URBAN AIR QUALITY STRATEGY IN ASIA
PROJECT REPORT

Kathmandu, Nepal and Bombay, India
November 27 to December 9, 1993

Prepared for:

US - ASIA ENVIRONMENTAL PARTNERSHIP

WORLD ENVIRONMENT CENTER

DISCLAIMER

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I. EXECUTIVE SUMMARY

From November 27 through December 9, 1993, Dr. Greenfield traveled to Kathmandu, Nepal and Bombay, India on a mission sponsored by the US-AEP through a Cooperative Agreement with WEC. Dr. Greenfield is Senior Vice President of Systems Applications International (SAI) in San Rafael, California. SAI is a division of ICF Kaiser International, Inc., and is an environmental consulting firm specializing in the analysis of the causes of air pollution and the development of effective control and management strategies. Dr. Greenfield has more than 40 years of experience in the environmental sciences with particular emphasis on air quality.

In 1970 Dr. Greenfield helped to found and organize the U.S. Environmental Protection Agency and served for four years as Assistant Administrator and head of its Office of Research and Development. Dr. Greenfield is also a Senior Associate of the Pacific Basin Study Center a not-for-profit research group formed by the University of California, Davis and The California State University in San Francisco. He is the author or co-author of numerous scientific journal articles, reports, and books, and is a Fellow of the American Meteorological Society. He is listed in *American Men of Science.*

Dr. Greenfield's participation in this exchange was supported under the United States-Asia Environmental Partnership (US-AEP) Environmental Business Exchange (EBE) program, through a Cooperative Agreement with the World Environment Center (WEC). The purpose of this exchange was to join the team taking part in the Urban Air Quality Strategy in Asia (URBAIR) project of the World Bank designed to provide ongoing assistance to Kathmandu and Bombay in addressing their perceived serious air pollution problems.

The ultimate objective of this project is to assist the cities involved in developing air quality Action Plans which will identify the necessary steps to be taken in a program designed to significantly reduce their air pollution. The objective of this current segment of the exchange was to participate in the initial URBAIR workshop in Kathmandu.

In addition, Dr. Greenfield took part in meetings in Bombay, India, as a follow-on to the workshop held in that city in April 1993. These meetings took place December 6-8, 1993 and were held at the Trade Center, the Ministry of Environment and Housing, and K.E.M. Hospital.

Based on the results of the first workshop in Kathmandu, a local effort will be undertaken to begin the development of the Action Plan and make preparations for the second workshop. The second Workshop is planned in Kathmandu for

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late August or early September 1994. Similarly, the committee activity currently under way in Bombay, in association with the local consulting group, has begun the development of the Action Plan, and will lead to a second workshop to take place in April, 1994. Dr. Greenfield will be returning to Kathmandu and Bombay to participate in these workshops.

It should be noted that in both Kathmandu and Bombay the technical issues are well understood, or can be readily approached. The institutional, policy and regulatory issues are not as straight-forward or as well understood, and will have to be approached carefully, taking into account the varying cultural requirements.

The following are recommendations of what should be undertaken to effectuate air quality improvement in Kathmandu, Nepal.

- Update the inventory of energy use developed for the Kathmandu Valley. Establish strict emissions regulations.
- Continue ambient air quality monitoring and develop a dispersion model for the Kathmandu valley.
- Undertake health studies to determine impact of pollution exposure.
- Reexamine fuel pricing policy.
- Strengthen local governments' ability to deal with pollution problems.
- Continue the Kathmandu Valley Vehicle Emission Control Project.
- Remove taxes on emission control device parts.
- Develop strict regulations on diesel vehicle emissions.
- Consider maintenance options for 2-stroke engines, phase out 2-stroke tempos, and ban import of 2-stroke motorcycles.
- Improve the public transportation system to reduce dependence on private transport modes. Improve traffic management. Educate vehicle owners and drivers. Establish traffic regulations.
- Control quality of fuel sold in the Kathmandu Valley.
- Control road dust.
- Identify industrial zones and restrict location of new industries to these zones. Require EIA for construction of new industries. Establish emission standards and an inspection program to determine compliance.
- Consider relocation of Himal Cement Factory.
- Consider new process technologies and pollution control for brick industries.
- Reassess efficiency of boilers using rice husks.
- Review management of small-scale industries.
- Ensure that new home construction includes installation of stoves with proper ventilation of gases.
- Utilize data obtained to develop effective strategy and regulations to control air pollution in the Kathmandu Valley.

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Regarding market opportunities in Nepal, there is the need to eliminate and/or convert the two-stroke Tempos to a less polluting form. It is conceivable that by using Kathmandu as a demonstration of the feasibility of a Tempo conversion to electric power, including the required infrastructure, a market for these conversions could be established throughout Asia. In addition, improving the air quality in Kathmandu Valley involves moving industries, such as carpet making or cement making, to other regions in Nepal. The required infrastructure for this relocation would also offer opportunities for U.S. companies.

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I. INTRODUCTION

This report presents the findings, conclusions and recommendations by Dr. Stanley M. Greenfield as the result of an URBAIR exchange to Nepal and India extending from November 27, 1993 to December 9, 1993.

Under the auspices of the United States-Asian Environmental Partnership (US-AEP) EBE program, through a Cooperative Agreement with the World Environment Center (WEC), the Urban Air Quality Strategy in Asia Project (URBAIR) is providing ongoing assistance to the governments of Kathmandu, Nepal and Bombay, India to address their perceived serious air pollution problems. The primary assistance provided is directed towards the development of an Air Quality Action Plan whose purpose is to identify the specific steps required to establish a program that could lead to a significant improvement of the air quality in each of these highly populated cities. As part of the URBAIR process the World Bank, directly or indirectly, makes available to the city and its agencies, consultants with the appropriate expertise and experience to provide guidance and input.

The air pollution problem in Kathmandu is localized, but quite severe. While there is some small amount of industrial activity in the Kathmandu Valley, the primary sources of the air pollution in the city appear to be particulates emitted by badly maintained diesel cars, buses, trucks, and two-stroke motorcycles, as well as resuspended particles from uncleaned and unpaved roads, and discarded construction waste. However, specific quantitative data are lacking in most cases.

The deteriorating air quality in Kathmandu has had a noticeable negative effect on this country's very important tourist industry. This negative impact is primarily in the form of degraded visibility which hides the normally magnificent mountain vistas. One suspects, however, that a significant health impact also exists. A very urgent enthusiasm and determination is expressed by people in Kathmandu, that the necessary steps be taken to improve the air quality. However, it must be recognized that Nepal and Kathmandu are at the very beginning of the process that could lead to an improvement in the air quality. Even though the basic technical steps and directions appear evident, they have some very difficult institutional and infrastructure decisions to make.

A workshop on air quality in Kathmandu was held on December 1-3, 1993, at the International Convention Center in the district known as New Baneshwor. This workshop was jointly sponsored by the World Bank (MEIP), the United Nations

Development Program, and the World Health Organization (WHO). It was well attended by more than 50 people representing a cross-section of governmental and non-governmental groups. Meetings were also held with various Nepalese groups, individuals, and local representatives of USAID.

The workshop resulted in a fairly large set of specific recommendations. The primary recommendations concerned (a) controls and restrictions on the vehicular fleet in the Kathmandu Valley, (b) consideration of infrastructure changes which would encourage certain activities to locate outside of the Kathmandu Valley, (c) the need to develop an extensive emission inventory for the valley, and (d) the need to develop an improved meteorological analysis of the valley (horizontal and vertical distribution of wind and temperature, variation and distribution of mixing depth, etc.).

This exchange also included a trip to Bombay, India to participate in meetings held in April, 1993 as follow-up to an earlier air quality workshop. These meetings were primarily with the local committees and consultants charged with gathering the required data and preparing the issue papers that are the necessary steps leading to the development of an effective Action Plan.

The air pollution problem in Bombay is also quite severe, but not as localized, definable, and straight-forward as that in Kathmandu. Bombay is a city of approximately 11 million people (10% of whom live on the streets). Greater Bombay covers an area of over 400 km^2 and has almost 7000 industrial units consisting mainly of textile, chemical and petrochemical, and engineering plants. Its motor vehicle population exceeds 600,000. Additional sources of air pollution are the use of LPG and kerosene for cooking, and the ship traffic in the port area. In terms of air pollution levels, Bombay does not appear to have a significant SOx or NOx problem, but the observed particulate loading exceeds the WHO and U.S. standards. One also observes a high ammonia level in the ambient air, and suspects a high road-way lead concentration and possibly the occurrence of elevated ozone levels.

The meetings in Bombay concentrated on discussions with the three committees established after the initial workshop. These committees were to address (a) emission data collection, (b) health impact data - economic issues, and (c) policy, regulatory, and institutional issues. Based on these discussions issues papers are being drafted in preparation for a second Bombay URBAIR workshop which will consider the contribution of the various sources of Bombay's air pollution problem. This workshop will be directed towards the development of an Action Plan that takes into account the costs and benefits of alternative air quality management strategies, within various institutional and regulatory frameworks.

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The second Bombay workshop will be held in April of 1994, and the second Kathmandu workshop will be held in late August or early September of 1994. Dr. Greenfield will return to Bombay and Kathmandu to participate in these workshops and to continue discussions with governmental and private sector representatives in these cities.

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III. DISCUSSION AND FINDINGS

A. Introduction

With the sponsorship of the United Nations Development Programme (UNDP), the World Bank has developed the Metropolitan Environmental Improvement Program (MEIP) designed to assist the megacities of Asia in solving their growing environmental problems. Recognizing that a major environmental problem, common to every rapidly growing city, is significantly degraded air quality, the World Bank established the Urban Air Quality Management Project (URBAIR) as part of the MEIP. The URBAIR program was initially designed to provide specific assistance, to four major Asian metropolitan regions, accomplishing this through a series of locally organized workshops that bring together the government and non-governmental interests in each city and making available, as a resource, outside experts.

It should be emphasized that it is not the purpose of the URBAIR project to develop the strategy for each of these cities, but rather to assist the local authorities and the concerned and involved private sectors, in arriving at their own effective Action Plan. In carrying out this purpose, the World Bank prepared a guidance document summarizing the available information on each specific city, providing a general approach to the development of an Action Plan. This is, as indicated, followed by the locally organized and directed initial workshop that brings together the concerned and affected agencies, organizations and individuals to discuss the perceived problems and the additional data required for their understanding. This workshop also identifies the nature and extent of the potential institutional and infrastructure changes that must be addressed in seeking effective implementable solutions to the perceived problems.

This particular exchange was concerned with two of the four major cities chosen by the World Bank to participate in the URBAIR program - Kathmandu, Nepal and Bombay, India. The first Kathmandu workshop was held as part of this exchange; it represents the major portion of this report. The Bombay workshop was held prior to this exchange, in April, 1993. At that time Dr. Greenfield was not, as yet, a participant in the program. The nature of the visit to Bombay was to update the team on the progress made in acquiring the data needed for the next steps leading to the second workshop and the completed Action Plan. It was a relatively short visit dominated by meetings of the three committees formed after the first workshop and charged with the responsibility of developing the material for the second. While a short visit, it did provide Dr. Greenfield with an opportunity to meet and interact with a broad spectrum of people involved in various aspects of this program, and to experience, first hand, the nature of the air pollution problem in Bombay.

