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South-South Solidarity

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SECTION I: INTRODUCTION AND OVERVIEW

The environment-health link, or what we are denoting here as eco-health[1] is an attractive new arena for research in the years ahead. It is evident to the public at large that declining ecosystems -- whether natural or man-made -- are having an adverse impact on the health of our population, and this in turn is compounding the rate of environmental decline. Needless to say, this downward environment and health spiral will pose an immense challenge to state planners and administrators in future. Slogans like 'Health for All by the Year 2000' will become hollow, and remain like some kind of panacea at best, if the present state of affairs continues.

In the most recent of the Government's Five Year Plans[2], industrialization programs and development generally, have to be accompanied by planned social benefits and environmental entitlements to the weaker sections of the population, particularly those most affected by declining ecosystems-- that is, if constitutional regularity is to be observed[3].

Whatever welfare measures the Government has adopted for the environmentally destitute have clearly not been adequate. Part of the reason may be that Government planners are not properly supplied with health status reports on these populations. The absence of health reporting is unfortunate given the scores of environmental health experts in this country. Added to this, is the fact that little attention is paid to evaluating health risks and potential hazards in development programs. This is not because techniques are not available, on the contrary, the pioneering work carried out in environmental assessment and monitoring in India, have quantitative techniques which apparently lend themselves readily to health assessment[4]. In spite of this, health impacts are rarely considered in development projects[5].

It goes to show that the State is more interested in environmental assessment and monitoring related to regenerating natural resources than it is in safeguarding people's health. After all, natural resource preservation will provide a long-term economic return, whereas health safeguards are merely a welfare measure requiring more Government investment.

[1] ecosystems and health, not ecology and health.

[2] 1985-89 Five Year Plan.

[3] As is the case with many of Government's policy prescriptions, entitlements rarely reach poor households. In any event an example of such entitlements is the case of the incentives provided to tribal communities to switch over to settled farming from traditional 'slash and burn' cultivation.

[4] See discussions with Dr Badrinath at NEERI.

[5] Health impacts are rarely considered both in setting up industrial centres, and are also not adequately figured into state-sponsored development schemes i.e. ground-water development, etc.

ENVIRONMENTAL HEALTH RESEARCH

Environmental health research has hitherto been linked to a greater extent to industrialization or infrastructural development -- more than it has to social development [6]. Consequently in the large body of literature consulted for this report[7], the research focus generally has either been on environmental hygiene or on civil and industrial engineering as it relates to public health. This leads researchers to determine various standards and permissible limits related to food, water and air safety, quantifying the degree of contamination rather than looking at its impact on the overall rural and urban environment, and the consequent decline of human health.

Moreover scant attention has been paid to the effect of these ecosystems on the plight of the poor. With a clear in-built bias towards the urban elite and industrial work-places, it is difficult for environmental health research to meet contemporary challenges. Even with an increasing public awareness of the problems of health emanating from a good environment, only exceptional studies have dealt with environmental health.

There are exceptions however. In this report we have noted some examples of programs and scientific papers carried out at a variety of research centres in India that have advanced these notions of environmental health. We have categorized these studies with a view to identifying priority areas for future research. It is the contention of the authors that if some of this research systematically addresses some of the urgent problems, it could have an impact on the development programs sponsored by NGOs and governmental bodies in future.

OPPORTUNITIES IN ENVIRONMENTAL HEALTH RESEARCH

Based on a literature review, there seemed to be two progressive strands of environmental research to date. Firstly, the micro studies that have assessed the changing health status of a number of vulnerable groups because of their environment[8]. (Workers in the unorganised sector, tribals, women, etc.); and secondly, the studies that use an integrative (interdisciplinary) approach to environment and health which evaluates the capability of a population to withstand a changing external environment. In what follows we assess in what institutions, this kind of research is being carried out.

[6] Environmental health research has been pursued since the British period of administration. After Independence from the 2nd Five Year Plan onwards such research was linked to India's infrastructural development. Unlike other development sectors, it has not become community based technology.

[7] See Annexure II for listing of review publications.

[8] Environment here could mean that which is ecological, economic, psychosocial and so forth.

(A) Vulnerable Groups

Occupational health of poor in the unorganised sector - An example of vulnerable groups are the poorer sections of the labour force. Mine and quarry workers, agricultural and plantation workers, those in agate production, bidi rolling, glass manufacture, carpet weaving, to name only a few, all draw a certain relation between internal health and the external environment. In these cases, the environment is usually detrimental to their health and well-being, primarily because the workers cannot control the economic, political, social conditions that give rise to their environment.

Microstudies are being carried out which look at some of the health hazards within these environments. These have been done by many of the national institutes and other research centres.

In the institutional profiles found in this report, the two institutes principally involved, in environmental health research of vulnerable workers groups have been ITRC and NIOH.

Women's Health - Another example of vulnerable groups has been the whole area of women's health. In this case, actual experiences with women in mobilizing them to development have led to a number of development documentaries. From this increasingly a holistic approach has been developed in which the environment (whether physical, psychological, or ecological) is believed to be responsible for a process of general weakening, and the high incidence of morbidity and mortality among women.

A substantial amount of work has been carried out by groups in the NGO sector. In view of the interest also generated by Government institutes/ departments there is a number of occupational studies concerning women's health that can be found. In the institutes surveyed particular attention was given to this by ITRC and NIOH.

Tribal Health - Specialists relate the degenerating ecosystem of a given tribal community to their health conditions. Drawing on clinical, anthropological and other social studies, they do not so much integrate the disciplines of environment and health, as presume that tribals (who are forest dwellers) are ecologically determined. They argue that their external state mirrors their inner state of health. Therefore with the current rate of deforestation for instance, there will be an impact on their rate of morbidity and mortality.

In looking at where environmental health studies on tribals are being carried out, it is clear some of the Tribal Research Centres (of which there are more than ten in India) are doing studies, but some of the most pioneering work is being carried out by individuals, NGOs and in academic circles. Such studies reflect a multi-disciplinary approach[9].

[9] See Annexure III.

B) INTEGRATIVE AND INTERDISCIPLINARY RESEARCH

The other progressive research thrust is the attempt to integrate environment and health sciences either through the use of an integrative science or by using an inter or a multi-disciplinary approach. In the case of a vulnerable group, it is a self-evident that a group would have a deleterious ecosystem. But for a large portion of the population it is not visibly evident that the environment is negatively impacting on the health of this population. That is why an integrative science/interdisciplinary science is an important tool.

It is crucial therefore to have a way of assessing the capacity of a population to adapt to a changing environment. This requires a method for understanding the point at which a population begins to weaken and where their natural systems -- environment and health -- are no longer able to cope. Judging by the capacity does not mean waiting for their weakened state to become manifested in disease or death.

As this general weakening process is not part of the clinical practices held by medical scientists other sciences or methods are sought. A few of the examples cited below are epidemiological methods, population or ecological studies. Each of these are integrative and are capable of being incorporated with an inter or multi-disciplinary approach.

Epidemiological Studies: Many epidemiological studies, in illustrating how disease is affecting a given community draw on data other than clinical observations to substantiate their claims. Socio-economic and environmental data are usually assessed. Through this integrative technique environmental conditions which are responsible for rendering a poor health status of a given population can be identified. Although the environmental conditions are defined as physical causal agents by conventional epidemiology, some effort has been made at using a multi-disciplinary approach so as to broaden the scope of epidemiological techniques.

In the institutes reviewed, all of them use epidemiology to varying degrees. What is noteworthy is that the research most systematically addressing environmental health, are those with a multi-disciplinary approach.

Population Studies: Population studies, through the use of various demographic techniques can project a certain set of epidemiological variables into the future and suggest the level of risk to a population's health. In this sense population studies carried out by specialists are using an integrative approach to environmental health.

Studies that have been pioneering new techniques for assessing the health status of ecologically vulnerable populations tend to take a quasi-holistic approach, and are

not as much an integrative science. Drawing on social sciences and developmental research, they can show some of the social consequences of environmental decline, particularly on people affected by development projects and on those affected due to a declining resource base. The destructiveness of this environmental change can be verified through environmental sciences.

INSTITUTIONAL REVIEW

Simultaneous to the literature review, we carried out an assessment of the capability of a few of the research institutes in this country, which handle aspects of environmental health, to evaluate whether they were concerned as institutes (not individuals in institutes) with a) the changing health pattern/ecosystem of vulnerable groups; b) the integrative or interdisciplinary approach to environmental health. Out of six that were reviewed in detail all of them used the integrative discipline of epidemiology and only a few focussed on vulnerable groups[10].

NEERI (National Environmental Engineering Research Institute) functions under the CSIR (Council of Scientific and Industrial Research), and has to some extent adopted a multi-disciplinary approach to the issues of air and water quality assessment and to the disposal of waste-water and solids (see Sec.II for details). Although their work may be uniquely interdisciplinary in the context of environmental engineering, they are not integrating disciplines of environmental health. For instance they do not have quantitative techniques for assessing health risks in their environmental assessment and monitoring, and they do not have any medical officers in their institute.

MRC (Malaria Research Centre) -- This institute, is a part of the constellation of the, ICMR (Indian Council of medical Research) and focuses on the public health hazards related to malaria. Using a multidisciplinary method drawing from the environmental and health related sciences, it has located endemic centres and taken preventive, often bio-environmental control measures, which are ameliorative both from the social and environmental point of view.

NIOH (National Institute of Occupational Health). This institute also functions under the ICMR. They have done an extensive amount of work on vulnerable/economic groups. Mostly focussing on agricultural labourers, and those in the unorganized sector, fully studying the health hazards associated with their working environment. They have also tried to promote occupational safety as a health priority through intersectoral coordination.

ITRC (Industrial Toxicological Research Center) functions under the aegis of CSIR. It has carried out a number of pioneering studies on worker's groups. However, less attention has been paid to environmental health problems in the rural or urban environments.

[10] We specifically chose research institutes instead of NGOs in this study. We appreciate however that many voluntary groups have done pioneering work in environmental health. In the second of the Eco-Health Series, we plan to cover this.

AIHPH (All India Institute of Hygiene and Public Health), is under the Ministry of Health, Government of India. It has taken up some important studies related to sanitary engineering. In collaboration with NEERI, it is studying two sites on the Ganga to determine the quantum of pollution as part of the National Ganga Action Plan. Paradoxically these two studies are being carried out by non-medical staff of the Institute.

NICED (National Institute for Cholera and Enteric Diseases), also functions under the ICMR. This institute by and large is confined to the gambit of environmental hygiene in its studies of communicable diseases.

