4/1994 of Egypt was modified in 2005 so that tables pollution load limits were added, and tables of permissible limits of pollution concentrations were revised to lower these limits[5].

- Institutional Instruments: in most EMS, there is one governmental authority responsible, by law, for the protection of the environment. In some EMS, there are two bodies; one is responsible for biodiversity and wildlife protection (the green side), and the other is responsible for the brown side, i.e. management of pollution mitigation, including mitigation of air pollution. During the past five years the environment protection agencies in some EMS, e.g. Syria and Yemen, reviewed/restructured there organizational setup, including air quality management institutional units, in order to warrant efficiency and effectiveness. However, there is a strong need in most EMS environment agencies to improve/upgrade the quality of their human resources through various types of training in various fields of air quality monitoring and also in inspection, especially at the level of middle management and junior staff[1].

- Embedding Environmental Dimensions into National Strategic Planning: this is the most important factor to ensure environmental sustainability, and hence achieving sustainable development. Various adverse impacts of urban air pollution could have been avoided if environmental considerations were taken into account at the national strategic planning level. For example, the choice of several industrial complexes and establishments near cities in Syria, Oman, and Kuwait could have been better if proper environmental impact assessment studies were conducted and followed, to say the least. In addition, embedding environmental dimensions into national strategic planning will prevent, for example, the expansion of urban development towards industrial complexes. Several EMS are now at the beginning of this process; e.g. the Kingdom of Saudi Arabia started this process during the development of its Strategic Sustainable Development Plan (2005 – 2025), and also incorporated environmental considerations in its population policies; the Sultanate of Oman is now embarking on developing the institutional instruments to ensure embedding environmental considerations in strategic planning[1].

- Crisis Management Unit (CMU): the main purpose of this special institutional instrument is to respond to the information produced by the Early Warning System by putting pre-designed scenarios into operation, in full cooperation with pertinent authorities, in order to minimize the adverse impact of higher-than-acceptable levels of urban air pollutants on the public.

3- Setting Objectives

SMART objectives could be developed if pertinent information on the current status of urban air quality is available, and also if the required instruments to achieve these objectives are in place. The process of objective development should be carried out through engagement of All stakeholders. Accordingly, it was noticed that, in

various EMS, This process was carried out in the past mainly by teams composed of government officials and technical experts, with some involvement of the polluters, e.g. plant owners, official from transport sector, power station officials, etc. Top management commitment to these objectives is paramount, as in most developing countries.

4- Defining Policies

The selection of appropriate policies to achieve set objectives is a sophisticated process that depends on available information and resources, among other things. For example, Egypt adopted the policy of switching to cleaner fuel (wherever possible). In 1999, it was estimated that about 300 tons of SO_2 were emitted daily in the Cairo air from the four power stations due to the use of heavy oil, which has sulpher content of ~3%. Through negotiations between Ministries of Petroleum, Electricity, and Environment under the umbrella of the Prime Minister, it was found that all four stations had a dual system that can be switched to burn natural gas immediately because all needed infrastructure was in place. Therefore, switching to cleaner fuel was adopted as a policy by the Ministry of Electricity, and the Ministry of Petroleum was committed to supply all needed natural gas; a protocol was signed between the three Ministries in October 2000, and more than 290 tons/day of SO_2 were eliminated from Cairo air [8].

5- Designing Programmes

Programmes aimed at reducing urban air pollution are, in many cases, implemented by the polluters themselves. Therefore, realistic programmes can only be designed through involving partners who are going to implement it; which can only succeed if their interest is kept in mind. This was the key for the successful implementation of switching automobiles from gasoline to natural gas (NG), in Cairo (started in 1997). Implementation of this programme was so successful that, in the beginning, the number and capacity of fueling stations could not respond to the number of taxis willing to switch to NG.

6- Implementing Programmes

As in any programme, two major factors are instrumental in the success, or failure, of implementation of any urban air quality improvement programme: top-policy maker/management commitment; and availability of proper resources (human, financial, and otherwise). Political will is the key (On/Off), especially in developing countries where civil society is not yet empowered to exert pressure on polluters and decision makers.

7- Continuous Improvement

Continuous improvement is the key to warrant system sustainability and its ability to cope with changes in loads and type of pollutants. Therefore, an institutional unit should be incorporated in the system of urban air quality management, with the sole task of reviewing the current operational procedures to examine its efficiency and effectiveness; and hence recommend changes to accommodate any shortcomings that resulted from newly developed factors. Figure (2) provides an example for designing, implementing and continuously improving a program for the management of on-road vehicle emissions based upon the wholistic approach concept.

Conclusions and Recommendations

1. It became apparent that in most EMS, top-level officials/decision makers, are not fully aware of the fact that sustainable development cannot be achieved without ensuring environmental sustainability; this in turn makes it difficult for environmental authorities to convince them of the vital importance of allocating funds for urban air improvement programmes. Therefore, one of the most important tasks for environmental protection authorities is to gain political commitment through continuously engaging top officials in environmental awareness programmes, translating environmental degradation into economic losses, and focusing on the positive contribution of urban cleaner air into the national economy.

2. The second step should be working on embedding environmental considerations into strategic planning at the national level. This will warrant incorporating key preventive environmental instruments, e.g. EIA studies, into planning and designing national urban/industrial projects. In addition, it will present the decision makers with the full picture and assist in adopting the most effective scenarios to ensure sustainable development.