B. Kathmandu, Nepal

1. Meetings

The World Bank team met in Kathmandu, as a group, on the 29th of November to discuss the mechanics of the workshop, and to attempt to achieve a somewhat better qualitative understanding of the problems faced by this city of some 600,000 people. To this end, meetings were held with several relevant organizations in the area, and a short excursion was taken to higher elevations in the Kathmandu Valley to get a sense of the nature of the visible air pollution blanket that overlays the city.

Two meetings were held in this preliminary phase. The first meeting was with Dr. M. L. Shrestha, Chief of the Meteorological Forecasting Division, Department of Hydrology and Meteorology. This discussion concerned the availability of data on (a) the distribution and variation of the mixing height in the valley, (b) the dynamics of wind flow in the valley and, (c) frequency of occurrence and intensity of inversions. It was immediately evident that these data are not available and, in fact, little data are routinely taken except at the airport serving Kathmandu. We were surprised to find that the Department of Hydrology and Meteorology has obtained four to six "HI-Vol" samplers from Envirotech, and Indian environmental equipment firm. These units are essentially patterned after the equipment originally developed for the U.S. EPA. They have been modified to permit the separation of the PM_{10} fraction from Total Suspended Particulates (TSP). In addition they contain chemical "bubblers" that permit the continuous sampling of the standard pollutants (i.e., SO_x, NO_x, etc.). Equally surprising was the indication that the department had an analytical laboratory capable of analyzing the bubbler samples (but not the respirable particulate fraction). Unfortunately, these samplers have not yet produced a useful body of data.

The second meeting was with Mr. Hari Lal Rajbahak, Team Leader of the Kathmandu Valley Vehicular Emission Control Project. This effort, sponsored by the UNDP has been directed specifically at contending with the emissions from the many old diesel trucks, buses and cars in the valley. This phase of the project has now been completed. They have smoke tested seven to eight percent of the diesel vehicles in the valley, and have found that over 75 percent of the diesel vehicles exceed a smoke test level of 75 units. Since they are totally dependent on India for their fuel and since they cannot control the quality of the fuel used, they have explored the inspection and maintenance approach to controlling emissions. Interestingly enough, they have found that relatively simple, cost-effective measures can bring most diesel vehicles into compliance with a 75 smoke unit standard. These measures involve first, cleaning (or replacing) clogged air filters. Second, if necessary, cleaning injection nozzles, and third, if all else fails, repairing possible leaking piston rings. Given these favorable results,

the desirable implementation of this approach now awaits institutional solutions (i.e. reducing the import tax on new air filters, devising an effective enforcement plan, etc.). the team was very impressed by the progress made by this project in a relatively short time.

2. Workshop Background

The URBAIR workshop in Kathmandu was convened on December 1, 1993 in the new International Convention Center built as a gift to Nepal by the Chinese Government. The agenda of the workshop is presented as Appendix B of this report. In preparation for the workshop the World Bank/MEIP had opened an office in Kathmandu and hired Mr. Guru Bar Singh Thapa to run it, and take the lead in organizing the workshop effort. Considering the lack of local environmental consulting help, Mr. Thapa, in cooperation with various agencies of government and the Royal Nepal Academy of Science and Technology (RONAST), did an excellent job structuring a workshop with the following objectives:

a. To discuss the present status of air quality management in the Kathmandu Valley and related studies on the subject.

b. To identify monitoring requirements, economic/health impacts, and information/data gaps that must be filled if an effective air quality management strategy is to be developed for the Kathmandu Valley.

c. To consider ways and means to fill the information gaps and begin the process of investigating alternative air quality management strategies.

d. To identify policy measures and specific items for inclusion in an action plan designed to reduce air pollution in Kathmandu.

Prior to the workshop, the World Bank had contracted with the Norwegian Institute of Air Research (NILU) and the Institute of Environmental Science (Amsterdam) to prepare the draft Air Quality Management Guidebook. This guidebook provided some of the background information bearing on the current and growing air pollution problem in Kathmandu, and provided a template to aid in examining potential cost-effective and cost-beneficial solutions. Of particular interest was the essential requirement that an emission inventory be developed for Kathmandu and the surrounding area that would allow one to establish the relative contribution of the various sources to the perceived problem. In addition, data would have to be obtained which would permit one to assess the economic impact of the current air

quality. It is this latter information that permits an effective consideration of the costs and benefits associated with actions directed at improving the air quality in Kathmandu.

A reading of the guideline documents and discussions with the consultants involved, quickly revealed the fact that an extensive, relevant data set did not currently exist in a form usable for the required analysis. This is not to say that no information is available. Ambient pollution data are being collected by the Kathmandu Valley Emission Control Project, at least one master's thesis has been written that has attempted to examine the distribution and strength of various categories of sources, and a three year block of radiosonde data are available. However, what is lacking is a consistent set of data taken over a long enough time period to provide some statistical assurance as to its representation of conditions in the valley.

What is available, is a very high degree of enthusiasm, determination, interest and commitment by all agencies (both government and NGOs), and at all levels to solve the problems that are evident. The World Bank team was impressed by the effort that has been expended and the amount of work that has been accomplished by HMG agencies and the NGOs during the time preceding the workshop. A significant number of activities have been initiated, directed at addressing some of the difficult questions associated with developing an air quality management strategy for the Kathmandu Valley. The World Bank team was impressed by the concern expressed by the local participants, at all levels of HMG, for the state of the air quality, as well as their uniform desire to contribute to its improvement.

3. Workshop - Introductory Sessions

The Workshop was opened by an introductory talk by Mr. Dipak Gyawali, Pragya (Academician), the Royal Nepalese Academy of Science and Technology. Mr Gyawali discussed the workshop approach and the study mechanism to be used during the following three days. Immediately following the introductory talk, the entire workshop went on a brief field trip to the Himal Cement Factory and the Harisiddhi Brick Factory. This was quite an interesting and useful visit because it gave the non-Nepalese attendees an opportunity to view representative members of the primary industries in the Kathmandu valley. The cement factory was particularly interesting because, with the aid of the Germans, they are busily attempting to reduce the emissions. From our observations they appear to be taking the proper steps, considering their economic conditions. They do talk about the possible need to move their factory, but I think that is premature until we have had an opportunity to determine the plant's relative contribution to the valley's pollution load. From what I have seen of the valley wind flow and the

placement of the plant (south of the city), it is difficult to view this factory as a serious contributor. However, in the absence of adequate meteorological data, it is not possible to eliminate them from consideration.

The inaugural session was held following the field trip. This session was chaired by Mr. P.L. Singh, the first elected mayor of Kathmandu Municipality. The opening address was given by the Chief Guest, the Hon. Mr. Bal Bahadur Rai, Minister of Housing and Physical Planning. Minister Rai gave an impassioned talk in which he cited the deteriorating environmental conditions in Kathmandu Valley due primarily to the brick kilns, cement plants, uncontrolled urbanization, and construction activities. He felt that the pollution from these sources impacted both health and the agricultural sector and therefore felt that it was of the utmost importance that these emissions be controlled as quickly as possible.

Mr. Joe Manickavasagam, Resident Representative of the World Bank, pointed to waste disposal, inadequate sanitation and water supply systems, and poor regulation of traffic and polluting vehicles, as the primary causes of environmental problems in the Kathmandu Valley. He very strongly stated that holding workshops was not enough, that the words had to be translated into actions. Further, he stated that action had to start with the people and leaders in the Valley.

Dr. Ram Prakash Yadav, Member, National Planning Commission, talked about discomfort and ill-health experienced by people living in the Valley, due to the very bad air quality. He called on all the participants to put forth their best efforts, engage in open and substantive discussion, and come forward with concrete recommendations that can be implemented. He asked that the workshop participants also consider indoor pollution, which he felt played a significant role in exposing Valley residents to harmful pollutants. Finally, he pledged himself to work with the various institutions to implement the recommendations that emerged from the URBAIR workshop.

Dr. Jitu Shah, leader of the World Bank mission, discussed the MEIP/URBAIR approach, how he expected the activity to proceed, and what he expected to result. He reiterated the fact that for the URBAIR approach to be effective, the Action Plan must be developed by the local interests and reflect their commitment to improving the air quality.

Mayor Singh echoed the previous remarks but added the observation that the deterioration in urban life was a direct result of rapid increase in rural to urban migration. He contended, therefore, that proper zoning of Kathmandu Valley was desperately needed which, with proper attention to environmental protection,

would ultimately improve conditions in the Valley as a whole. He indicated that this improvement would not be realized without national and international assistance.

4. Workshop - Technical Session and Report

The first technical session started immediately after the inaugural talks and proceeded for the next day and a half. Every session was very well attended, and every paper provoked considerable discussion by the local participants. One did not have the impression that anyone was tempering their remarks or questions because of bureaucratic reluctance. Remarks and questions were open and critical when they had to be. Ideas were put forth eagerly, and one had the impression that a very good exchange was taking place.

The last session on the second day was reserved for the World Bank team. Dr. Larssen of NILU and Mr. Jansen of IES discussed their respective sections of the Urban Air Quality Management guidebook. Dr. Greenfield presented a short discussion on the development of a regulatory approach to environmental protection, from the perspective of the U.S. experience. Ms. Cohen of Global Resources Institute discussed the results of the first phase of the project to test the economic feasibility of converting Tempos to electric power. This was a project funded, in part, by US-AEP.

The final day was devoted to developing a set of Action Plan recommendations. To accomplish this, the local participants decided to utilize a group discussion/planning process called ZOPP. This approach had been developed and used in Germany and had been introduced in Nepal several years ago. The workshop was split into two groups, one to concentrate on industrial air pollution and the other to discuss vehicular air pollution. Each group was led by a moderator trained in the ZOPP approach. In essence, the approach involved the creation, by the group, of a listing of a large number of environmental problems and approaches to dealing with or solving these problems. With these lists in hand, the group would then attempt, in a structured way, to arrive at a priority consensus, thereby producing a finite set of recommendations.

In principle there is nothing wrong with this approach. From a practical standpoint, given the short time and the large number of participants, it resulted in a somewhat chaotic situation. At the completion of the workshop it was clear that the ZOPP process was not producing a specific priority-ordered set of action items that could be addressed in the immediate future. Of particular concern was the fact that a structured set of conclusions and recommendations did not emerge in a form that could lead to a specific action plan. This disappointment and concern was expressed by Dr. Ram Prakash Yadav, member of the Nepal

Planning Commission, in his closing remarks for the workshop. For this reason, the World Bank team decided to write a draft report which would provide a structured set of conclusions and recommendations that could act as precursors to the action plan. Such a report could help to provide direction for the near term effort to improve the air quality in Kathmandu, and institutional encouragement to the forces that have been set in motion.

The report was written in parts over the next few days following the workshop, with each of the team members contributing and commenting on various sections. It was assembled into final draft form after the team left Kathmandu, and will be transmitted to the proper governmental entities in Nepal.

This World Bank team report presents the most complete summary of the conclusions and recommendations that could be drawn from the workshop. For this reason it is included, in part, in this report. As written, it summarizes both the technical/environmental and the institutional problems without attempting to separate them. It includes both recommendations regarding activities already underway and specific items to be included in the action plan.