PRIORITY AREAS FOR ECO-HEALTH RESEARCH

In suggesting some priority areas for future eco-health research, it is necessary to make a radical departure from present day environmental health research. As we have seen in the sample literature review, and institutional study, these state-of-the-art publications are only partially advancing the study of a degenerating ecosystem and its impact on people's health.

One of the priorities of research is to develop a health sociology of environmental change. Over the last two decades there is increasing recognition of the damage caused by the destruction of our natural resources, the processes of industrialization, urbanization and modernization, and the consequences of underdevelopment and exploitation. What is less understood however is how these and other changes impact on people's immediate environment, and to what extent do they alter people's conditions predisposing them to disease and premature death.

Through micro-studies, various environmental health studies can be recorded. In achieving a large enough sampling it will be possible to generalize on some of the health problems that are a direct result of environmental change, and to determine which are the most vulnerable populations. This could be done on a block by block basis so that it would not be restricted to any traditional group per se (tribals, women, etc.) In this way we would be understanding another major factor of poverty since India's program of industrialization began.

A second priority area is to look at basic needs. Once these vulnerable groups are identified, environmental health researchers would have to redefine basic needs in a way that preserves a balance between their internal and external environments. The currently practised basic needs focus only on subsistence and not on ameliorating the environment which causes the health decline. New parameters for determining basic needs will need to be drawn up.

A third priority area would be to take up health impact assessment in all development projects. This would mean that methods for quantifying and forecasting health risks would have to be refined for assessment and for monitoring, and that these health risk statements would have to be part of the design and operationalization of projects.

And finally a research priority is to develop an integrative approach to environment and health so preventative measures can be taken in advance. Through a transdisciplinary method (or at least a more holistic approach) the long-term decline of people's environment and health can be avoided.

Sociology of Environmental Change

Micro-studies that reflect the large scale destruction of our natural, physical and social environment can be done using a systems approach. By adopting the following five groups as a reference for the micro studies, we will be able to reflect upon the large scale environmental changes and pin-point the vulnerable groups as well.

These are:

- 1) Factors and processes of environmental change leading to a degeneration of land and land-based ecosystems and the decline of a population's health.
- 2) Factors and processes of environmental change leading to a degeneration of water and water-based ecosystems and the decline of a population's health.
- 3) Factors and processes of environmental change leading to a degeneration of urban ecosystems and the decline of a population's health.
- 4) Factors and processes of environmental change leading to a degeneration of rural ecosystems and the decline of a population's health.
- 5) Factors and processes of environmental change leading to a degeneration of social environment and the decline of a population's health.

Basic Needs Assessment of Vulnerable Populations

This can only be carried out once the vulnerable populations are identified. Basic Needs may include such items as:

- 1) Food - Production, availability and distribution
 - Food Safety
 - Food Security
- 2) Drinking Water and Sanitation
 - Availability, Distribution and Conservation

Looking at basic needs of food using parameters of eco-health may involve the following:

- Identifying major causes and contributing factors of malnutrition (more particularly undernutrition) in specific circumstances, due to degradation of the environment and degeneration of the eco-system (i.e. drought affected area/arid areas/hilly areas, etc.).
- Establishing linkages and relationships between environmentally degraded areas and not only malnutrition (visible forms like PEM - Gr. III and IV i.e. severe Gr. II - moderate and some specific nutritional deficiency disorders) but also general physical and psychological weakness.
- Detecting communicable/non-communicable diseases (including genetic disorders) which either aggravate or precipitate malnutrition.
- Detecting maternal malnutrition (particularly among those having babies with low birth rate and high perinatal/high seasonal mortality.)
- ✓ Evaluating health risks due to agricultural chemicals (pesticides, fertilizers etc.) and elaboration of food standards and codes of practice relating to various food contaminants and to chemicals used in food storage and food processing (additives and preservatives).
- ✓ Preventing reduction and control of food contamination of biological origin to prevent food borne diseases.
- ✓ Assessing of safety of food irradiation applied for preventing food wastage both directly (extension of shelf life) and indirectly (primary prevention of food borne diseases).

Assessment of Health Impact in Development Projects

There is also an urgent need to incorporate or include component/health impact analysis statement in all feasibility studies of infrastructural (industrial/developmental projects both major/small) as a necessary part of the broader environmental Impact Assessment/Analysis (EIA) studies. This will also require the development of appropriate methods / techniques / parameters / indices which could be used in providing a health impact statement, not only of major projects (industrial / thermal / mining / irrigation etc.) but also on smaller projects so as to evaluate the health risks involved (including determining the causal relationships between environmental change and weakening condition of the body.)

Integrative Approach to the Study of Environment and Health

The environment in which we live is an ecosystem or an integration of physical and social relations. Therefore usually the conditions of ill-health are the result of a multiplicity of events. This makes the correlation between environment and ill health difficult. Generally scientists today determine all the

environmental factors through clinical testing of the disease and its causal agents, but this is very partial. What is necessary is to identify the social and physical relations, so that preventive health measures can be established. Through such an exercise we can determine the kind of environments that are connected with ill-health.

The social factors that may impinge on a person's health can be found in many settings whether in the home or work-place or in the rural or urban environments.

The physical relations in contrast may be more difficult to categorize. Simply stated, a common disease like malaria can be used as an illustration.

Much work has been done in India on the bio-organic conditions that predispose a population to malaria. Biologists have a clear notion on the optimal conditions for parasite breeding and vector transmission such as the quantum of humidity, temperature and other spatial and temporal conditions. But along with this, there has been little exploration of people's use or misuse of water resources, and its impact on increases in malaria. This may be related to such things as the location of settlements, the impact of modern agriculture and the increased use of pest management among the field crops, the impact of large-scale dams, the pollution in urban centres and many other factors that have raised the incidence of malaria.

Without a shift in viewpoint health specialists will continue to treat symptoms, and environmentalists will be unable to orient environmental change towards more balanced human health. This although is the greatest of challenges, nonetheless an imperative of sustainable development for human survival, and new efforts must be made in this direction.

SECTION II: INSTITUTIONAL PROFILES

Introduction

The purpose of this section is to have an idea about the type of research being carried out in the field of environmental health in some of the selected research institutes of the country and to review research literature on environmental health (with a view to what ought to be done) available in these institutes. The selection of the institutes to be visited was initially not guided by any specific criteria except that the institute should be of national stature and importance, relatively old enough and also should have contributed considerably in the field of environmental health research. The following six institutions were selected for the study:

- (1) Industrial Toxicological Research Centre (ITRC), Lucknow.
- (2) National Institute of Occupational Health (NIOH), Ahmedabad.
- (3) All India Institute of Hygiene and Public Health (AIIHPH), Calcutta.
- (4) National Institute for Cholera and Enteric Diseases (NICED), Calcutta.
- (5) Malaria Research Centre (MRC), Delhi.
- (6) National Environmental Engineering Research Institute (NEERI), Nagpur.

A four-week travel program was designed to gain an overall understanding of the type of research work being carried out in these institutes. Discussions were held with most of the senior researchers in each place. Not only the personnel from these institutes, but others having relevant expertise and experience were also contacted. While list of contacts and institutes visited is appended in Annexure I, the list of resource materials/publications collected from these institutes is appended in Annexure II. What follows is the profiles of the Institutions visited.

ITRC - (Industrial Toxicology Research Centre)

Industrial Toxicological Research Centre under the aegis of CSIR is a pioneer laboratory dealing with effects of industrial and environmental pollutants on environment and human health. A number of epidemiological surveys have been conducted and occupational health problems have been studied by the epidemiological division of ITRC. The main categories of problems that have been studied in ITRC with an epidemiological approach have been dealt with in detail in paragraphs that follow. However, it would be worthwhile to highlight here that, studies on the role of various factors like age, sex, physiological status, nutritional status, genetic make-up in relation to morbidity which had remained hitherto largely unexplored in the Indian context are being taken up - as also multimodel studies establishing links between socio-economic conditions and toxic stress.

Since the mid-1980s when the project on Human Exposure Assessment Location (termed HEAL) had been initiated, some attention has been diverted from occupational health to the studies of human exposures from air, water and food. Besides the environmental monitoring (analysis) of the pollutants in air, water and food, analysis of environmental pollutants and their metabolites in blood and urine of populations exposed to metals, pesticides, and some other chemicals have been also carried out. Holistic studies under the National Drinking Water Mission at Koraput and Barmer have highlighted the need for bringing health protection to rural masses in times of climatic and environmental stress.

The epidemiological section of this Institute is quite strong with a good team of doctors. Though a substantial amount of work has been done in the area of epidemiology focussing on those in the unorganised sector, sufficient attention has not been specifically paid in studying such vulnerable groups like women workers. To sum up, although the work of epidemiological section may be interdisciplinary in the approach, the epidemiological studies are lacking in integrating the environmental linkages. Also, there is no meaningful collaboration and coordination between different sections of the institute in the process of designing such interdisciplinary studies. Therefore, it seems there is scope and opportunity to develop a more systematic approach in conducting multidisciplinary epidemiological studies drawing expertise from the disciplines of environmental sciences of the various sections of the same institute. Even collaborative ventures with environmental institutes like NEERI may yield more multi-disciplinary findings.

The ITRC at Lucknow was founded in 1965 with the following aims and objectives:

- ✓ 1) To identify through systematic epidemiological surveys the health hazards to which industrial and agricultural workers are exposed in their work environment.
- ✓ 2) To undertake safety evaluation of chemicals used in industry, agriculture and day to day life.
- 3) To conduct experimental studies on the mode of action of chemical pollutants and develop research capabilities in relevant scientific disciplines.

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- 4) To develop suitable diagnostic tests and suggest remedial/preventive measures and,
- ✓ 5) To collect and disseminate information on hazardous chemicals.

In ITRC, indepth toxicological research has been done on priority chemicals such as heavy metals, industrial dusts and fibres, plastics and polymers, hydrocarbons, pesticides, detergents, dyes and food additives. These research activities are being done in separate sections.

Various research and development sections have been listed under five broad groups, viz:

- i) Preventive Toxicology
- ✓ ii) Pesticide Toxicology
- iii) Systematic Toxicology
- iv) Ecotoxicology, and
- v) Environmental Health Research

In each group there are many sections. (While in Preventive Toxicology and Pesticide Toxicology there are six sections,) in Systematic Toxicology there are eight, in Eco-toxicology there are four, in Environmental Health Research there are five sections.

One of the sections belonging to Environmental Health Research Group is "epidemiology" (where studies of our interest) are mostly conducted.

The aims and objectives of the Epidemiology section are mainly as follows:

- * To study health hazards of workers exposed to various toxicants in different industries (both organized and unorganized sectors)
- * To conduct industrial hygiene studies and biological monitoring to assess the magnitude of the problem;
- * To act as referral centre for occupational health problems encountered in various industries;
- * To identify problems related to workers' health on which laboratory research is needed, and
- * To suggest preventive measures to safeguard the health of working population.