3. There is a strong need to establish air quality monitoring networks in major cities, which is expensive. However, this can be achieved through implementing a plan based on prioritization, simplicity, and effectiveness. A simple urban air quality monitoring programme, measuring key air pollutants at three carefully chosen locations, with the flexibility for further expansion, can be a good start for a future more sophisticated system.

4. There is a wealth of scattered data and information pertinent to urban air quality gathered through studies conducted by universities and research institutes in various EMS. This knowledge base can be a good source of guidance to the starting point.

5. All stakeholders should be involved in the process of setting objectives; this is the only way to warrant their commitment throughout programme implementation.

6. Setting policies should be a process on the national level as it involves national commitments. For example, moving to cleaner fuel may mean moving to unleaded gasoline first, switching to natural gas first, or go simultaneously. This is why we put political commitment at the top of the list.

7. Starting implementation with the most effective programme that produces maximum abatement of air pollutants with the minimum cost at the shortest period of time; this will present a quantum leap in the mode of thinking of decision/policy makers at the national level and also within the public at large.

8. An effective corrective mechanism should be an integral part of the whole system to ensure sustainability

9. Throughout the whole process, the utilization of national expertise in various fields is pertinent to ensure environmental sustainability in general and urban air quality improvement in particular. In addition, it is also important to call for the assistance of regional and international organizations in order to speed up the process. Regional and international organizations are usually encouraged to provide technical assistance when they realize that the addressed issues are of national concern. Therefore, effectiveness of the role these organizations is highly dependent on the commitment and clarity of vision at the national strategic and operational levels.

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FIGURE (1) A STRATEGY FOR AMBIENT AIR QUALITY MANAGEMENT

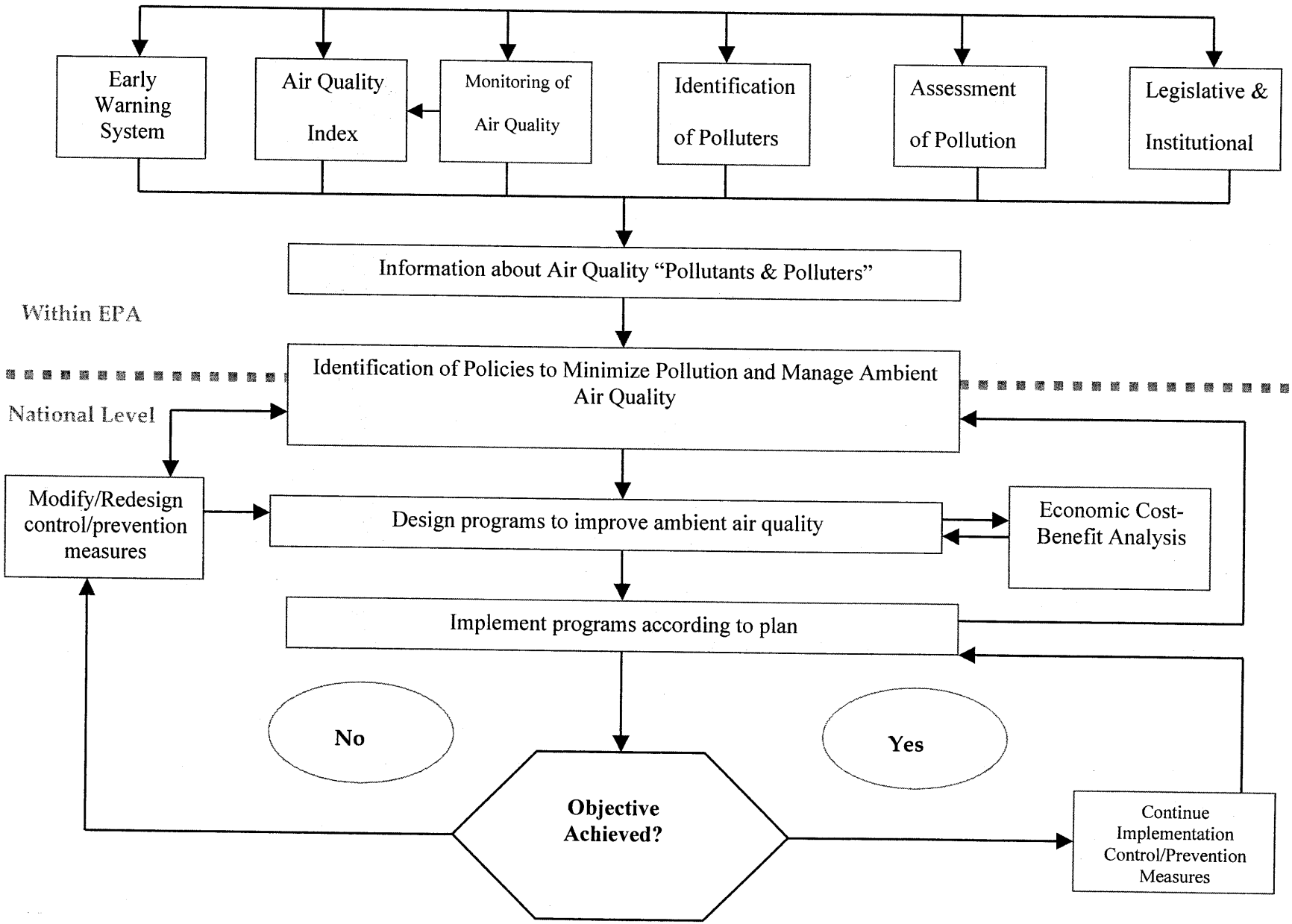

FIGURE (2) NATIONAL PROGRAM FOR MOBILE EMISSIONS