5. Environmental Issues and Institutional Framework

a. Air quality measurements in Kathmandu performed over the last several months show very high concentrations of TSP, particularly PM_{10}, with concentrations reaching several times the air quality guidelines. Indoor exposure to CO, and particularly particles, is very high for the general population, due to the current cooking practices.

b. Motor vehicles are the major source of the population's exposure to air pollution. Brick and cement industries also provide significant contributions. Due to the continued growth and development in Kathmandu one can expect a continued worsening of the air quality situation unless significant action is taken. Of the motor vehicles, buses and trucks, tempos, and 2-stroke motorcycles and scooters are probably the most significant contributors.

c. The major portion of the exposure occurs on the roadside and while commuting on the road network. Traffic congestion, low quality fuel, old and inadequately maintained engines, and resuspended road dust are the main causes of the very high concentrations occurring on the roadside.

d. A particular air pollution problem of the Kathmandu Valley, is the reduced visibility, which significantly degrades the views of the surrounding hills and the Himalaya Mountains, one of the main tourist attractions of the valley. All

sources contribute to the fine particles which directly or indirectly cause the visibility degradation. The size of the valley population may be the single most important factor for visibility degradation.

e. The air quality in Kathmandu has degraded very rapidly, with significant changes over the last five years.

f. The projections of continued growth in population (5.7 percent, per year) will maintain and increase the pressure on the carrying capacity of the Kathmandu Valley.

g. Considering the continued deterioration of the air quality in Kathmandu, serious consideration should be given to the decentralization of the industry currently clustered in the valley.

h. If it is desired that Kathmandu once again be the "Shangri-la" that the world remembers, we must move immediately to stop and reverse the environmental deterioration, and seriously initiate and implement the process of long-term planning. One action that could be implemented immediately would be to select several streets in the center of the city, clean and refurbish them, designate them "no vehicle zones", and use them only as pedestrian malls.

i. Institutionally, a start has been made in that an environmental impact assessment (EIA) policy has been prepared by the Ministry for Industry, and is being implemented. In addition, an "umbrella" act is being prepared by parliament and, as discussed in the workshop, could provide an impetus for the development of a more integrated environmental agency in Nepal.

C. Bombay, India

1. General Comments

As indicated previously, the initial URBAIR workshop for Bombay was held in April, 1993, prior to Dr. Greenfield joining the World Bank team. Unfortunately, the report of that workshop and the presentation materials were not available to read prior to the trip. However, Dr. Greenfield had available a copy of the draft Urban Air Quality Management Guidebook - Bombay, prepared for the initial workshop by NILU. This guidebook provided him with some background as to the general problem in Bombay.

Unlike Kathmandu, Bombay has a relatively large population of environmental consulting and engineering firms. In addition to setting up a MEIP office in

Bombay, the World Bank also contracted for the services of Mr. U.H. Joglekar and his firm, Aditya Environmental Services. This firm serves as the primary focal point for the on-going activities in connection with URBAIR. They are overseeing the actions of the three local committees, that were established as a result of the initial workshop, and are engaged in gathering the emission inventory and environmental impact data. In addition, they will be involved in implementing the dispersion modeling activity in Bombay, directed towards the development of effective control strategies.

The primary purpose of the brief trip to Bombay was for the team to determine the degree to which the actions proposed after the last workshop had been accomplished, and to provide what additional guidance was required. From my standpoint, the primary purpose also was directed towards getting acquainted with the various groups and individuals involved in the URBAIR program in Bombay, and seeking possible opportunities as stipulated in the agreement with US-AEP.

The meetings in Bombay concentrated on discussions with the three committees established after the initial workshop. These committees were to address (a) emission data collection, (b) health impact data - economic issues, and (c) policy, regulatory, and institutional issues. Based on these discussions, issues papers are being drafted in preparation for the second Bombay URBAIR workshop which will consider the contribution of various source categories contributing to Bombay's air pollution problem. This workshop will be directed towards the development of an Action Plan that takes into account the costs and benefits of alternative air quality management strategies, within various institutional and regulatory frameworks.

The meeting on the first day involved discussions with committee concerned with developing the emission inventory and applying dispersion models. This committee, under the coordination and leadership of the local consultant, has been collecting the ambient data produced by the 22 monitoring stations operated by the Bombay Municipal Corporation and the several put in place by the National Environmental and Engineering Research Institute (NEERI). When completed and graphed, these data will provide a basis for estimating population exposure and carrying out an impact assessment, and will be useful for evaluating the accuracy of any dispersion model that is installed. In addition, this committee is collecting the information that will permit an emission inventory to be developed.

The meeting on the second day brought together the committee involved in assembling an estimate of health impacts that, when combined with exposure estimates based on ambient concentration distributions, will yield the required impact assessment. Due to disappointing progress with this committee, the meeting was continued to the following day by Dr. Greenfield and Mr. Huib

Jansen of IES. The meeting reconvened at the K.E.M. hospital with Dr. A.A. Mahashur and his staff in the Department of Chest Medicine, Mr. U.H. Joglekar of Aditya Environmental Services, Mr. M.G. Rao of Rashtriya Chemicals & Fertilizers Ltd., and Mr. A. Krishna of Coopers & Lybrand. This was a much more productive meeting. A procedure was agreed upon with regard to collecting the relevant health data and determining the cost impact of pollutant exposures.

On the third day, a meeting was also held with the committee concerned with institutional, policy, and regulatory matters. This meeting was held with Mr. U.K. Mukhopadhyay, Secretary (Energy and Environment). The actual meeting of the policy/institutional committee was somewhat disappointing. It was Dr. Greenfield's understanding that group had fifteen members. In fact, attendance at the meeting consisted of K.H. Meta (Maharashtra Pollution Control Board), T. Saranathan (Society for Clean Environment), A. Ranu (Environmental Medical Association of India), U.H. Joglekar, Dr. Jitu Shah (World Bank), and Huib Jansen (IES).

The meeting consisted of the members of the World Bank team giving their impression of the progress to date. In addition, Dr. Greenfield gave a short lecture on the benefits of establishing a working dialogue between the regulators and the regulatees, thereby encouraging the development of innovative solutions rather than an adversarial relationship. Dr. Shah gave a very strong lecture to the committee members present, on the need to develop policies that will permit solutions to be implemented. He emphasized the need not to simply have a final workshop and depart, but to have a sense that defensible policies had been developed that would result in effective solutions for improving the air quality in Bombay. To this end he insisted that the group prepare a one or two page paper listing the issues that must be addressed (e.g., the problem of vertical organization and its impact on the ability to achieve effective air quality improvement in Bombay). This issue paper would be circulated and discussed and would become the basis for the group's contribution to the April workshop. The general impression, as enunciated by various members of the team is that, despite some disappointments, the progress being made in Bombay with regard to obtaining the data needed to examine potential control strategies, is greater than the other cities involved in URBAIR. What is not clear is whether the apparent institutional problems associated with Greater Bombay will inhibit the implementation of an evolved Action Plan.

It is now anticipated that the second workshop will be held in Bombay in April, 1994.

2. Environmental Issues and Institutional Framework

a. Major Environmental Issues

The air pollution problem in Bombay is also quite severe, but not as localized, definable, and straight-forward as that in Kathmandu. Bombay is a city of approximately 11 million people that has grown so rapidly its infrastructure has fallen far behind the needs. Currently, 50 percent of the population lives in inadequate housing, slums or shanties without proper sanitation.

Greater Bombay covers an area of over 400 km^2 and has almost 40,000 industrial units of different scales, manufacturing a considerable variety of products. Over 500 of these units produce chemical and/or petrochemical products, a similar number of textile mills and products, 2,000-3,000 units produce a variety of products ranging from engineering plastics to pharmaceuticals. The heavy industries (power plants, refineries, fertilizer plants, chemicals and petrochemicals) are clustered in the eastern part of Greater Bombay. The textile mills are primarily in the central section of the city. The northern and western sections contain a mixture of textile, pharmaceuticals, foundries, etc. Small store-front plants are scattered throughout the city. A great majority of the industrial units are small scale plants, including store front operations. Bombay's motor vehicle population exceeds 600,000, but over half of these are powered by two-stroke or diesel motors. Additional sources of air pollution are the use of LPG, animal dung, wood, and kerosene for cooking, the ship traffic in the port area, and the approximately 100 tons of wood per day that are burned for ritual cremations.

In terms of air pollution levels, Bombay does not appear to currently have a significant ambient SOx or NOx problem. SOx dropped markedly between 1980 and 1987, primarily due to the use of cleaner fuels. However, there is some evidence that in a recent three year period (1987-1990) ambient concentrations of SOx have increased substantially, though still below the WHO guidelines. It is not clear why this occurred. Ambient NOx concentrations continue to remain relatively low. The observed particulate concentrations exceed the WHO and U.S. standards by factors of four to ten, and probably constitute the major, observable air pollution problem in Bombay. One also observes a high ammonia level in the ambient air, probably due to the presence of many animals and the lack of adequate sanitary facilities. In addition, one would expect high road-way lead and CO concentrations and possibly the occurrence of elevated ozone levels.

In terms of total tons of pollutants emitted, the estimate for 1992 is approximately 2,000 per day, of which 60 to 70 percent is the result of emissions by vehicles. Thirty-five percent of the anthropogenically produced TSP results from emission by the transportation sector. It appears, therefore, that the transportation sector offers the greatest potential for substantial near-term reductions in total emissions.

It should be noted, however, that NEERI has pointed out that industrial production has been increasing by about 90 percent, per year during the past several years. This is expected to continue and will result in an increasing contribution from the industrial sector unless more stringent controls are required.

An analysis is required that will indicate the relative contribution of the various source sectors to population exposure. Such an analysis will permit the development of cost-effective and cost-beneficial control strategies for Bombay. The ability to carry out such an analysis requires the availability of data that will permit the development of defensible emission inventories and impact assessments. A large part of the thrust of the URBAIR effort is directed toward developing and extracting such inventories and assessments and aiding the local agencies to use them in the development of effective control strategies.

b. Institutional Issues

Viewed superficially, Greater Bombay operates under an effective set of national and state environmental laws. Standards are set, permits are required, penalties are assessable, and regulatory agencies are constituted. As can be surmised from the above discussion of the meeting of the committee concerned with institutional, policy, and regulatory matters, despite this appearance of an adequate regulatory framework, there are some serious institutional problems associated with attempting to significantly improve the air quality in Bombay. Let us just examine some of these problems in the context of some obvious actions that must be taken if any progress is to be made in improving the air quality. For example:

i. It is known that vehicular emissions account for over 50 percent of the total anthropogenic emissions in Bombay, and 35 percent of the TSP emissions. To alleviate this condition they must:

   - Institute an inspection and maintenance program
   - Put catalysts on new cars
   - Get the lead out of gasoline
   - Ban two stroke, 2 and 3-wheel vehicles
   - Institute effective traffic management

ii. Maharashtra Pollution Control Board has a permitting or licensing program with regard to emission limitations. This program has consented (permitted) to the operation of some 7,000 of the largest industrial plants. These

consents are on a plant by plant basis and, in effect, represent an agreement on the part of the government to allow the plant to emit up to a certain level. The actual number of industrial units in Bombay is 40,000 and growing. Most are small store-front types of manufacturing units. It has been assumed by the government that these small units do not require consents because they emit such relatively small amounts of pollutants. Experience has shown that many small emitters can have a significant impact on the distribution of ambient concentrations and hence population exposure. Given the rapid industrial growth in Greater Bombay, the analysis of emissions and their contribution to population exposure may reveal that more stringent controls of industry with regard to size and location are called for.