The main categories of problems that have been studied in ITRC with an epidemiological approach are:

1. Observation of the occurrence of illness in different categories of workers

The epidemiology division of ITRC has conducted studies on workers in a number of industries with this objective. Some of these are agate grinding industry, cotton textile industry, hemp processing units, different heavy engineering industries, glass industry, electronic industries and workers exposed to pesticides, petrochemicals etc.

2. Observation of changes in the occurrence of illness

Follow up studies on victims of Bhopal disaster have been conducted to observe changes in morbidity. Lung function and behavioural studies have been performed in many industries to observe the change in morbidity following exposure to industrial toxins in tropical conditions which may be quite different from those reported from industries in western countries.

3. Diagnostic studies for completing the clinical picture

Major efforts have been put in for completing the clinical picture of occupational diseases among industrial workers. Clinical psychology parameters have been used to study preclinical neurological morbidity induced by toxic agents like petrol, benzene, xylene, toluene, pesticides and heavy metals. Harmful effects on lungs produced by various industrial toxins like inorganic and organic dusts, chemicals, metals, fumes etc. have been assessed by performing pulmonary physiological studies to elicit the early and late changes. Acute effects have also been studied using pre and post shift studies. Studies conducted by ITRC in the villages of Unnao district in UP on persons suffering from Lathyrism have for the first time reported the synergistic action of Lathyrus sativus consumption and high manganese content in food and water. It has for the first time reported the occurrence of sub-clinical cases of Lathyrism. ITRC, for the first time, described a syndrome "Flour workers' disease". Epidemiological studies showed that the workers engaged in grinding wheat and other cereals at small flour mills were suffering from respiratory symptoms and the cause of this high prevalence of respiratory morbidity was the increased numbers of spores and mycelia of various fungi such as Aspergillus niger, penicillium, mucor etc.

4. Multiple causes in Occupational Diseases

Various factors which may have a role in the causation of occupational disease are routinely investigated in almost all the epidemiological studies carried out in ITRC. As mentioned earlier the factor of age, nutritional status, exposure to toxicants and combined effects of environmental conditions have been illustrated among glass workers, pesticide sprayers

etc. Multimetal exposure was found to be responsible for pneumoconiosis type of respiratory morbidity among glass workers.

5. Study of Diseases for which Animal models do not exist:

Animal models are often not available for many conditions encountered in our industrial workers. Industrial bronchitis is a case in this context. It is common among majority of industrial workers. Detailed studies on the specific role of different industrial toxins in producing symptoms of bronchitis have been conducted. A number of ocular problems occurring among industrial workers may also be cited as other examples. Glass workers have been studied for this problem with special reference to occupational exposure.

6. Exposure Effect and Exposure Response Relationship

Exposure related studies have been conducted to find the effects of various heavy metals in relation to morbidity observed among glass workers. Such studies using behavioural test battery have also been conducted to study neurological damages caused by neurotoxic industrial chemicals. Attempts have also been made to correlate combined exposures to subliminal changes in ocular system.

Studies conducted by ITRC have showed that Threshold Limit Values (TLV) recommended by the western countries are not applicable in Indian conditions. Workers in heat treatment and case hardening plants in a factory were found to be suffering from typical symptoms of cyanide poisoning and their biological monitoring showed a higher concentration of cyanide and thiocyanate in blood and urine whereas the concentration of cyanide in the ambient environment was well within permissible limits as per western guidelines. Similarly workers exposed to organic solvents like xylene and toluene suffered from various symptoms and were found to have impaired performance on behavioural test battery although the concentration of these chemicals was within permissible limit. ITRC studies have emphasised the need for having National Threshold Limit Values for various toxic chemicals in India.

7. Measurement of the effect of Prevention:

Intervention measures have been proposed in case of hemp workers disease. Evaluation of improvement has also been assessed. A rapid detection test of phenol in urine has been developed by ITRC. It is in the form of a tablet over which the person has to pass urine and the colour changes in the urine reveal the presence or absence of phenol in it. Thus the workers exposed to benzene during their occupation can monitor themselves and know whether they are over exposed. ITRC has also developed such tests to diagnose manganese toxicity among exposed workers.

ITRC has adopted and standardized various behavioural tests for the earliest detection of the adverse effects of chemical, physical and psychological factors on the workers. This behavioural test battery has been used in a number of ITRC studies and has yielded very useful information.

ITRC has collected voluminous data on lung function in a wide range of population, both urban and rural of different age groups and belonging to different ethnic groups with varying physical, nutritional and environmental conditions. ITRC is also credited with the publication of national norms for ventilatory functions in male and female populations belonging to different geographical areas of the country. ITRC has for the first time compared the lung function data of Indian population with those of foreign population particularly of European descent, American negroes and Caucasians.

No doubt the focus of the studies conducted by ITRC is primarily on assessment and abatement of problems in occupational and environmental toxicology, however at least two other areas in which some significant work has been done, are:

- 1) Studies on Food colours
- 2) Studies on water quality assessment.

✓ 1. Studies on Food Colours: A major programme on the evaluation of the magnitude and usage pattern of artificial synthetic colours in food stuffs was initiated by ITRC and the first 10 years of a detailed survey revealed that 70% of food stuffs contained non-permissible synthetic colours and as many as 18 prohibited dye were used quite commonly. Another 10-year survey showed that the usage pattern of non-permissible food colours has changed. About 30% of food stuffs in rural areas still contained non-permissible food colours. The improvement in urban usage was perhaps due to ITRC data which focussed the attention of regulatory authorities on the need to take necessary steps, the report reveals. Detailed studies were also undertaken to elucidate the toxicity of various dyes. Similarly, another survey showed that of 1100 samples of mustard oil collected from 57 districts of UP, 28.5% were adulterated, 34 samples contained synthetic cancer producing colours such as butter yellow while 13 oils contained argemone alkaloids which produce paralytic syndrome. ITRC has also developed a portable minicolumn kit for rapid identification of aflatoxin in food commodities under field conditions.

2. Studies on Water Quality Assessment: Safety evaluation of drinking water was carried out by ITRC in 13 problem districts in 11 states covering over 14 lakhs of population from over 2600 villages of UP, West Bengal, Meghalaya, Mizoram, Arunachal Pradesh, Sikkim, Orissa, Rajasthan, Jammu & Kashmir, Himachal Pradesh and Maharashtra. The studies involved physico-chemical and bacteriological analysis of water samples from drinking water supply sources. Water from hand pumps in Bankura, Mirzapur, Tripura and Nagpur districts gave coliform counts <10 per 100 ml in 96, 76, 83, and 79 per cent of samples respectively and faecal coliform counts of <1/100 ml were observed in between 83.3 and 95% of samples. Very few open dugwells were satisfactory. Piped water supply schemes showed significant variation in water quality: between 10.8 and 57.1 per cent of samples from different areas contained <1 thermotolerant coliforms per 100 ml. ITRC has also developed a portable water analysis kit for water analysis and a model water analysis laboratory.

NIOH - National Institute of Occupational Health.

NIOH functions under ICMR and has done extensive amount of work on vulnerable/economic groups, mostly focussing on those in the unorganised sectors and agricultural labourers, and studying in a systematic manner the health hazards associated with their working environments? Though the research activities of NIOH cover a wide spectrum of areas viz: environmental work-stress monitoring, laboratory based toxicological investigation and operational research, however, the major thrust is on multidisciplinary epidemiological studies related to occupational health problems of workers of both organized and unorganized sectors of industries. Brief summaries of some of the important epidemiological studies undertaken by NIOH are presented in the paras that follows.

From the inception of the Institute till about 1983/84, most of the studies were of conventional nature with a focus on organised industrial sector. However, since 1985 onwards there is a definite shift in the priority areas and more emphasis has been given to occupational health studies in the unorganized agricultural and small scale industries sector (mostly in rural areas) which are generally not covered by existing health and safety legislations. Most of the research inputs of NIOH presently aim at recognizing the magnitude of this above mentioned problem, the causative factors and there cause-effect relationships followed by developing appropriate intervention strategies to bring about improvement in the work environment and workers health.

The more important and positive aspects in some of the recent research studies carried out by NIOH is the occupational health problems of working women, especially those employed in cottage industry where health risks are high. A study to assess the workstress and adverse health impact on women in sewing operation has showed the prevalence of work related backache, pain, swelling in legs as most common causes of morbidity among these women.

Another interesting study on indoor air pollution and its effect on rural women, showed that indoor air-levels of PAH (Polycyclic Aromatic Hydrocarbons) were exceptionally high in houses using cattle dung and wood and were less in houses using coal.

To sum up, most of the research inputs of NIOH aim at recognising the magnitude of the problem, the causative factors and their cause-effect relationship, followed by developing appropriate intervention strategies to bring about improvement in the work environment and workers health. It is satisfying to note that the epidemiological studies carried out in this institute are more systematically planned and designed by meaningfully collaborating with other sections like toxicology, environmental pollution and operational research. Some of the studies are truly interdisciplinary in nature where links between socio-economic conditions, environment and health are established, because of the non-conventional nature of such studies, where more socio-economic criteria for assessment are used (not strictly medical oriented in their approach).

Because of their interdisciplinary integrated approach, it seems that they may be in a better position to look into the environmental linkages while focussing on unorganized sector in future. Moreover, there is much scope for an institute like NIOH to do pioneering work in the area of environmentally vulnerable population and to look at the whole setting of urban environment and health. Unfortunately no serious work has been done in this area so far.

The NIOH at Ahmedabad was started with a view to study interactions between work and health. The main objectives of NIOH are the following:

To help provide a safe, healthy and comfortable environment for work and living through multi-disciplinary approach:

- Research - Education - Service.

Research

- * Epidemiological and Environmental monitoring and corollary toxicological studies in hazardous occupations for recognition and evaluation of risk factors.
- * Development of tools for early diagnosis of health impairment.
- * Designing of appropriate intervention measures for prevention of hazards at work places.

Education

University courses: D.O.I.H.(Diploma), M.D., Ph.D. courses,

Orientation courses:

- For doctors, safety officers, factory inspectors, and managers, to promote health and safety, and
- worker's education for health awareness.

Service

- * Consultancy to Government regulatory authorities and industries.
- * Retrieval and dissemination of information through publication of monographs and technical reports.

The Thrust Areas of Research which the institute has identified are the following:

- i) Occupational epidemiology,
- ii) Toxicology
- iii) Environmental pollution
- iv) Development of safety norms, and
- v) Operational Research.