To accomplish the above would require: (a) very effective cooperation between governmental departments and (b) a commitment on the part of the government to establish more stringent restrictions on growth, locations, emissions, etc., and a willingness to enforce them. In essence, it would require a willingness to establish a carrying capacity for the area and to live within it.

That is the dilemma. Given the effort underway in URBAIR it will be possible to develop a meaningful control strategy. Whether it can be implemented within the institutional framework that exists is somewhat questionable. Typical of the policy/institutional problems faced is the fact that the Bombay Metropolitan Region (BMR) formulated a special "Industrial Location Policy" that was first laid down in 1974. The last revision to this plan was in November, 1984. This plan has recently been revised to reflect the liberalized industrial policy announced by India. Under this revision, manufacture of electronics, plastic products, watches, gems and jewelry, textile products, food products, etc, (all of which are judged to be "non-polluting" at some level), will be allowed to grow and diversify. One can imagine the difficulty faced by an aggressive pollution control agency attempting to implement a stringent control strategy in the face of a government plan that encourages "growth and diversity".

IV. CONCLUSIONS AND RECOMMENDATIONS

KATHMANDU, NEPAL

Following the workshop, Dr. Shah and Dr. Greenfield had a meeting with the resident USAID representatives, Richard Byess and Daniel J. Miller. Mr. Byess is Chief, Program and Project Development Office, USAID/Nepal, and Mr. Miller is an environmental specialist. One point raised by Mr. Byess was the concern over the fact that none of the World Bank team, or for that matter any of the external experts made available for this effort, were planning to stay in Nepal for any extended period. His concern stemmed from the fact that he felt that extended periods of contact were required if any positive results were to occur.

In this connection, the team raised the question of support for an emission inventory specialist from EPA, to come and spend at least one month in Kathmandu. Mr. Byess indicated that he felt that USAID would probably be interested in providing this level of support. In view of the reduced budget available to EPA in FY 95, external support would be the only way to guarantee that an EPA expert would be available. One disturbing note was struck by the fact that neither of the USAID representatives appeared to be aware that I was coming to Kathmandu with the support of US-AEP.

The following are recommendations of what should be undertaken to effectuate air quality improvement in Kathmandu, Nepal.

Recommendation 1: Update the inventory of energy use developed for the Kathmandu Valley. Establish strict emissions regulations.

An emission inventory of energy use in the Kathmandu Valley has been developed. It should be updated, modified as appropriate, and expanded in scope to include remaining factors such as re-suspension of road dust and burning of agricultural wastes.

Consider strict emission regulations that are phased in so that the vehicle fleet will be gradually upgraded to the state-of-the-art level.

Recommendation 2: Continue ambient air quality monitoring and develop a dispersion model for the Kathmandu Valley.

Ambient air quality monitoring was initiated and a few month's data have been collected. It should be continued for at least a one year period, so as to obtain

information on seasonal variation. It is strongly recommended that continuous air quality monitoring stations be established (2 - 3 along roadside, 2 - 3 in residential areas, 2 - 3 in industrial areas, and 1 - 2 as background stations) to monitor SOx, NOx, TSP (as well as PM10), CO and HC. Also, a dispersion model for the whole Kathmandu Valley should be developed to analyze the carrying capacity of the Valley.

Utilize the improved data bases to analyze and better define, dynamically, the meteorology of Kathmandu Valley. Drawing on air quality models already developed outside Nepal and adapted for local use, develop analytical tool for examining alternative control strategies for Kathmandu Valley.

Recommendation 3: Undertake health studies to determine impact of pollution exposure.

No data currently exists that can be used to establish the pollution health impact in Kathmandu Valley. Health studies of the population should be undertaken immediately to establish the impact of pollution exposure.

Recommendation 4: Reexamine fuel pricing policy.

Fuel pricing policy should be re-examined and possibly adjusted to take into account the potential for progressively discouraging the use of high polluting vehicles.

Recommendation 5: Strengthen local governments' ability to deal with pollution problems.

Local governments could play an important role in environmental pollution control. Appropriate measures should be taken to strengthen the capacity of local government officials to deal with environmental pollution problems, in particular, air pollution. Consider giving municipalities/ local governments responsibility for enforcing emission and dust control regulations.

Recommendation 6: Continue the Kathmandu Valley Vehicle Emission Control Project. Remove taxes on emission control device parts. Develop strict regulations on diesel vehicle emissions. Consider maintenance options for 2-stroke engines, phase out 2-stroke tempos, ban import of 2-stroke motorcycles.

Diesel vehicles, 2-stroke engines and the resuspension of road dust was identified as significant sources of air pollution from traffic. This form of pollution is a source of annoyance and serious health concern for people on the streets in Kathmandu. It is also a cause of very significant visibility reduction near the road network in the city, and contributes to the visibility reduction in the valley in general.

The Kathmandu Valley Vehicle Emission Control Project (KVVECP) has managed, in a short time, to devise methods to gradually reduce smoke emissions from diesel buses and trucks operating in the city. This work is very useful and will, if strongly implemented, have a positive impact on the pollution situation in Kathmandu. The project should be continued so as to further improve the maintenance approach to diesel and vehicle categories.

Removal of taxes on parts needed for engine maintenance related to pollution emissions, should be seriously considered. In the long-term, strict regulations on emissions from diesel vehicles should be adopted, so as to gradually bring the vehicles operated in Kathmandu up to the state-of-the-art.

- Tempos and motorcycles are observed to be significant emitters of visible smoke and fumes. The KVVEC project should also consider the value of possible maintenance options for these vehicles.

- Consider rapidly phasing out 2-stroke tempos (e.g., replacement of 2-stroke engine with 4-stroke). Alternatively, consider the cost-effectiveness of converting Tempos to electric power.

- Consider a ban on the import of 2-stroke motorcycles. Either set emission standards low enough to assure that one could not import two stroke motorcycles or, if that is not acceptable, phase out their import.

- Consider differential vehicle taxation with regard to vehicle type and age, so as to encourage the purchase of low-polluting vehicles.

Recommendations 7: <u>Improve the public transportation system to reduce dependence on private transport modes. Improve traffic management. Educate vehicle owners and drivers. Establish traffic regulations.</u>

The public transportation system is responsible for some 10 percent of the fuel consumption in the valley, and approximately 25 percent of the particle emissions from traffic. An improved public transportation system would reduce the need for

the private transport modes, including the continuing need for the tempos. The development of a less polluting, efficient public transportation system includes consideration of the following:

- Develop trolley bus network, (e.g., to include the ring road)

- Convert to low-polluting buses and minibuses

- Re-engineer (and enforce) the traffic patterns of Kathmandu and other traffic management factors, so as to improve the flow, thereby reducing idling time and the need for many acceleration bursts both, of which, contribute significantly to the emissions of CO and VOC.

- Initiate awareness campaigns aimed at drivers, vehicle owners, schools, and garage owners, to educate them as to the impact of air pollution and the beneficial results (both economic and environmental) of regular vehicle maintenance and use of fuel of the required quality.

- Establish regulations and awareness building regarding the detrimental effects of idling, are needed.

- Replace traffic light system in city.

- create traffic-free zones to protect selected areas of high-population density, or monumental or cultural heritage zones from high exposure. Traffic-free zones can also provide very attractive pedestrian mall areas that add to the quality of a cities ambiance.

- create one-way streets (possibly ones that change direction as a function of commute period), changed hours of delivery truck usage in inner city (e.g., night, only after 8PM). This latter could alleviate the blocking of major roadways during daylight hours, thereby increasing traffic flow.

Recommendation 8: <u>Control quality of fuel sold in the Valley.</u>

Exhaust emissions are, to a degree, a function of fuel quality. The excessive emissions from vehicles in Kathmandu may, in part, be due to the low fuel quality available. The quality of motor fuels sold at gas stations in the valley should be controlled effectively to eliminate adulteration. Laboratory facilities to accomplish the necessary testing, should be established. Plans to put lead-free gasoline on the market should be made to allow for the eventual introduction of catalyst cars.

Implement the recommendations of the Traffic Emissions Control Project regarding diesel vehicles (i.e., repair of vehicles to meet 75 HSU standard). Workshops should be upgraded to deal with the problems. Fund the next phase of this project.

Recommendation 9: Control road dust.

The visible air pollution in the streets of Kathmandu is, to a considerable extent, caused by resuspended road dust. The large volumes of dust available for resuspension is largely caused by litter and refuse, e.g.,

- dust migrating into the streets from unpaved side roads, and unvegetated areas near the streets

- debris from construction materials

The resuspended dust contributes significantly to the high TSP concentrations measured in the Kathmandu Valley. A street dust control plan should be developed and implemented rapidly. Such a plan could include elements such as (i) regular street cleaning, (ii) paving of roads, (iii) planting on unvegetated street-side areas, (iv) implementing an effective garbage/refuse disposal system, and (v) enforcing of regulations against littering and dumping of construction material.

Recommendation 10: Identify industrial zones and restrict location of new industries to these zones. Require EIA for construction of new industries. Establish emission standards and an inspection program to determine compliance.

Cement, brick and tiles, carpet and other dying industries were identified as major industries which need particular attention in the Kathmandu Valley. Industrial zones should be clearly identified and new industries should only be allowed to locate in such zones. Relocation should also be encouraged for those industries which are heavily polluting and are now located in residential areas. New industrial location should be prohibited inside the Valley, and relocation of existing industries to outside the Valley should be encouraged. For a long term policy, adequate infrastructure arrangements (power, water supply, transportation, etc.) should be promoted to attract industries to locate outside the Kathmandu Valley.

An Environmental Impact Assessment (EIA) requirement should be implemented for new construction or expansion of industries, so that adverse impact could be mitigated. New industrial pollution control regulations should be enforced as soon as possible after the Environmental Protection Law comes into effect. Emission

standards should be established, taking into account the currently available technologies in Nepal.

Inspection of respective factories, with regard to emissions and emission control, should be carried out periodically by either central or local government agencies. In this connection, (i) legal authority should be provided for carrying out the inspection, (ii) adequate training and equipment should be provided for government officials both at central and local level, in order to strengthen capability to carry out inspections. Establishment of a special task force for industrial inspection/consultation may be one of the possible options.

Continue the development and application of permit and license programs based on determined impact zones. Utilize improved data availability to improve designation of impact zones.

Socioeconomic impacts of mitigation measures, particularly on employment, should be carefully examined before adopting such measures.

Recommendation 11: Consider relocation of Himal Cement Factory. Consider new process technologies and pollution control for brick industries. Reassess efficiency of boilers using rice husks. Review management of small-scale industries.

Current arrangements for mitigating air pollution from the Himal Cement factory are generally considered appropriate.
In the long run, relocation of the factory should be considered under the overall framework of industrial location policy.

Assessment of new process technologies and pollution control equipment should be considered for use in the brick industries in the Kathmandu valley is in the process and should be continued.

Environmental impacts and the energy efficiency of boilers using rice husk should be assessed in comparison with those using diesel. Based on the study, changing from rice husk boilers to diesel fired boilers may be indicated.

Attention should be paid to the management aspects of small-scale industries, which may not have sufficient technical and financial capacity to adopt adequate air pollution control measures. Necessary technical assistance and probably tax exemption or other forms of financial assistance should be clearly identified.

Recommendation 12: Ensure that new home construction includes installation of stoves with proper ventilation of gases.

A recent survey by the Central Bureau of Statistics showed a rapid growth of house construction in the valley. Action must be taken to assure that proper stoves (with ventilation of exhaust gases) are installed. These stoves would both reduce emissions to the ambient air and lessen the impact on the indoor environment.

Recommendation 13: Utilize data obtained to develop effective strategy and regulations to control air pollution in the Kathmandu Valley.

Utilizing improved data bases, knowledge, and analytic tools, begin the development, implementation, and enforcement of standards and regulations designed to improve and maintain the air quality of Kathmandu Valley. The information and knowledge gained in the Short and Medium-Term phases, should be used to analytically determine the "carrying capacity" of Kathmandu for the various impacting activities (industries of various types, vehicles, population, etc.) Fully incorporate the environmental impact analysis and the concept of "carrying capacity" into the urban/regional/national planning process for Nepal.

Examine the feasibility and desirability of integrating all aspects of environmental activity (monitoring, analysis, regulatory design, policy recommendations, regulatory implementation and enforcement, budget recommendations, etc.) under one authority for the Kathmandu Valley.

V. MARKET OPPORTUNITIES

A. Kathmandu

Nepal is one of the poorest nations in the region and, as such, it does not provide a very attractive direct market. Most of the large facilities have been underwritten by other nations (e.g., the International Convention Center was built by the Chinese Peoples Republic, the Himal Cement Factory was originally built by the Germans, who are also helping to fund the environmental controls). If the air quality is to be improved in Kathmandu, it will be primarily funded by outside sources. Even under these circumstances, there are possible opportunities for U.S. companies, if they look beyond Kathmandu.

Of particular note is the need to eliminate and/or convert the two-stroke Tempos to a less polluting form. US-AEP/USAID has already helped to fund Global Resources Institute in its demonstration of a Tempo conversion to electric power. Many of the parts used in this conversion have come from manufacturers in the U.S. The air pollution impact of these vehicles is a common problem in most Asian cities of any size. It is conceivable that by using Kathmandu as a demonstration of the feasibility of this approach, including the required infrastructure, a market for these conversions could be established throughout Asia.

A second area of possible interest is the fact that one aspect of a strategy for improving the air quality in Kathmandu Valley involves moving industries, such as carpet making or cement making, to other regions in Nepal. For this to occur, however, will necessitate the building of the required infrastructure (airports, roads, waste treatment facilities, etc.). Once again, this will require loans and outside financing, but it does offer opportunities for U.S. companies.

B. Bombay

As described in this report, if Bombay is to take the steps that appear to be required to improve the air quality they will be needing help in everything from catalytic converters for cars and reformulated gasoline to innovative approaches to traffic management and sophisticated photochemical modeling. Unlike Nepal, India has a strong technical, scientific, and manufacturing base. In the past India has looked, primarily to Europe and Asia for assistance, and the U.S. has been conspicuous by its absence. My impression is that there are opportunities in the environmental market in India, but U.S. firms must find Indian partners to gain entry. A typical example would be an Indian company, such as Envirotech Instruments, New Delhi, which has produced an improved form of a USEPA monitoring instrument. Partnership with a U.S. company owning technology that

is approved and currently in use in this country, would bring improved capability to India and possibly open markets for the partnership throughout Asia.

Three days filled with URBAIR meetings does not offer enough time to meet with many members of the private sector and discuss possible market opportunities. The Bombay workshop in April of this year will offer a significantly greater opportunity to have such meetings.

APPENDIX A

ITINERARY

ITINERARY

11/27/93	Leave San Francisco, CA, USA.
11/28/93	Arrive Bangkok, Thailand (Overnight).
11/29/93	Arrive Kathmandu, Nepal; meetings with other members of team.
11/30/93	Meetings with officials of Department of Hydrology and Meteorology; meeting with officials of Kathmandu Valley Vehicular Emission Control Project.
12/1-12/3/93	URBAIR workshop, International Convention Center, Kathmandu, Nepal.
12/4/93	Meeting with local USAID representatives and HMG/N personnel.
12/5/93	Leave Kathmandu, Nepal
12/5/93	Arrive Bombay, India; meet with local consultant group.
12/6/93	Meet with MEIP representative and URBAIR/Bombay committee on emission data.
12/7/93	Meet with URBAIR/Bombay committee on health effects/economic impact.
12/8/93	Meet with Secretary of Ministry of Environment and Housing; meet with URBAIR/Bombay committee of institutional/regulations/policy; meet with health impact data group at K.E.M. Hospital.
12/9/93	Leave Bombay, India
12/9/93	Arrive San Francisco, CA, USA

Appendix B

Workshop Agenda and List of Attendees

WORKSHOP AGENDA

Metropolitan Environment Improvement Program
Urban Air Quality Management Workshop (URBAIR)
1-3 December 1993, Kathmandu, Nepal

December 1, 1993

08:30 - 09:00 - Registration of participants

09:00 - 09:30 - Approach study of the URBAIR Workshop by **MR. DIPAK GYAWALI**, Pragya, RONAST.

09:30 - 13:00 - Field Visit:
1. Himal Cement Factory
2. Harisiddhi Brick Factory

13:00 - 14:00 - Lunch

INAUGURAL SESSION

Chairman: **MR.P.L. SINGH**, Mayor, Kathmandu Municipality.

13:45 - Arrival of guests

13:55 - Arrival of Chief Guest, **HON. MR. BAL BAHADUR RAI**, Minister, Ministry of Housing and Physical Planning

14:00 - 14:10 - Welcome address by **MR. SHIVA BAHADUR PRADHANANG**, Secretary, Ministry of Housing and Physical Planning.

14:10 - 14:20 - Inauguration and opening address by the Chief Guest.

14:20 - 14:30 - Address by **MR. JOE MANICKAVASAGAM**, Resident Representative, World Bank.

14:30 - 14:40 - Keynote address by **HON. DR. RAM PRAKASH YADAV**, Member National Planning Commission.

14:40 - 14:55 - Introduction of MEIP and URBAIR by **DR. JITU SHAH**, World

Bank.

14:55 - 15:00 - Address from the Chair by **MR. P.L. SINGH,** Mayor, Kathmandu Municipality.

15:00 - 15:10 - Vote of thanks by **MR. UMESH B. MALLA,** Joint Secretary MHPP/Member Secretary UEMC/EPC.

15:10 - 15:30 - Refreshment

AIR QUALITY ASSESSMENT IN KATHMANDU VALLEY

Session I

Chairman: **PROF. KEDAR LAL SHRESTHA**, Vice Chancellor, RONAST

15:30 - 16:00 - Air Quality in Kathmandu Valley, by **MR. ANIL S. GIRI,** RONAST

16:00 - 16:30 - Industrial Contribution to Air Quality, by **MR. MUKESH BHATTARAI,** Ministry of Industry.

December 2, 1993

Session II

Chairman: **MR. NARAYAN RAJ TIWARI**, Secretary, Ministry of Works and Transport

09:30 - 10:15 - Kathmandu Valley Vehicular Transportation and Emission Problems, by **MR. HARI LAL RAJBAHAK**, Team Leader, KVVECP.

10:15 - 10:45 - Role of Traffic Management in Reducing Air Pollution in Kathmandu Valley, by **DSP S. THAPLIA**, Kathmandu Valley Traffic Police.

10:45 - 11:00 - Coffee/Tea break

Session III

Chairman: **DR. B. BAIDYA**, Member National Planning Commission

11:00 - 12:00 - Health Impacts of Air Pollution in Kathmandu, by **DR. KOKILA VAIDYA**, Joint Secretary, Ministry of Health and WHO

12:00 - 12:30 - Emission of Air Pollutants from Energy Use in Kathmandu, by **DR. RAM MANOHAR SHRESTHA**, Associate Professor, AIT, Bangkok

12:30 - 13:00 - Air Pollution and Meteorological Factors, by **DR. MADAN L. SHRESTHA,** Dept. of Meteorology and Hydrology

13:00 - 14:00 - Lunch

AIR QUALITY MANAGEMENT IN KATHMANDU VALLEY

Session IV

Chairman: **MR. PUROSHOTTAM BHATTARAI,** Acting Secretary, Ministry of Civil Aviation and Tourism

14:00 - 14:30 - Air Quality Degradation and Impacts in Tourism, By **MR. DIPAK DHITTAL,** Department of Tourism

14:30 - 15:00 - Quality of Tourism in Kathmandu Valley Over Time, by **MR. BIRENDRA MAN SHRESTHA,** the Hotel Association of Nepal

15:00 - 15:15 - Coffee/tea break

Session V

Chairman: **MR. SHIVA BAHADUR PRADHANANG,** Secretary, Ministry of Housing and Physical Planning

15:15 - 15:45 - Urban Air Quality Management: Its necessity and procedures for AQM development, by **DR. STEINAR LARSSEN,** Norwegian Institute for Air Research (NILU)

15:45 - 16:15 - Urban Air Quality Management: Economic evaluation and possible AQM framework, by **MR. HUIB JANSEN,** Institute of Environmental Studies (IES), Amsterdam

16:15 - 16:45 - Conversion of 2-stroke Tempos to electricity, by **MS. MARILYN COHEN,** Global Resources Institute, USA

Establishing a regulatory agency, by **DR. STANLEY M. GREENFIELD,** USAEP/WEC consultant

Session VI

December 3, 1993

09:30 - 10:00 - Orientation for group discussion

10;00 - 10:15 - Group Formation: Air Quality Management

- Industrial Air Pollution sub-group
- Vehicular Air Pollution sub-group

10:15 - 13:00 - Group discussion

13:00 - 14:00 - Lunch

14:00 - 15:30 - Preparation of sub-group reports and action plans

15:30 - 15:45 - Tea/coffee break

Concluding Session

Chairman: Chief Guest **HON. DILENDRA PRASAD,** Asst. Minister, Ministry of Housing and Physical Planning

Co-chairman: **HON. DR. RAM PRAKASH YADAV,** Member, National Planning Commission

- Presentation of sub-group reports and discussion at plenary session, by Sub-group Chairpersons
- Conclusions and recommendations for further actions/data/studies to fill perceived gaps
- Concluding remarks by the Chief Guest
- Adjourn

LIST OF ATTENDEES

First URBAIR Workshop
Kathmandu, Nepal
December 1-3, 1993

HMG/N

1. National Planning Commission	Mr. Purushottam Kunwar
2. Environment Protection Council	Mr. Purushottam Kunwar
3. National Planning Commission	Dr. Ram Prakash Yadav
4. Dept. of Housing and Urban Dev.	Mr. M.D. Sharesta/Dr.J.Joshi
5. Dept. of Transport Management	Mr. J.N. Shiwakoti
6. Ministry of Health	Dr. K.P. Ghimire
7. Nepal Bureau of Standards	Dr. U.K. Kunwar
8. Ministry of Finance	Mr. K. Joshi
9. Ministry of Law and Justice	Mr. B.K. Beniya
10. Royal Nepal Army	Lt. Col. K.B. Bhandari
11. Valley Traffic Police	DSP S. Thapaliya
12. Dept. of Buildings	Mr. M. Subba