The sub-areas under each head are:

✓ i) Occupational Epidemiology: Occupational health -- Problems of Population in agricultural, unorganized, and organized sectors of industry, and vulnerable groups women and child workers.

✓ ii) Toxicology: Controlled exposure experiments and toxicological investigations on early detection of health impairment for:

- ✓ - Pesticides
- ✓ - Fertilizers
- Metals
- Solvents
- Dyes
- Dusts, and
- Chemical carcinogens.

iii) Environmental pollution:

- Air pollution
- Water
- ✓ - Agrochemicals pesticides
- Metals (Lead, Mercury, Cadmium).

iv) Development of Safety Norms:

- Chemicals
- Physical agents: Heat, noise, illumination.

v) Operational Research

Models for delivery of occupational health care system for workers through primary health centres and group occupational health clinics. Research activities, that are currently being carried out in the NIOH, the specific studies on occupational health problems of agricultural sectors, which are the following.

- ✓ - Pesticide exposure in applicators
- Exposure to vegetable dusts like cotton, tobacco and rice (paddy)
- Plantation workers (tea and coir)
- Ergonomic studies on agricultural tools, agricultural accidents and work safety in agricultural jobs.

In the unorganized sector, the specific studies/activities are on the following areas:

- * Silicosis in quartz crushing units, quarries, slate-pencil, and ceramic industries.
- ✓* Exposure to toxic chemicals, dyes, pesticides and metals.
- * Health problems in carpet weaving, match and fireworks industry and metal artwares.

In the organized sector: Studies on health problems in asbestos, cotton textiles, jute and glass manufacture, pesticides, petrochemicals, solvents and fertilizers industries were taken up.

Presently, NIOH has two Regional Centres viz: 1) Regional Occupational Health Centre (Southern Region - located at Bangalore) and ii) Regional Occupational Health Centre (Eastern Region - located at Calcutta). While the Eastern-Regional Centre (Calcutta) is supposed to specialize in occupational respiratory diseases (Pneumoconiosis in coal miners, respiratory diseases among jute mill workers, etc.), ✓ the Southern-Regional centre (Bangalore) in occupational agricultural health problems of workers in coir industry (especially in Kerala) and tea plantation workers ✓

The three main groups working in NIOH are the following::

- 1) Health Science Group
- 2) Environmental Work-stress group
- 3) Group on "Experimental Studies.

Following are the sections under each group:

1. Health Science Group:

- i) Occupational Epidemiology
- ii) Respiratory physiology
- iii) Statistics (Bio-statistics)
- iv) Radiology.

2. Environmental Stress Group:

- i) Occupational Hygiene
- ii) Occupational Psychology
- iii) Work physiology/ergonomics
- iv) Air pollution.

3. Experimental Studies:

- i) Environmental carcinogenesis
- ii) Medical Toxicology
- iii) Experimental Toxicology
- iv) Aquatic Toxicology
- v) Histochemistry
- ✓ vi) Agricultural health
- vii) Instrumentation
- viii) Biochemistry.

Some of the epidemiological studies of our interest which have been taken up by NIOH are the following:

- * Asbestosis in Miners
- * High altitude pneumoconiosis
- * Pneumoconiosis in underground coal miners
- * Byssinosis in textile mills
- * Health survey in Ginning industry
- * Dye related water pollution and its impact on health
- * Nicotine toxicity among workers working in tobacco fields.

Asbestosis in Miners

The objective of this study was to find out the prevalence of asbestosis in asbestos miners and the study was carried out in two mines and six mills located in Andhra Pradesh, 633 workers (52% in mining units and 32% in milling units), were evaluated by medical examination, Pulmonary Function Test (PFT), Vocal Capacity (VC), Forced Vocal Capacity (FVC), Forced Expiratory Volume (FEV), and chest radiographs. The overall prevalence of asbestosis was as high as 11.5% and was more common in milling workers about 21% as compared to mining workers little less than 4% and it increased with duration of exposure.

High Altitude Pneumoconiosis:

An environmental-cum-health/medical study was undertaken by the institute to investigate the cause of high prevalence of respiratory morbidity in three villages at high altitudes in Central Ladakh. Three villages with different frequencies of dust storms situated near Leh were selected for this study. The results of medical/health and radiological investigations in 150 subjects from each of the three villages showed high prevalence of pneumoconiosis over 45% in the village, where they are more frequent, about 20% in the village where they are less frequent and only about 2% in the village where they are rare, thus showing a direct correlation to the frequency of occurrence of

dust storms in these villages. The occurrence of Pneumoconiosis cases in the absence of occupational exposure is exceedingly rare and this is the first study in our country on non-occupational pneumoconiosis in the community.

An environmental hygiene survey of seven mines and health/medical study of 1575 miners was conducted and the prevalence of pneumoconiosis was around 4%.

Byssinosis in Textile Mills:

An epidemiological study was conducted during the year 1983-86 in three textile mills at Ahmedabad. Byssinosis is an occupational lung disease often observed among workers exposed to cotton, flax and hemp dust. The extent of the problem are well recognised in the developed countries and control measures have been implemented to prevent the disease but this is not true in the case of India where the severity and extent of the problem are not well studied and therefore preventive measures are virtually nonexistent. 929 workers were studied/examined in three textile mills at Ahmedabad. The important finding of this study was that the prevalence of byssinosis is not low in the textile mills (as reported in many earlier studies), it is high. The mean prevalence of byssinosis in the blow section was about 30% whereas in the card section was over 37% (the concentration of cotton dust (dustless fly) were high in both the sections).

Health Survey in Ginning Industry:

Though there are several studies/reports or prevalence of byssinosis in cotton textile mills in the country, this study is the first of its kind to evaluate the cotton dust exposure and health status of cotton ginning workers in the unorganised sector. This environmental-cum medical survey was undertaken in four roller type gins in Gujarat and cotton dust (dustless fly) levels in 289 workers were also measured, About 40% of workers complained of work related symptoms i.e. dry cough, chest lightness, breathlessness and burning eyes.

Dye Related Pollution and Its Impact on Health

A study of impact of pollution of river Bhader on the health of the population living in between Jetpur and Dhoraji (in Gujarat) as part of the Technology Mission on Drinking Water was carried out. The main objective was to assess the impact of Pollution of river water caused by cotton dyeing industry, which is a household cottage industry in that region, on the population dependent on this water for drinking, bathing, washing etc. To assess the pollution pattern of the river water works, detailed physio-chemical and microbial analysis of water was carried out. A total of 743 residents were clinically examined from this area (belt) and for comparison 391 persons belonging to an upstream village were also clinically examined, as a control group. In the exposed population, municipal water supply is the major source of water for drinking, bathing, washing, etc. The municipal water works draws polluted water, usually red in colour from the river Bhader. The health survey revealed that about 19% of exposed population had immediate health related complaints, mainly G.I. tract complaints/manifestations (i.e. pain in throat, burning in epigastric region and itching over the skin following the use of municipal water for drinking and bathing. However,



the control population, which included residents of an upstream village reported no such complaints.

Nicotine Toxicity in Tobacco Workers:

A study has been initiated by NIOH among the Tobacco workers. It is observed that through the skin the tobacco worker absorbs nicotine. Nicotine (in small doses is no doubt a stimulant, while in large doses it acts as a ganglion blocking agent). Therefore, the symptoms of nicotine toxicity generally observed are nausea, vomiting, giddiness, headache etc. The tobacco workers (majority about 80%) showed these symptoms after 5-6 hours of work. However, these symptoms gradually disappear during the rest period. It was also observed that blood nicotine levels were much higher (about 3-4 times higher than control group) in the tobacco workers. Nicotine exposure was confirmed by measuring nicotine and its metabolites in urine in the study.

Some of the older, not current studies of interest taken up by the NIOH during the late 70s and early 80s are the following:

1. Studies in silicosis in slate pencil workers at Mandsaur (M.P.)
2. Multicentric study on body burdens of DDT and BHC in Indian population at Agra, Ahmedabad, Bangalore, Bhopal, Bombay, Calcutta, Chandigarh.
3. Effects of BHC on malaria spraymen.
4. Evaluation of health hazards in workers occupationally exposed to pesticides other than spraying operations.

1. Silicosis in Slate Pencil Workers at Mandasur:

Amongst a sample of 593 slate pencil workers an overall incidence of about 55 per cent of silicosis was found in the initial study. In a follow up undertaken 16 months later, only about 300 of the original workers surveyed could be traced 3.9 per cent of whom had expired in the interim period. All of them had progressive massive fibrosis at the outset. It was found that in this occupation it took about seven years to produce radiologically manifest silicosis and the progression to the next higher category took about three years.

✓ 2. Multicentric Study on the body burdens of DDT and BHC in Indian Population at Agra, Ahmedabad, Bangalore, Bhopal, Bombay, Calcutta, Chandigarh:

Fat samples from cases of medico-legal autopsies from urban areas of various centres indicated mean values of 11.05 ppm and 3.49 ppm of DDT and BHC respectively. Wide variations, reflecting variation in intensity of use of the pesticides, were observed between centres. These findings were of obvious relevance to the pesticide policy of India.

✓ 3. Effects of BHC on Malaria Spraymen:

Short term study showed that after one seasonal round of spraying, there were no specific clinical signs and symptoms,

no haematological abnormalities. Serum BHC residue increased 3-5 times over pre-exposure values. Long term studies showed that repeated exposure gave rise to dermatitis and neurological abnormalities such as impairment of coordination and imbalance in a few cases. These findings were of obvious importance to the national malaria spraying programme in existence (at that point of time).

4. Evaluation of health hazards in workers occupationally exposed to pesticides other than in spraying operations:

The study revealed 70 per cent of pesticide formulations showed depressed cholinesterase activity and associated clinical signs and symptom changes in biochemical and ECG parameters were seen in 22 per cent.

Though the research activities of NIOH cover a wide spectrum of areas viz: epidemiological survey, environmental work-stress monitoring, laboratory based toxicological investigation and applied operational research, however, the major thrust was and still is on occupational health problems of workers of both organized and unorganized sectors of industries.

AIIPH (All India Institute of Hygiene and Public Health).

AIIPH functions under the Ministry of Health and the only department which is actively engaged in the study of various environmental health problems is the department of Sanitary Engineering. Most of their work is devoted to water pollution and solid waste management. The water pollution study is a collaborative venture with NEERI, where AIIPH is supposed to study the health aspects, while NEERI is to provide the expertise on environmental side. Paradoxically the team in the Sanitary Engineering department is mostly composed of engineers and there is only one doctor. In contrast, the department of Epidemiology which has a number of health experts and which in the past had done pioneering work in the field of Public Health is currently engaged mostly in conducting traditional types of epidemiological studies.