Semi Government

1. RONAST	Dr.T.M. Pradhanang
2. T.U. Physics	Dr. D.D. Poudyel
3. T.U.T.C. Campus	Dr. Bidur Upadhyay
4. Institute of Medicine	Dr. K.P. Ghimire
5. Institute of Engineering	Dr. B.R. Ghimire
6. Nepal Oil Corporation	Mr. M.R. Upadhyay
7. Solid Waste Management	Mr. A. Shahi
8. Institute of Science and Tech.	Dr. S.P. Dhoubdel

Local Government

1. Kathmandu Municipality	Mr. N.R. Shrestha
2. Lalitpur Municipality	Mr. S.R. Upadhyay
3. Bhaktapur Municipality	Mr. B.B. Beniya/Mr. R. Bhattarai

NGOs

1. Nepal Forum of Envir. Journalists	Mr. K. Pokharel
2. Nepal Transport Association	Mr. H.P. Adhikari
3. Nepal Medical Association	Mr. K.K. Rai

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4.	Envir. & Public Health Org.	Mr. S. Thapa
5.	Save the Bagmati Campaign	Dr. S. Shah
6.	Nepal Engineers Association	Mr. H.D. Shrestha
7.	Nepal Nursing Association	Ms. M. Shakya
8.	Greater Janakpur Area Dev. Co.	Mr. M.N. Mishra

Individuals

1. Dr. Ram B. Khadka, IUCN
2. Dr. (Mrs.) Bimla Shrestha
3. Mr. Shyam P. Adhikari
4. Mr. N.P. Pokharel
5. Mr. G. Upreti, INHURED

Donors and International Consultants

1.	USAID	Mr. Richard Byess
2.	World Bank	Mr. Tashi Tenzing
3.	UNDP	Mr. B.K.L. Joshi
4.	GRI (USA)	Mrs. Marilyn Cohen
5.	UMPAP	Mr. Clarence Shubert
6.	USAEP/WEC	Dr. Stanley M. Greenfield
7.	World Bank	Dr. Jitu Shah
8.	World Bank	Mr. K. Suzuki
9.	IES	Mr. Huib Jansen
10	NILU	Dr. Steinar Larssen
11.	NILU	Dr. Trond Bohler
12.	WHO	Mr. D. Nitipavachon

Papers Presented By

1.	Dept. of Tourism	Mr. Dipak Dhittal
2.	Dept. of Met. and Hydro.	Dr. Madan Lal Shrestha
3.	KVVECP	Mr. H.L. Rajbahak and Mr. K.M. Joshi
4.	Ministry of Industry	Mr. M.D. Bhattarai
5.	RONAST	Mr. Anil S. Giri
6.	Hotel Assoc. of Nepal	Mr. Birendra M. Shrestha
7.	Ministry of Health and WHO	Dr. Kokila Vaidya and Dr. Aggarwal
8.	AIT, Bangkok	Dr. Ram Monohar Shrestha

Moderators

1. Mr. R. Pradhan
2. Mr. B.K. Shrestha

APPENDIX C
PERSONS AND ORGANIZATIONS VISITED

PERSONS AND ORGANIZATIONS VISITED

KATHMANDU:
Meeting on 11/29/93-12/5/93

Richard Byess
Chief, Program and Project Development Office
USAID/Nepal

Daniel J. Miller
USAID/ARD

Dr. Madon L. Shrestha
Chief, Meteorological Forecasting Division
Dept. of Hydrology and Meteorology
Kathmandu, Nepal

Hari Lal Rajbahak
Team Leader
Kathmandu Valley Vehicular Emission Control Project
(HMG/UNDP Joint Project for Environmental Protection)

Guru Bar Singh Thapa
Program Coordinator
MEIP/Environment Protection Council
Kathmandu, Nepal

BOMBAY:
Meetings on 12/6-8/93

K.H. Mehta
Maharashtra Pollution Control Board
Bombay

U.H. Joglekar
Aditya Environmental Services
Bombay
(Local consultants for URBAIR)
G.N. Warade
National Program Coordinator
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APPENDIX D

BUSINESS CARDS OF PEOPLE CONTACTED

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K. H. MEHTA
B.E. (Civil), M.E. (P.H.)
M.A.P.C.A. (U.S.A.)
Air Pollution Abatement Engineer

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Gram: Prepoll

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7662277
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Anand Krishna
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✆ 02142-50151

tulip

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APPENDIX E

LIST OF DOCUMENTS RECEIVED

LIST OF DOCUMENTS RECEIVED

KATHMANDU, Nepal:

1. URBAIR Guidebook for Kathmandu (draft)--"Urban Air Quality Management in Asia - Kathmandu", NILU, June 1993

2. EIA Guidelines for the Industry Sector--prepared by Ministry of Industry, His Majesty's Government of Nepal.

3. Papers presented at the URBAIR workshop in Kathmandu.

4. Industrial Policy--His Majesty's Government of Nepal, Ministry of Industry, 1992.

5. Foreign Investment and Transfer of Technology Act, 1992, His Majesty's Government of Nepal, Ministry of Law, Justice and Parliamentary Affairs.

6. Industrial Enterprises Act, 1992, His Majesty's Government of Nepal, Ministry of Law, Justice and Parliamentary Affairs.

7. "The Study on Kathmandu Valley Urban Road Development--Interim report, summary", Japan International Cooperation Agency, July 1992.

8. "Energy Utilization and Air Pollution in Kathmandu Valley, Nepal", Thesis submitted by Surendra Raj Devkota, Asian Institute of Technology, Bangkok, Thailand, April, 1992.

BOMBAY, INDIA:

1. URBAIR Guidebook for Bombay, "URBAIR Air Quality Management Strategy in Asia--Bombay", NILU, March 1993

2. Government of Maharashtra, Industries, Energy and Labour Department, Government Resolution No. ILP. 1092/3410/IND-2, Modification of Industrial Location Policy in Bombay Metropolitan Region, May 4, 1993.

3. Paper prepared by local MEIP consultant (ADITYA Environmental Services), on (a) consumption of fuels in Greater Bombay, and (b) legal aspects of pollution control-operational requirements.

4. "Summary of Studies Done by Environmental Pollution Center", paper prepared by the Environmental Pollution Research Center, K.E.M. Hospital, Bombay.

5. Bombay Air Pollution--Health Study, prepared by the Municipal Corporation of Greater Bombay, Dept. of Chest Medicine, K.E.M. Hospital and Seth G.S. Medical College, 1984.

6. Air Pollution Control Measures and Strategies for Bombay, prepared by K.H> Mehta, Chief, Air Pollution Control Division, Maharashta Pollution Control Board. Presented at the International Conference on Computerized Air Quality Management, Bangkok, Thailand, Nov. 30-Dec. 3, 1003

GENERAL

1. The generic chapters 5,6,7 & 8 of the URBAIR Guidebook, prepared by Mr. Huib Jansen, Institute for Environmental Studies,The Free University, Amsterdam.

APPENDIX F

CURRICULUM VITAE

CURRICULUM VITAE

STANLEY M. GREENFIELD

EDUCATION

1967 Ph.D., meteorology/physics, University of California at Los Angeles
1950 B.S., meteorology, New York University

PROFESSIONAL REGISTRATIONS AND CERTIFICATIONS

California Registered Environmental Assessor (REA-00425)

EXPERIENCE

Dr. Stanley M. Greenfield, senior vice president of Systems Applications International (SAI), is director of Global, Environmental, and Exposure Assessment Programs. Dr. Greenfield is a noted geophysicist who has over 40 years of management and program experience in the environmental area. His environmental management experience has been in the public and private sectors both nationally and internationally. Dr. Greenfield has extensive expertise in analyzing regulatory requirements and alternative sources of energy. From 1971 through 1974, he served as Assistant Administrator for Research and Development of the U.S. Environmental Protection Agency, where, as one of the nation's key environmental policy makers, he operated at the highest levels of government. He was instrumental in developing the technical support structure for the regulatory policy formulation activities of EPA.

Before his EPA appointment, Dr. Greenfield was head of the Environmental Sciences Department of the Rand Corporation, where he worked for 21 years. At Rand, Dr. Greenfield developed a program that brought together, for the first time, the physical, social, and economic sciences to consider the growing problem of man's impact on the environment. His interest and involvement over the last several years have been directed towards the use of models to derive cost-effective air pollution control strategies.

Dr. Greenfield is a Fellow of the American Meteorological Society and a Councilor of the Pan American Medical Association. He has served on numerous advisory panels including NASA space exploration, National Academy of Science panels in the areas of atmospheric science and energy, and the California State Assembly Science and Technology Advisory Committee.

Specialized Professional Competence

- Environmental science research management
- Environmental risk assessment
- Analysis of regulatory requirements
- Litigation support
- Global climate change
- Analysis of alternative sources of energy
- Indoor air pollution
- Research in environmental pollution, cloud physics and climate modification, ionospheric physics, infrared radiation, satellite meteorology, and the atmospheric transport and impact of radioactive materials

Other Professional Experience

- Teknekron Research, Inc.--senior vice president and technical director
- Teknekron, Inc.--director of Energy and Environmental Systems Division
- Flow Resources Corporation--president and senior member of the technical staff; development and direction of the company, which was dedicated to helping governmental and industrial clients deal with environmental management and energy use and development
- U.S. Environmental Protection Agency--Assistant Administrator for Research and Development; setting up, implementing, and managing the agency's entire environmental research and development program, which involved 2,000 people operating 30 laboratories located in 20 different states; determination of the health and ecological effects of pollution and the development of control technology; federal government's technical representative concerning environmental matters at numerous national and international

meetings and before commissions

- The Rand Corporation--head of the environmental sciences department; management of a department that conducted significant research in geomagnetism, cloud physics,weather modification, climate dynamics, environmental pollution, energy, and biological dynamics

PROFESSIONAL AFFILIATIONS

- Listed in American Men of Science
- Listed in Who's Who in American Science
- American Meteorological Society (Fellow)
- International Academy of Environmental Safety
- Air & Waste Management Association
- Pan American Medical Association
- American Association for the Advancement of Science
- Sigma Xi Honorary Research Society

Awards

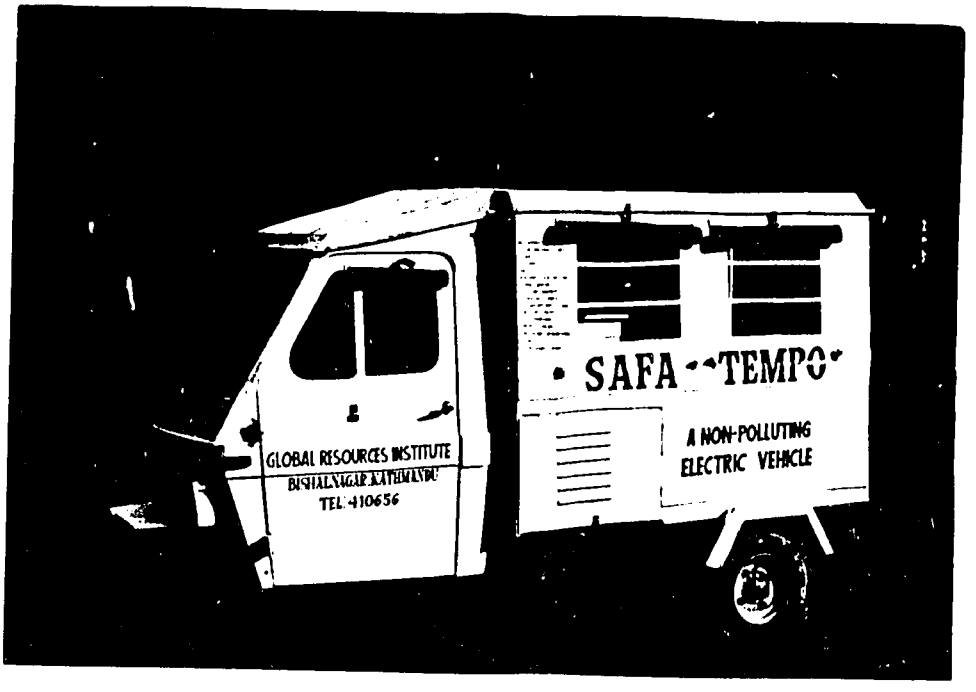
- Special award from the American Meteorological Society, 1961 ("For Pioneering Effort in Planning a Meteorological Satellite")