To sum up most of the studies carried out in this Institute are of conventional nature, excepting a few studies conducted by Sanitary Engineering department, which has adopted a more or less integrated approach.

It is however, surprising to note that the department of Epidemiology which has expertise and potentiality for conducting interdisciplinary studies for dealing with the ecologically vulnerable groups is not utilising this opportunity. It would be worthwhile if this department along with the sanitary engineering department could take up collaborative studies with NEERI on various dimensions of environmental health. Being located in one of the major metropolitan cities of the country it has also the potentiality of studying the deteriorating urban environment and its impact on health, particularly among the slum dwellers of Calcutta.

AIIPH is the oldest institute of Public Health in India, established about 60 years back, i.e. in 1932. The main objectives of AIIPH are:

- * To develop health manpower by providing post-graduate training facilities;
- * to conduct research directed towards the solution of various problems of health and disease in people; and
- * to conduct fundamental and operational research to develop methods for optimum utilization of health resources and application of these findings for protection and promotion of health of the people.

There are fourteen departments in the Institute viz: i) Biochemistry and Nutrition, ii) Epidemiology, iii) Health Education, iv) Maternal and Child Health, v) Microbiology, vi) Occupational Health, vii) Preventive and Social Medicine, viii) Public Health Administration, ix) Public Health Nursing, x) Sanitary Engineering, xi) Statistics and Demography, xii) Veterinary Training centre, Singhu, xiv) Urban Health Centre, Chetla.

To be frank, most (almost all) departments are concentrating mainly on teaching. Even, a department like Biochemistry and Nutrition, which is supposed to give importance to applied research (operational research) is more concerned with basic teaching or research (general biochemistry/basic research type). The department of Health Education is mostly engaged in teaching health personnel who undertake different courses. Out of all the 14 departments, the three departments, where some work of our interest/concern is being carried out are:

- 1) Sanitary Engineering
- 2) Epidemiology and
- 3) Occupational Health.

Again, out of these three departments, both Epidemiology and Occupational health are supposed to give more time and attention towards research and carry out comprehensive studies, however, in actual practice due to lack of sufficient person power and the demanding pressures towards teaching, not much is being done (as expected from an institute like AIIHPH where in the past the department of Epidemiology had pioneered methodology for health surveys of various kinds). No doubt, presently the epidemiology division is engaged in some studies of epidemiological surveillance of communicable diseases and chronic arsenic poisons. However, even the department of occupational health is not able to give much time for research (as it ought to).

As mentioned earlier, the only department which is actively engaged in the study of various environmental health problems is the Department of Sanitary Engineering. Most of their work has been devoted in the areas of water pollution and solid waste management. One interesting study on health impacts of Ganga Action Plan (at two points in Nabadweep and Varanasi) is being carried out in collaboration with NEERI, however the results are yet to come.

In this department all the scientific staff is from Engineering background and only two years back one doctor joined the department. Even the urban health Centre which is supposed to identify priority urban health problems and carry out action research is busy only in training activities.

Another interesting study carried out by Sanitary Engineering Department is on "Socio-economic and health aspects of recycling of urban solid waste through scavenging in Calcutta." The main objectives of the study were:

- * To collect baseline information regarding the status of scavenging of solid waste in Calcutta;
- * To evaluate the health risk associated with the living and working environment of the scavengers by conducting epidemiological surveys among them;
- * To study the socio-economic aspects of occupation and to evaluate the role of scavengers in solid waste management and resume recycling.

The epidemiological study has shown that of the three open

systems of the body viz. i) the respiratory system, ii) the gastrointestinal system and iii) the skin, the scavengers are particularly vulnerable to the diseases of the respiratory and G.I. tract. The prevalence of respiratory diseases among the scavengers were over 70 percent as compared to that among control group which was 34 percent. The prevalence of diarrhoeal diseases and protozoal and helminthic infestations was also very high among the scavengers as compared to control group. Occupational health hazard of the scavenging population becomes all the more significant when one considers that the control population itself has a very poor socio-economic status and lives in extremely unhygienic and insanitary environment.

NICED (National Institute of Cholera and Enteric Diseases).

NICED functions under the ICMR and has carried out studies mostly relating to diarrhoeal diseases and has done some pioneering work on cholera and Oral Rehydration Therapy (ORT). However, research studies on various aspects of health and environment adopting an integrated and interdisciplinary approach or even an epidemiological approach were missing. Most of the studies conducted by this institute are of more fundamental nature giving importance to microbiology, biochemistry or genetics rather than of applied nature. Although in the past the major focus of the studies was on cholera and diarrhoeal diseases. Currently it has shifted its attention to the newly emerging problem of AIDS.

NICED started about 30 years back. The ten divisions of the institute are:

- i) Division of Microbiology
- ii) Division of Epidemiology
- iii) Division of Immunology
- iv) Division of Pathophysiology
- v) Division of Virology
- vi) Division of Clinical Medicine
- vii) Division of Biochemistry
- viii) Division of Microbial Genetics
- ix) Division of Electron Microscopy
- x) Division of Training and Extension

Moreover, there is a Vibrio Phage Reference Laboratory and three sections viz: i) Media section, ii) Maintenance, Instruments and Equipments Section, and iii) Animal House Section. Community studies occupy an important place in the research agenda of the Institute and most of them are related to diarrhoeal diseases (including some epidemic investigations).

An interesting study (from our point of view) on "Intervention of transmission of eltor cholera in Calcutta communities (urban slums), effect of simple sanitational measures" (using "sorai" -- an earthenware narrowneck vessel) was carried out by NICED. Since eltor cholera appears to have an endemic tendency, cases are regularly being reported from city slums in the country every year. Though, poverty, malnutrition, overcrowding and unhygienic living conditions are important contributory factors, but persistence of the disease in these communities has been attributed to the large number of inapparent infections by the eltor organism and mild cases throughout the year. The exact mode of transmission of this disease is still poorly understood and sometimes even the role of drinking water in the transmission of cholera in highly endemic areas is still debated or questioned. The study points out that cholera control measures

are very often practised arbitrarily in our country without having any proper scientific basis and perhaps these hypothetical measures are mostly responsible for the failure of control programs.

Some of the earlier studies of the Institute on the mode of transmission of vibrio cholera in the families of bacteriologically confirmed patients in Calcutta, showed that the contact of cholera cases had higher rate of isolation of vibrio cholera from their stools and finger washings as compared to those in control houses. Stored water which is liable to frequent contamination by fingers in the former group also showed higher isolation rates than those in the control group. All these observations point towards the fact that simple provision of safe water supply (provision of tubewell water of presumed good quality) in the community might not prevent transmission of infections. Only improvement of hygienic habits coupled with supply of a reasonably safe water might cut down the transmission of infections to a significant level. With the above objectives in view a study was undertaken by NICED to determine whether simple measures (sanitational interventions) that are cheap -- affordable--could effectively breakdown the chain of infection of eltor cholera in communities of lower socio-economic status. Two methods -- chlorination of stored water and use of a narrow-necked earthenware vessel "sorai" for storing the water were found to be effective in reducing the transmission of infection among the family contacts of cholera patients. According to the findings of the study the cholera carrier rates in the chlorination and "sorai" intervention groups were 7.3% and 4.4% respectively, compared with 17.3% in the control group. Moreover the "sorai" is cheap and was well accepted by the local communities, its narrow neck prevented the introduction of the hand and contamination of the stored water.

Another study on "Intra-familial transmission of vibrio cholera and control group of houses, respectively, showed that the former had higher rates of positive stools (9.7%) and fingerwashes (5.6%) for vibrio cholera. The respective rates in control houses were only 0.8% and 0.4%. Simultaneous examination of five types of water sources actually used left-over cooked food and flies in these houses for a period of five consecutive days showed that only stored water (8.5%) and cooked food (8.5%) had significantly higher detection rates of vibrio cholera as compared to those in control houses. On the basis of the observations from the above study, it is argued that simple provision of safe water in the community may not be sufficient to control the spread of cholera infection as is evident from higher positive rate of stored water. In the absence of continuous piped water supply within the houses, people will be compelled to store water in an unhygienic fashion thus leading to transmission of the infection.

A prospective community based study was also conducted by NICED to evaluate the effect of handwashing on the incidence of diarrhoeal diseases in Calcutta slums. Handwashing was implemented in one slum and the other nearby slum without handwashing program served as control. The difference in the incidence of watery diarrhoea during the thirteen-month period, between the study and control groups was not significantly different. However, the incidence of dysentery in individuals above five years of age in the control group was significantly

higher as compared to those in the study group. The results of this study indicated that handwashing with soap may reduce the incidence of dysentric cases in the community by interruption of transmission of the pathogens from one person to the other.

MRC (Malaria Research Centre).

MRC is an institute of ICMR which has made considerable strides in its use of an interdisciplinary approach in malaria research in the country. The institute has contributed quite a lot and has considerable conceptual research capability -- building to design the protocols for conducting such studies where in addition to physical indices, sociological linkages have been established using multidisciplinary methods drawn from the social, environmental and health related sciences.

The institute has also located endemic centres in different eco-settings and has taken preventive, often bio-environmental control measures, which are ameliorative both from social and environmental point of view. Such types of integrative studies conducted by this institute have not only been significant achievements but have also been major path finders providing deeper insights to problems of other public health hazards in a holistic manner.

Malaria Research Centre (MRC), which is one of the permanent Institutes of the Indian Council of Medical Research (ICMR) was established with a mandate for undertaking research on Malaria, a problem of immense public health importance in India. Presently, every year about two million new cases of malaria are being reported in our country and tragically enough, the malaria situation has stagnated at this level for about a decade and malaria control has become problematic with the change in Vector behaviour, insecticide resistance, chloroquine resistance in *Plasmodium falciparum* and operational failures. Besides this large parts of the country are becoming more receptive to malaria as a result of increase in irrigation, population migration, urban growth and factors related to human ecology. With this background in mind most of the studies which are being undertaken by the MRC are directed to help control malaria on scientific lines utilizing the results of an interdisciplinary approach.

MRC has five broad divisions viz:

- i) Entomology
- ii) Parasitology
- iii) Epidemiology
- iv) Immunology and
- v) Bio-environmental control strategy.

During the last few years MRC has provided thrust to the Bio-environmental control of Malaria in the country. In order to provide support to the bio-environmental control strategy not only field research mainly by the Division of Epidemiology but also applied/basic research by other divisions (Entomology, Immunology, Parasitology) is undertaken. One of the areas of applied field research by the MRC on the role of *Anopheles culicifacies* sibling species is being used in the malariogenic stratification for prospective planning of malaria control, and results of stratification have found application in decision making on suitability or otherwise of the continuation or change

of insecticidal spraying to interrupt transmission. As MRC is the premier Institute in developing the bio-environmental control strategy (involving an integrated and inter-disciplinary approach and is of interest for us from eco-health point of view), it would be worthwhile to discuss in detail the bio environmental control strategy.

Bio-environmental Control Strategy:

The return of malaria in the seventies on a nationwide scale was a matter of serious concern and required a long term solution. By 1976, total malaria incidence reached 6.4 million cases. It was very difficult for the Government to combat the widespread resurgence of the disease, however, with the revised strategy of NMEP known as MPO (Modified Plan of Action) the malaria situation showed some improvement and by 1983 annual malaria incidence was reduced to about 2 million malaria cases per year, but thereafter there was stagnation and no further progress could be made.

The epidemiological profile of the disease showed a distinctive pattern. The spraying strategy made little or no impact on malaria status in the hills, foothills and forested areas. These areas are predominantly tribal areas with high Plasmodium falciparum incidence (presently though most of the malaria cases are due to Plasmodium vivax, but tragically the proportion of P.falciparum is increasing and now accounts for about 35% of total infections) with nearly perennial transmission, under the influence of more than one vector. These areas are also subjected to population movement for exploitation of forest wealth and other development projects. It was difficult to implement insecticidal spray strategy due to the terrain of these regions. The Annual Parasite Incidence (API) was highest in the North-Eastern States, foothills of Orissa and West Bengal and hilly and forested areas of Andhra Pradesh, Maharashtra and Gujarat. Among urban areas, Madras city alone contributed 60-70% of total malaria.

A large number of factors contributed to the deteriorating malaria situation and some of the important factors were:

Refusal to accept spray in rural areas:

The community acceptance of insecticidal spray was very poor (or as low as 30%) and thus there was no impact on transmission.

Development of resistance to insecticides in vector

The rural vector A.culicifacies has shown widespread resistance to DDT and BHC. Alternative insecticides were very costly and could not be used.

Complacency in health workers and lowering of priority of malaria programme in health sector.

The peripheral worker under MPW scheme gave low priority to surveillance on account of emphasis on family planning and other health activities.

Thus due to multifaceted problems, viz. Technical, Operational, as well as financial, it had become apparent that there was an

urgent need for an innovative technology which would be indigenous, appropriate and socially acceptable and at the same time, would not rely entirely on the use of insecticides.

This challenge was accepted by the MRC and a theoretical model for such an approach to malaria control was evolved with the back up of basic and applied research. It was envisaged that soon after the successful demonstration of feasibility trials the alternate strategy would constitute a basis for a long term solution to the problem of malaria in the country.

With this background the MRC took up the first Integrated Disease Vector Control (IDVC) programme in 1983 in high malaria incidence villages of Kheda district. First it was only a field station of MRC in Nadiad taluk to test the feasibility of malaria control by integrating non-insecticidal methods. In subsequent years, the experimental areas were expanded and project was converted to feasibility-cum-demonstration project. In this area falciparum malaria epidemic was ongoing with the problems of drainage, vector resistance, parasite resistance, problems connected with spraying and innumerable mosquito breeding sites. In this difficult terrain implementation of bio-environmental methods produced promising results i.e. malaria incidence was greatly reduced and many collateral benefits were observed. Public acceptance and people's participation in the scheme was phenomenal.

The IDVC project exclusively uses non-insecticidal methods of disease Vector Control such as environmental modification and manipulation coupled with biological control of aquatic stages of vector. In this approach community involvement and cooperation is the key factor. Other supportive measures such as social forestry, provision of smokeless chulahs, soakage pits, and other income generating schemes such as fisheries are implemented in the study villages.

- 1) Nadiad and Sahjanpur - Control of rural malaria
- 2) Madras and Delhi - Urban malaria
- 3) Hardwar (BHEL, IDPL): Control of Industrial malaria
- 4) Haldwani: Control of Malaria in green revolution area
- 5) Allahabad (Sankargarh): Quarry areas and backward rural area
- 6) Gandla: Tribal and forested area
- 7) Sonapur (Assam).

One area of Eco-Health research that has made strides in its use of an interdisciplinary approach is malaria research. MRC, Delhi has contributed quite a lot in conducting such studies. In addition to physical indices, sociological linkages have been established in some of the studies conducted by this institute.

NEERI(National Environmental Engineering Research Institute)

The National Environmental Engineering Research Institute (NEERI), which functions under CSIR, started as CIPHERI i.e. Central Public Health Engineering Research Institute 30 years back and its objectives were essentially confined to help public health departments of various state governments in adopting scientific methods to control water-borne diseases. It was in fact the great jaundice epidemic in 1956 in Delhi that awakened the Health authorities to the fact that with the rapid modernisation and urbanisation (even in the fifties!) the old conventional notions about water and its purity need to be revised.

The Jaundice Enquiry Committee Report brought forth the fact that most of the water treatment plants were operated by persons who were neither trained nor properly qualified. And this report initiated the Public Health Engineering Research Committee (PHERC) of the CSIR to propose that a Public Health Engineering Research Institute be set up under the CSIR. Thus the CIPHERI (now NEERI) was born.

In the formative stages, scientists from this institute interacted with public health agencies attached to state and central governments in disseminating to public, information on hygiene and public health. In fact the research and development programmes of CIPHERI (now NEERI) were confined for quite some time to health related problems demanding the expertise essentially of biologists, chemists, and civil engineers, in the training in public health. The institute has to some extent adopted a multidisciplinary approach to issues of quality control in respect of air and water and to use of disposal of waste water and solids. Although, the institute's work is of unique interdisciplinary nature from a purely environmental point of view they are not integrating disciplines of medical sciences, even though they have an epidemiology section, manned mostly by biologists and without any medical doctors. Moreover, though there is ample scope and potentiality for a more integrative approach, in devising and developing techniques for health risks in Environmental Impact Assessment (EIA) and monitoring no serious attempt or effort has so far been made by the institute to incorporate health component in the EIA statement.

The synthesis between research and effectiveness in technological development is sought to be accomplished in selected areas of activities which are:

- * Analytical capabilities to improve detection and precision in monitoring of pollutants in air, water, and soil.
- * Characterisation and assessment of liquid industrial effluents to develop indigenous processes leading to development of appropriate pollution control technology.
- * Environmental monitoring with special reference to air, water and land.
- * Waste recycling and re-use through aquaculture and agriculture.

- * Urban and industrial solid waste management systems.
- * Environmental system analysis leading to air and water quality modelling techniques to forecast environmental impact of development programs.
- ✓ * Environmental impact analysis and assessment of major developmental projects including mining, iron, steel complex, thermal power complex, fertilizer, hydel power projects, industrial irrigation, and urban projects etc.
- * Environmental support programs in integrated rural development to minimize health hazards.
- * Appropriate technological process development for water treatment. Impact to toxic and hazardous wastes on environment and ecology.
- * Environmental information systems and sources with a strong database.

Some of the other functions which NEERI undertakes are:

- * Advising and consultancy services to other institutes and industrial undertakings.
- * Designing curriculae in environmental science and engineering with suitable linkages.
- * Liaisoning activities with local, state, national and international agencies engaged in implementation of environmental programmes.
- * Supporting the environmental programmes by installing demonstration units in the field.

During the past 30 years, NEERI has been engaged in a number of activities leading to indigenous and competent solutions of several environmental problems which has helped in laying down criteria and guidelines to safeguard environmental quality. Some of the immediate objectives of the institute is to provide R&D support to national programmes related to water supply, sanitation, and Environmental projection. In addition to being a nodal point for almost all R&D activities concerning environmental issues, pertaining to air, water, waste water, solid waste and rural sanitation, its efforts in near future are supposed to focus on the following areas:

- * Recycling and re-use of wastes (liquid, solid, etc.) of municipal and industrial origin to utilize the nutrient and energy contents ensuring environmental compatibility.
- * Promote appropriate technology by using available resources in the field of air, water, waste water and solid waste management (Research thrust: Advanced technologies in appropriate and relevant areas will be developed.)
- * Provide R&D support to activities of national water

supply and sanitation programme and Health For All by 2000 AD.

- * Evolve microbial cultures for degradation of specific wastes leading to process development in the field of biotechnology for pollution control.
- * Undertake studies in the areas such as acid rains and modelling in environmental engineering using computers.
- * Work as a National Documentation Centre for Environmental Engineering and Science using the available information base, infrastructure and expertise to publish books, journals, etc. for dissemination of knowledge.
- * Act as a Centre for conducting advanced level training programmes in field of water, waste water.
- * Assist the Dept. of Environment in formulation of policies for environmental management.
- * Participate in environmental impact, statement / assessment process that need improvement for scrutinizing of planning and decision making.

The various Divisions under NEERI are the following:

- 1) Air Pollution Control Division.
- 2) Basic Research & Training Division.
- 3) Computer Applications Division.
- 4) Environmental Bio-technology Division of Epidemiology Section.
- 5) Environmental Impact Assessment Division.
- 6) Instrumentation Division
- 7) Library and Documentation Division.
- 8) Recalcitrant Industrial Hazardous Wastes Division.
- 9) Solid Wastes Division.
- 10) Technology utilization and demonstration Division
- 11) Water Division.
- 12) Water Engineering Division.
- 13) Waste Water Engineering Division.

Since problems of one region differ from those prevailing in other regions, NEERI has set up nine zonal laboratories in major cities, i.e. 1) Bombay, 2) Ahmedabad, 3) Calcutta, 4) Cochin, 5) Hyderabad, 6) Delhi, 7) Madras, 8) Kanpur and 9) Jaipur. The zonal laboratories essentially investigate the problems of the region, keeping the objectives of NEERI in mind.

workers illustrates the hazards involved in the use of raw sewage for farming.

Environmental Impact Assessment (EIA) is an anticipatory mechanism which establishes quantitative parameters indicating the quality of the environment and natural systems, before, during and after the proposed developmental activity, thus allowing measures ensuring environmental compatibility and economic efficacy. Environmental risks are inherent in design and operation for large and complex industrial units.

Any failure in the system could lead to a disaster resulting in heavy toll of human life and devastating losses to ecology and property. Therefore, a comprehensive and scientific approach to risk assessment and management is considered essential in view of increasing number and magnitude of environmental risks. Various types of EIA studies have been undertaken by NEERI which includes ranking of alternatives for selection of site, rapid EIA based on one season data and comprehensive EIA based on three seasons data collection. EIA division has also developed methodology for regional EIA and carrying capacity based development planning process. However, Dr. Badrinath, Head EIA division, regretted that no serious effort has been so far made to incorporate health component in EIA studies and stressed the need to re-examine the applicability of already available health impact assessment techniques in the Indian context.