- Award from Department of Commerce on 25th Anniversary of TIROS I Meteorological Satellite ("For critical scientific leadership . . . whose studies laid the groundwork for TIROS I and subsequent meteorological satellites")

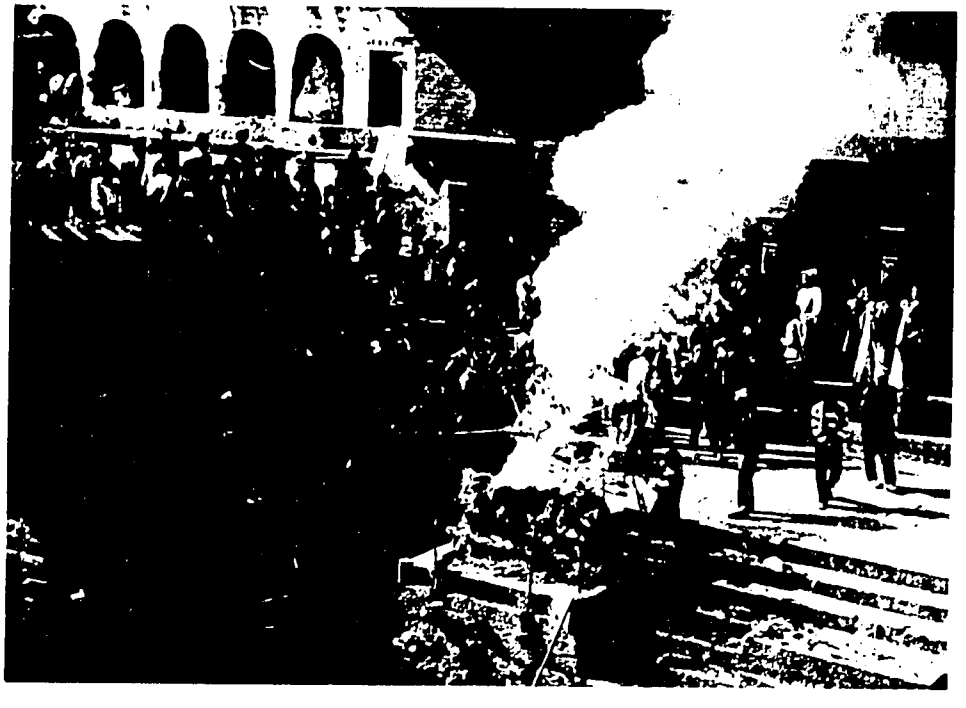
APPENDIX G

PHOTOGRAPHS

PHOTOGRAPHS

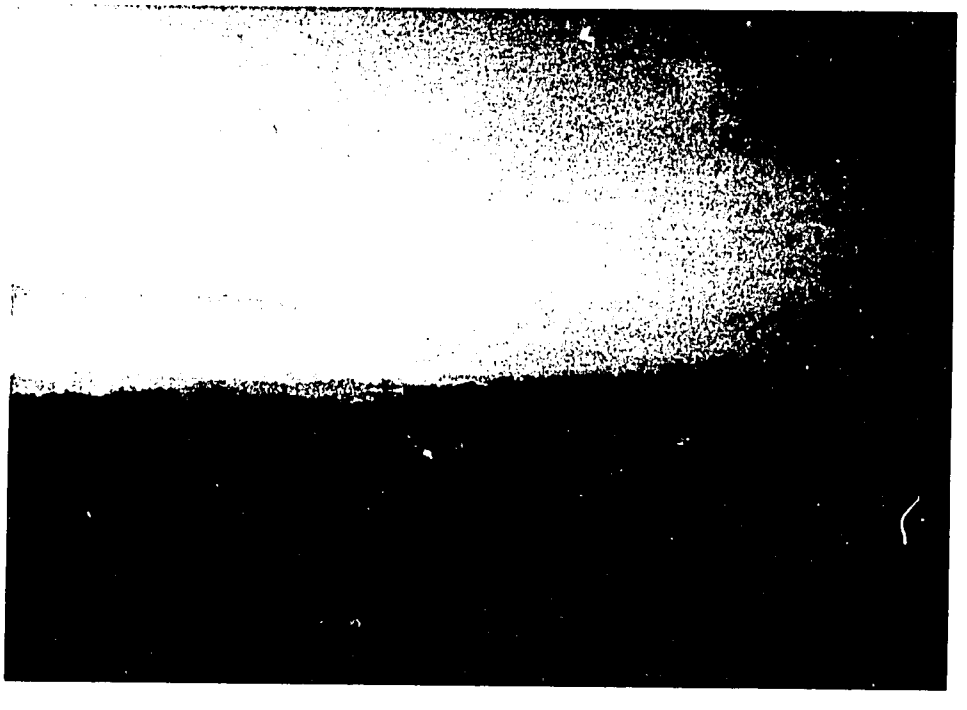


1. Demonstration of Tempo Conversion to Electric Power



2. One form of Air Pollution in Kathmandu and bombay--Ritual Cremation (1/2 ton of wood per cremation)

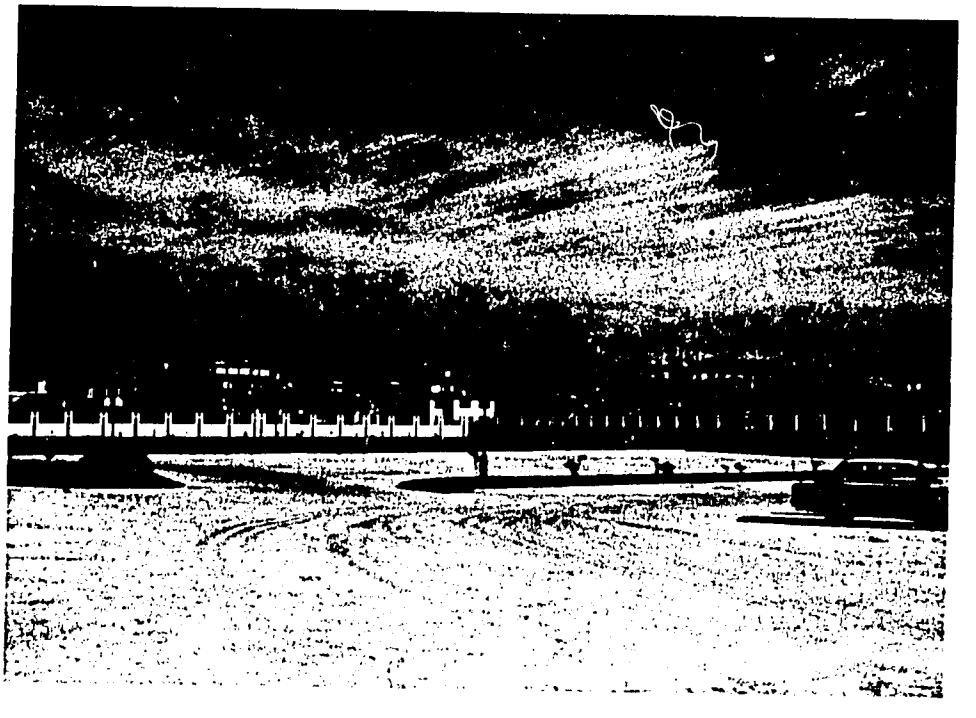
3. A Low Pollution Day in Kathmandu--Himalayan Mts. Still Not Visible



4. Blanket of Pollution Overlaying Kathmandu--Viewed From Himalayan Foothills

60

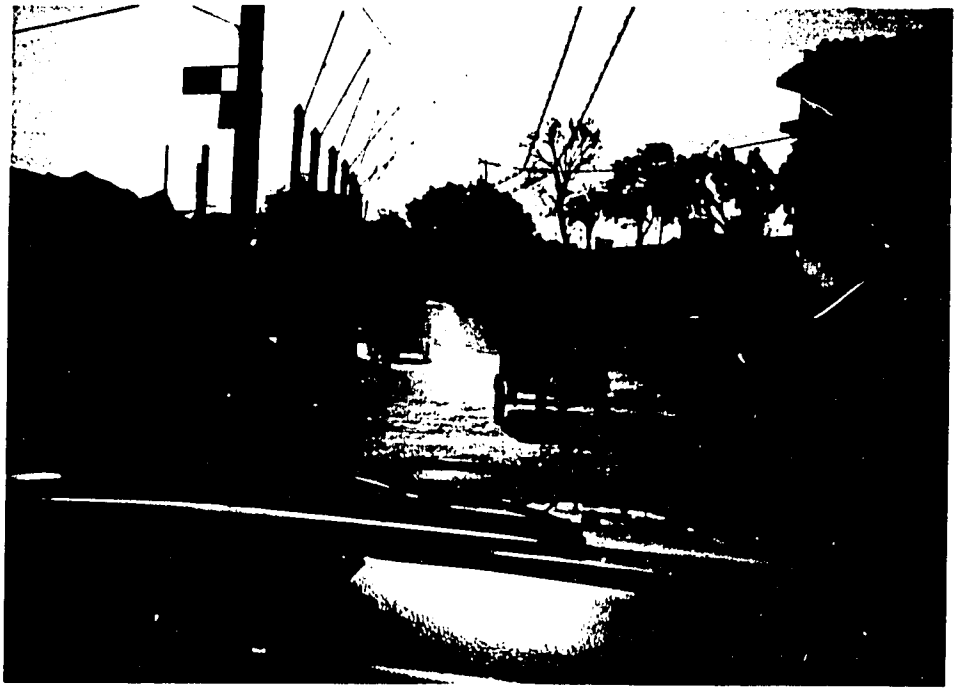
5. Inaugural Session of Kathmandu URBAIR Workshop--Speaker is Chief Guest, the Hon. Mr. Bal Bahdur Rai, Minister of Housing and Physical Planning