Current Research Thrust

Apart from the Epidemiological studies and EIA studies the other research and development activities of NEERI are mainly concentrated on air, water, waste water, solid waste, instrumentation, and analytical techniques development.

1. Monitoring and collection of Baseline data:

Air: A national air quality monitoring programme is being carried out in Ahmedabad, Bombay, Calcutta, Cochin, Delhi, Hyderabad, Jaipur, Kanpur, Madras, and Nagpur. Parameters included are oxides of sulphur, and nitrogen and suspended particulate matter (SPM), siltation rate and dust fall.

Water: Waste water and Sewage: Baseline data is being collected on heavy metals and organo chlorine pesticides levels in urban water supplies at Calcutta, Delhi and Kanpur. The study reveals the presence of most of heavy metals in raw waters. Extensive surveys have been conducted on aquatic eco-systems with different degrees of pollution. The studies on water quality assessment with reference to faecal indicator and pathogenic organisms are also being conducted in rural and urban areas. Leakage detection, assessment and control studies have been carried out in 10 cities and it is observed that leakage levels is 20 to 30 percent of total water supply. Water quality monitoring in Jamuna river is also being carried out at effluent out falls from Mathura and Karnal refineries.

Field testing of integrated water supply and waste water disposal in a Haryana village and studies of different enteroviruses in Nagpur sewage is also being conducted.

2. Evaluation of Treatment methods/plants

Air: Studies have been conducted to evaluate the effectiveness of air pollution control equipments.

Water: Research and development work in defluoridation has resulted in the development of "Nalgonda Technique" for defluoridation of portable water. The technique has been tested on domestic, community and large scale levels including rural areas and has been found most effective. Performance water treatment plants from different regions of the country have been evaluated.

Waste: Pilot plant studies on the treatment of sewage of Ahmedabad city and performance evaluation of various and sewage treatment plants are being carried out.
Sewage

3. Development of process and products

Air: Research and development work is being done on standardisation of analytical techniques and quality control procedure for air pollution studies.

Water: Development of analytical techniques of water research (monitoring of water quality and development of methodologies for determination of fluoride, cyanide, silver, sulphide, nitrite, ammonia, etc.)

Waste: Processes have been evolved for the treatment of low water temperature coal carbonization wastes, organophosphorous and wastes, pharmaceutical wastes and pesticides wastes.
Sewage

Concluding Remarks

While reviewing the six research institutes (five belonging to the Health sector and one to the Environment sector) it was noted that all the institutes reviewed without exception carried out epidemiological studies. However, the nature, type, methodology of these studies, and the target groups surveyed, varied a lot. It was refreshing also to note that most Institutes barring a few adopted a multidisciplinary approach for studying environmental health issues. Worth mentioning is the MRC which has made considerable strides in its use of an interdisciplinary approach to malaria research in India.

Most of these epidemiological studies encompassing multidisciplinary approach, meet some of the urgent challenges of environmental health, but they often have a reductionist approach, therefore we should also look forward to opportunities with greater potential to prevent adverse health effects resulting from environmental modifications that may occur with development projects. In our country today, some attention is given to the environmental concerns while planning an infrastructural developmental project by conducting EIA studies, but health components in this type of assessment is sadly lacking. This calls for ensuring visibility and attention of the health component in these efforts. Which is possible only by incorporating health impact analysis statement in all feasibility studies of development projects as a necessary part of the broader EIA studies.

ANNEXURE I

Persons contacted and Institutes visited

Lucknow

Institution : Industrial Toxicological Research Centre (ITRC).

Persons contacted:

1. Dr PK Ray, Director, ITRC.
2. Dr(Mrs) Q Rahman, Head, Fibre Toxicology Section.
3. Dr SK Khanna, Head, Dyes & Food Toxicology Section.
4. Dr PN Vishwanathan, Head, Ecotoxicology Group.
5. Dr BN Gupta, Head Epidemiology Section.
6. Dr SK Rastogi, Epidemiology Section.
7. Dr AK Shrivastva, Epidemiology Section.
8. Mr Neeraj Mathur, Epidemiology Section.
9. Mr Tanvir Hussain, Epidemiology Section.
10. Mr SK Bhargava, Environmental Monitoring Section.
11. Dr PK Seth, Head, Development Toxicology Section.
12. Dr(Mrs) F Jaffery, Ecotoxicology Section.
13. Dr Virendra Misra, Ecotoxicology Section.

Ahmedabad

Institution: National Institute of Occupational Health (NIOH)

Persons Contacted:

1. Dr SK Kashyap, Director, NIOH.
2. Dr SK Nigam, Deputy Director and Group Head of Experimental Studies.
3. Dr SK Dave, Asst Director, Head of Health Science Group
4. Dr JR Parikh, Incharge, Respiratory Physiology Section, Health Science Group.
5. Dr DJ Parikh, Asst Director, Head of Environmental Stress Group.
6. Dr TS Patel, Air Pollution Section, Environmental Stress Group.
7. Dr CB Pandya, Environmental Stress Group.

Nagpur

Institution: National Environmental Engineering Research Institute (NEERI)

Persons Contacted:

1. Dr SD Badrinath, Deputy Director, Head of Environmental Impact Assessment (EIA) Division.
2. Dr SK Gadkari, Scientist, EIA Division
3. Dr PVRC Panicker, Head Epidemiology Section, Environmental Biotechnology Division.
4. Dr (Mrs) AS Gadkari, Scientist, Epidemiology Section, Environmental Biotechnology Division.
5. Dr KR Bulusu, Deputy Director, Head of Water Division.
6. Dr WG Nawlakhe, Scientist Water Division.
7. AL Aggarwal, Head of Air Pollution Control Division.

8. Dr Phadke, Air Pollution Division.
9. Mr SG Bhat, Officer Incharge of Library and Documentation.

Bombay

Institutions:

1. Foundation for Research in Community Health (FRCH)
2. Tata Memorial Cancer Centre (TMCC)
3. King Edward Memorial Hospital (KEM)
4. Central Labour Institute (CLI)
5. Air Quality Monitoring Station, Bombay Municipal Corporation.

Persons contacted:

1. Dr NH Antia, FRCH.
2. Dr Ravi Duggal, FRCH
3. Ms Sonia Gill, FRCH
4. Dr LD Sanghvi, Head Cancer Registry, ICMR, TMCC.
5. Dr Sumati Bhide, Head, Biology Division TMCC.
6. Prof SR Kamat, Retired Professor, Chest Diseases, KEM Hospital.
7. Prof AA Mahashur, Professor Chest Diseases, KEM Hospital.
8. Dr Surendranath, Director, Medical Section CLI.
9. Dr S Deshpande, Head of Air Quality Monitoring Station, Bombay Municipal Corporation.

Calcutta

Institutions:

1. All India Institute of Hygiene & Public Health (AIIHPH)
2. National Institute of Cholera and Enteric Diseases (NICED)
3. School of Tropical Medicine.

Persons Contacted:

1. Dr BN Ghosh, Director, AIIHPH.
2. Prof AK Chakrabarti, Head, Epidemiology/Director Grade Scientist, AIIHPH.
3. Dr KJ Nath, Head, Sanitary Engg. Deptt., AIIHPH.
4. Dr A Kundu, Physician, Sanitary Engg. Deptt, AIIHPH.
5. Dr A Mazumdar, Associate Prof, Sanitary Engg. Deptt, AIIHPH.
6. Dr Samarjit Jana, Asst. Prof, Occupational Health Deptt, AIIHPH
7. Dr SC Pal, Director, NICED.
8. Dr BC Deb, Director - Grade Scientist, NICED.
9. Dr Dipankar Chakrabarty, Head, School of Environmental Studies, Jadavpur University.
10. Dr DN Guha Mazumdar, Prof of Medicine, Institute of Postgraduate Medicine and Education & Research.
11. Dr J. Sil, Prof Microbiology, Medical College, Calcutta University.
12. Prof Jayati Hazra, Senior Fellow of Geographic Deptt., Calcutta University.
13. Dr S Chakraborty, Head, Virology, School of Tropical Medicine.

Delhi

Institutions:

Malaria Research Centre (MRC)
South East Asia Regional Office (SEARO), WHO.
Persons Contacted:

1. Dr VP Sharma, Director, MRC.
2. Dr George A Garland, Chief Technical Advisor,
Environmental Health Division, SEARO, WHO.

ANNEXURE II

List of Publications consulted/resource material collected.AHMEDABAD

1. Technical Review of Pneumoconiosis in India, Special Report Series No.4 by Dr MN Gupta ICMR 1970.
2. Technical Information Bulletin No.4, on Byssinosis prepared by Adhoc Committee of ICMR, 1967.
3. Working Manual No.1, on the Health Problems of Bhopal gas victims: Assessment and Management prepared by Dr SK Jain and Dr SK Dave, ICMR and DST Centre for Visceral Mechanism, 1986.
4. Pesticide Pollution due to chlorinated insecticides especially DDT in the environment of man and other livestock in the country, Dr SK Chatterjee, Dr SK Kashyap, Dr SK Gupta, NIOH, DST Project (1976-1980).
5. Diagnosis and Treatment of Pesticide Poisoning Technical Report series No.11 by Dr SK Kashyap, ICMR, 1971).
6. Monograph - I, Ahmedabad Autoexhaust Pollution Survey, and its effect on exposed occupational group by AS Agrawal, TS. Patel et al, NIOH, 1979.
7. Integrated Air-quality surveillance Study over Vadodara Urban Development Areas (VUDA), NIOH, 1989.
8. Comprehensive report on the integrated environmental programmes on heavy metals phase I (April 1983-87) and Phase II (Oct 1987-June 1989), sponsored by Deptt. of Environment, Forest and Wild Life.
9. Pneumoconiosis due to Mica dust inhalation in the Mica processing industries in India, NIOH, 1982.
10. Proceedings of the Workshop on Safe Use of Pesticides (jointly organised by NIOH and Indian Pest Control Association, New Delhi August 1990).
11. Proceedings of WHO-ICMR Training course on 'Evaluation and Control of Industrial Environment' 17 Feb 1976 to 1 March 1976, ICMR 1976.
12. Hazards in chemical industry -- Proceedings of the Symposium organised by Gujarat Chemical Association in collaboration with NIOH (28 Dec 1988).
13. Status report on Genotoxicity Research (quick screening test for Identification and Quantification of Chemical Toxicants During Accidents), NIOH.
14. Status report on air-pollution study NIOH.
15. Status report on experimental toxicology (on agro-environmental chemicals), NIOH.
16. Status report on neurobehavioural toxicology NIOH.
17. Status report on reproductive toxicology, NIOH.
18. Status report on microbiology research programme NIOH.
19. Status report on health effects of Pesticides in Man -- An appraisal and approaches -- SK Kashyap, NIOH.
20. Status report on Child Labour -- Dr SS Ramaswamy, Dr SK Dave, Dr SK Kashyap, NIOH 1987.
21. Environmental Exposure to Cadmium (A selected Bibliography) 1921-'86, ENVIS.
22. Environmental Exposure to Manganese (A selected Bibliography) 1928-1986, ENVIS.
23. Environmental Exposure to Mercury (A selected Bibliography), 1935-'86, ENVIS.