6. Afternoon on a Low Pollution Day in Kathmandu--Himalayas are Faintly Visible in Background

7. Smoke Stack of Hirisiddhi Brick Factory in Kathmandu

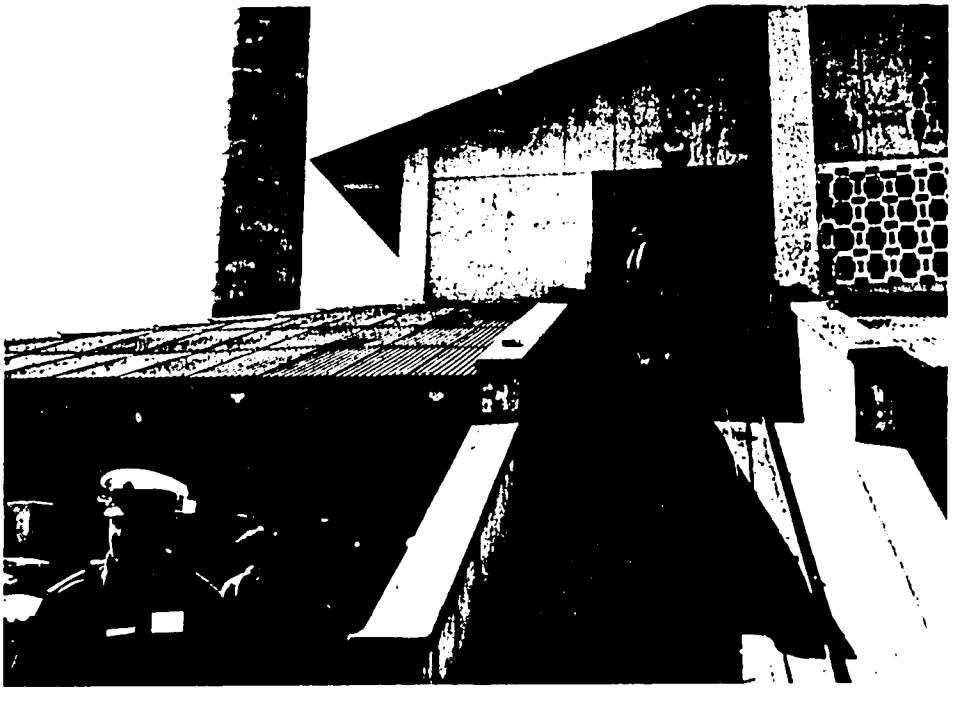
8. Primary Transportation in Kathmandu--Overloaded Tempo



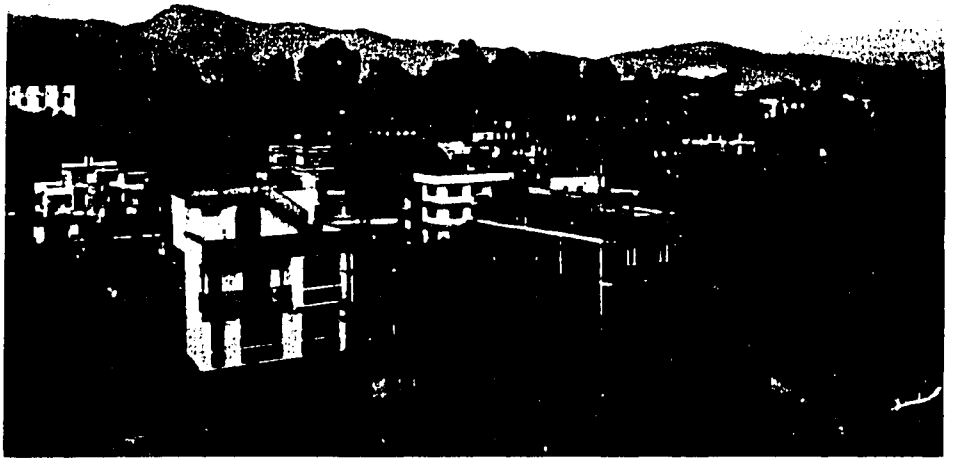
9. Typical Emissions from Vehicles in Kathmandu

10. Typical Emissions from Vehicles in Kathmandu

11. Top of Oven in Hirisiddhi Brick Factory in Kathmandu--This Factory Uses the "Chinese" Method of Brick Manufacturing



12. Entrance to Hirisiddhi Brick Factory--Dr. Trond Bohler of NILU Standing in Doorway, S. Thapaliya, Deputy Superintendent of Kathmandu Valley Police, in Uniform



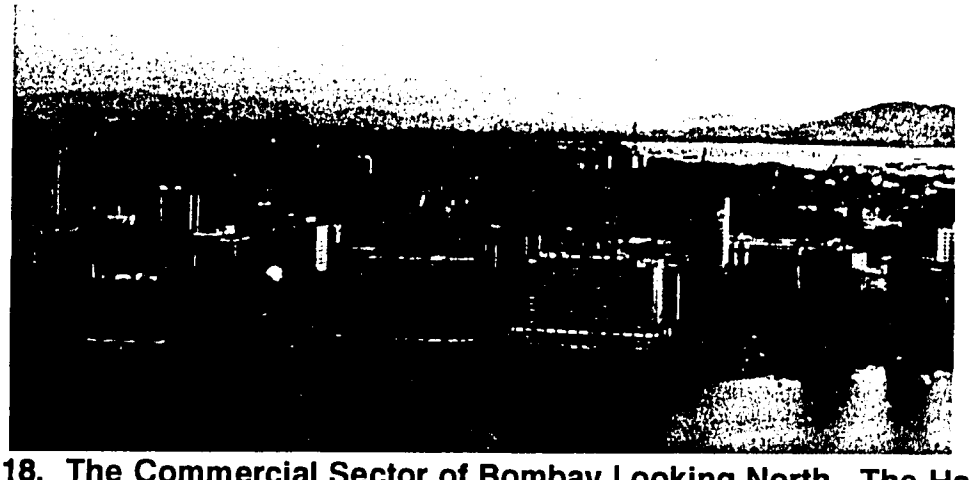
13. A Low Pollution Day in Kathmandu

14. A High Pollution Day (same view as photo #13)

15. URBAIR Workshop in Kathmandu--Breakout Session--2nd from right, Dr. Steinar Larssen, NILU; 3rd from right, Dr. Stanley Greenfield, USAEP/WEC;

16. URBAIR Workshop in Kathmandu--Breakout Session--Seated at left, Mr. Jitu Shah, World Bank; 2nd from left, Dr. M. Shrestha, Dept. of Hydrology and Meteorology; 3rd from left, Mr. Hari Lai Rajbahak, KVVECP

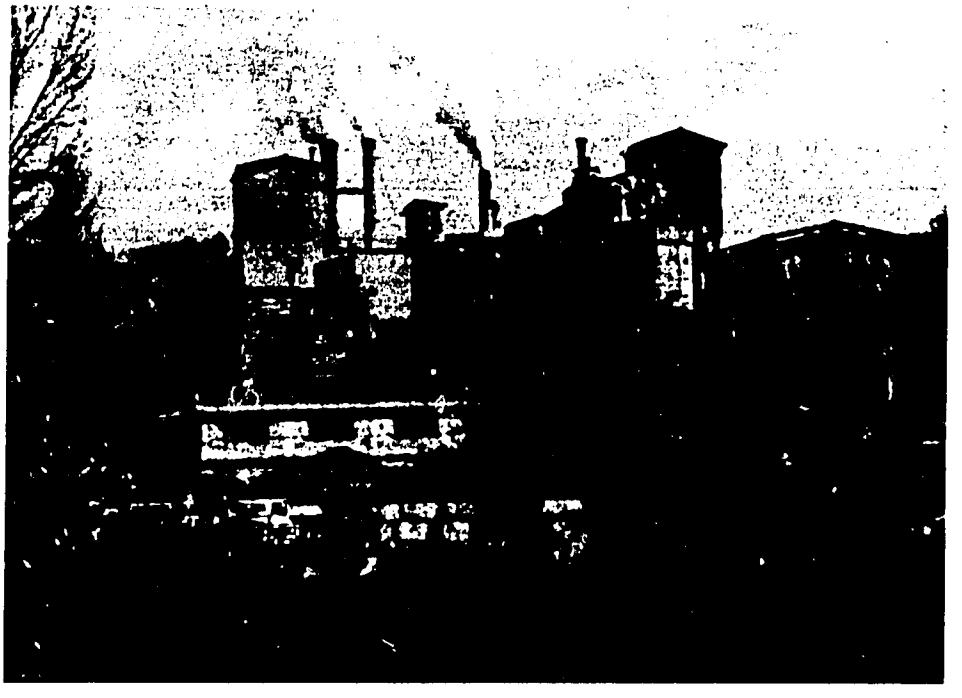
17. Emission Data Committee Meeting in bombay--from right to left, Dr. Stanley Greenfield, Dr. Steinar Larssen, NILU, Mr. U.H. Joglekar, Aditya Environmental, Mr. R.V. Aundhe, Aditya, Mr. Huib Jansen, IES, Mrs. S.S. Bhende, Maharashtra Pollution Control Board, Mr. M.G. Rao, Rashtriya Fertilizers, Ltd.



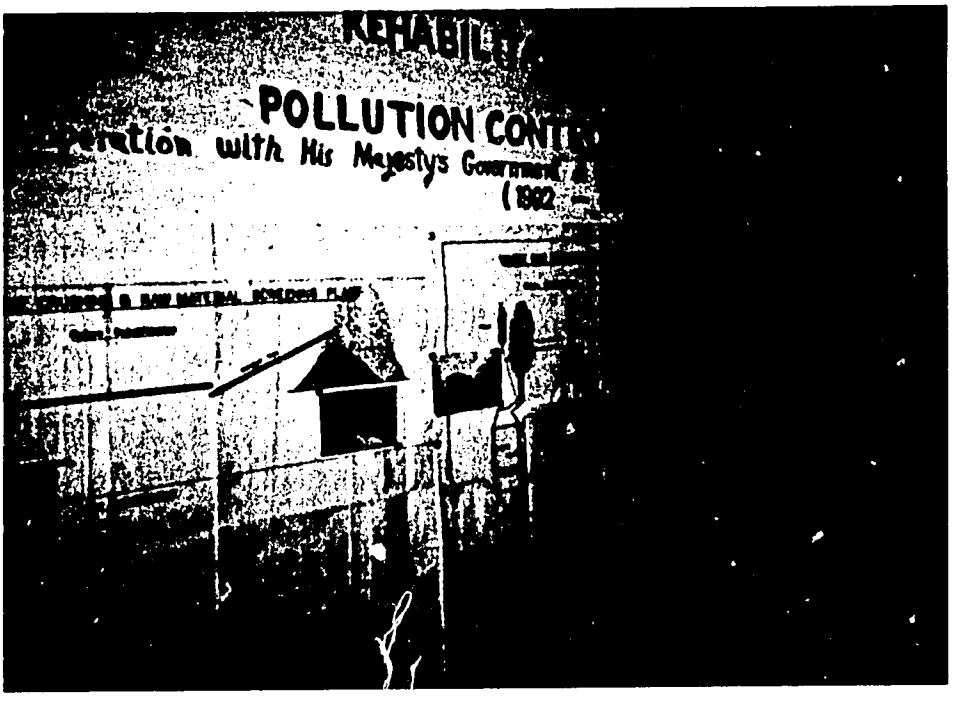
18. The Commercial Sector of Bombay Looking North. The Hazy Area on the Horizon is the Pollution Blanket Over a Major Industrial Sector

19. The Commercial Sector of Bombay Looking South. The cluster of Shacks on the Mud Flats is a Major Collection of Homeless Squatters

20. View of Himal Cement Factory in Kathmandu Valley



21. Close-up View of Himal Cement Factory



22. Briefing Chart Showing Pollution Control Program for Himal Cement Factory (1992-1994)--in Cooperation with Federal Republic of Germany