24. Environmental Exposure to Lead (A selected Bibliography) 1921-'86, ENVIS.
25. Environmental Exposure to Zinc and Arsenic (A selected Bibliography) 1935-1986, ENVIS.
26. Environmental and Health Safety Guides: Asbestos Everyday Problems, ENVIS.
27. Environmental and Health Safety Guides: DDT, ENVIS.
28. Environmental and Health Safety Guides: Dyes and Dye Stuff Industry. ENVIS.
29. Environmental and Health Safety guide: Chlorine. ENVIS.
30. Carcinogenicity of Organochlorine Insecticides -- DDT and BHC in experimental animals, ENVIS.
31. Environmental Informations: Abstracts on Occupational Health. ENVIS.
32. Experimental and Human surveillance on BHC and DDT insecticides commonly used in India -- SK Nigam et al, Annals New York Academy Sciences.
33. Health effects among workers involved in the manufacture of Hexachlorocyclohexane, P Chattopadhyay et al, J Soc. Occu. Med, 38, 1988.
34. Environmental lead exposure as a health problem in India (an overview) -- CB Pandya et al
35. Lead poisoning -- A community threat: Shah GM, Pandya, CB, Sathawara, NG, Parikh DJ and Kashyap, SK, Paper presented in the National Seminar on Lead and Environment, New Delhi, Feb 1991.
36. Biological monitoring of workers Occupationally Exposed to Lead -- CB Pandya et al.
37. Health Hazards of Lead and Monitoring of Health Status by RC Murthy and SV Chandra, Paper presented in the National Seminar on Lead and Environment, New Delhi, Feb 1991.
38. Environmental Lead Levels in Greater Bombay by RN Khandekar, Paper presented in the National Seminar on Lead and Environment, New Delhi, Feb 1991.
39. Brochure on HEAL Project, WHO/UNEP Publication.
40. "Autoexhaust and its effects on traffic policemen and shopkeepers" by TS Patel et al, published in Annual Report 1982, NIOH.
41. Economic Aspects of Environmental Pollution in India - An Exploratory Study by Arun C Vakil, 1984.
42. A Review of Occupational Health Research in India -third Review 1963 - 83, by BB Chatterjee, NL Ranganathan, MN Gupta, MN Rao, Special Report series No 61, ICMR, 1970.
43. Occupation, smoking and Lung Cancer by SK Dave et al, NIOH, 1988.
44. Annual Reports of NIOH for the years 1978-81, 1983-84 & 1988-89.

Studies/Research Papers of Special Interest:

- * Health Problems related to Pesticide Exposure in applicators.
- * Exposure to Vegetable dusts like cotton, tobacco and paddy etc. and related health problems.
- * Ergonomic studies in agricultural tools, agricultural accidents and work safety in agricultural jobs.
- * Health Problems of Plantation (tea and coir) workers.
- * Silicosis in quartz crushing units, quarries, slate-pencil, and ceramic industries.

- * Exposure to toxic chemicals, dyes, pesticides, and metals and its impact on health
- * Health problems in carpet weaving, match and fireworks industry and metal art-wares.
- * Asbestosis in Miners.
- * High altitude pneumoconiosis.
- * Pneumoconiosis in underground coal miners.
- * Byssinosis in textile mills.
- * Health survey in Ginning industry.
- * Dye related water pollution and its impact on health.
- * Nicotine toxicity among workers working in tobacco fields.

Bombay

1. Adverse health effects from industrial pollution - SR Kamat.
2. Sequential Health effect study in relation to Air pollution in Bombay, SR Kamat and VB Doshi in Europ. J., Epidemiology Sept. 1987
3. The health effects of Automobile exhaust and total ambient pollution in Bombay; SR Kamat et al., Lung India VII, No.1. (1989).
- ✓ 4. Methyl Isocyanate survivors of Bhopal sequential flow volume loop changes observed in 18 months follow up - MH Patel, SR Kamat and others -- Lung India, V No 2, (1987).
5. Sequential Respiratory changes in those exposed to the gas leak at Bhopal - SR Kamat, AA Mahashur and others, Indian Journal Of Medical Research, 86(Suppl), 1987.
6. Early observations on pulmonary changes and clinical morbidity due to the isocyanate gas leak at Bhopal - SR Kamat, AA Mahashur et al., Journal of Post Graduate Medicine, Vol. 31, No. 2, (1985).
7. FRCH Newsletter July-August 1987, Vol.I, No.5.
8. Tobacco and Health: The Indian Scene - L.D. Sanghvi and Perin Notani, Published by International Union Against Cancer and TMCC, Bombay.
9. Annual Report - 1982 - National Cancer Registry - A Project of ICMR.
10. Bombay Air Pollution - Health Study - Municipal Corporation of Bombay, 1983.

The Important Research Papers/Studies in the Document:

- * Prospective Three Year Study of Health Morbidity in relation to Air Pollution In Bombay.
- * A Cross-sectional Comparative Study between three Urban Communities with different Air Pollution levels for health morbidity and Lung Function.
- * Fluctuations of daily Air Pollution levels and Respiratory Symptoms in four Communities in Bombay.
- * Contribution of Food, Water and Air Pollution to the Health Status in Central Bombay.
- * Seasonal Factors in Health Morbidity with Air Pollution.

Delhi

1. Prevention, Diagnosis and Treatment of insecticide poisoning - R Plestina, WHO, Geneva, 1984.
2. Draft report on hazardous waste management in electroplating industries of Delhi region - SEARO, WHO, New Delhi.
3. Paryavaran Abstracts, vol.7 no.1 & 2 - Department of Environment, Forests and Wildlife.
4. Guidelines for the study of dietary intakes of chemical contaminants - prepared under the sponsorship of UNEP, FAO, WHO, Geneva. 1982.
5. Panel of Experts on Environmental Management for Vector Control jointly prepared by WHO, FAO, and UNEP (1982, 1986 and 1987), WHO, Geneva, 1982.
6. Environmental problems in Delhi -- status and suggested measures : by WHO, Jan.1989.
7. Annual Report 1986, National Institute of Communicable Diseases, Delhi.
8. Half yearly Progress Report (January-June '89) Integrated vector control of Malaria, MRC Delhi, ICMR, 1990.
9. Integrated vector control of Malaria, Filariasis and other vector borne Diseases, Malaria Research Centre, Delhi, 1989.

Calcutta

1. Impact of Drainage and Water supply system in Dumdum area on urban health - by Jayati Das, Paper Presented in the International Seminar on Health Care Planning in the Developing World, Feb, Calcutta, 1991.
2. Environmental hazard in the wake of industrialization - Durgapur, A Case Study by Dr Swapna Basu, Paper Presented in the International Seminar on Health Care Planning in the Developing World, Feb, Calcutta, 1991.
3. River Damodar and its effect on human health - A Case study of Asansol region by Dr Smita Sengupta, Paper Presented in the International Seminar on Health Care Planning in the Developing World, Feb, Calcutta, 1991.
4. Environmental impact assessment of water reservoir/Kamabati Dam and its impact on health, An interim report by AIIHPH and NEERI.
5. EIA of Ganga Action Plan and Health Impact Studies, An interim report by AIIHPH and NEERI.
6. Annual report of NICED for the years 1980, 1981, 1982, 1988.
7. Intra-familial transmission of vibrio cholerae biotype Eltor in Calcutta slums, BC Deb et al. NICED Publication.
8. Studies on Interventions to Prevent Eltor Cholera transmission in urban slums -- BC Deb et al. NICED Publication.
9. Socio-economic and Health aspects of Recycling of Urban Solid Waste through scavenging, Report by AIIHPH.
10. Environmental pollution and chronic arsenic poisoning in South Bengal by Dr BN Guha-Mazumdar, Paper Presented in the International Seminar on Health Care Planning in the Developing World, Feb, Calcutta, 1991.

Nagpur

Publications of NEERI

1. Annual Reports of NEERI for the years 1984, 1987-88, 1988-89 and 1990.
2. Silver jubilee Souvenir, NEERI, 1984.
3. Commemoration Volume (25 years of NEERI) 1984.
4. NEERI Research in Retrospect (1959-'83), 1984.
5. River Ganga-An Overview of Environmental Research, 1987.
6. Air quality in selected Cities in India, 1978-79, National Air-quality Monitoring Network, 1980.
7. Orange City Environment -- NEERI's Contribution, 1987.
8. NEERI in the Service of Gujarat, 1987.
9. NEERI in the Service of Rajasthan, 1986.
10. Proceedings of Indo-US Workshop on Environmental Impact Analysis and Assessment, 1982.
11. Proceedings of "Workshop on Research and Development Needs - Water Supply and Sanitation Decade (1981-90), 1979.

LUCKNOW

Scientific Papers and Reports Published from ITRC:

- 1) Health effects of industrial pollution in Firozabad; AR Shrivastava et al.
- 2) A study of Respiratory function in glass bangle worker's pneumoconiosis: SK Rastogi et al.
- 3) Case control study of chronic bronchitis in glass bangle workers: AK Shrivastava et al.
- 4) Pulmonary disease due to Multimetall exposure in glass bangle workers -- AK Shrivastava et al.
- 5) Pneumoconiosis among flour mill workers -- BN Gupta et al.
- 6) Respiratory Health effects from Occupational exposure to wood dust in saw Mills -- SK Rastogi et al.
- 7) Data linkage correlations of Morbidity and Mortality in Relation to Bacteriological quality of water at Nagpur -- AK Shrivastava et al.
- 8) Occulotoxins: Effects, implications and importance in occupational health -- AK Shrivastava and BN Gupta.
- 9) Study of the Prevalence of Ventilatory Obstruction in Textile Workers exposed to cotton dust -- SK Rastogi et al.
- 10) Evaluation of risk factors in the prevalence of Byssinosis log linear analysis -- Neeraj Mathur et al.
- 11) Occupational Health Hazards in Beedi Making Industry -- A Review -- BN Gupta and SK Rastogi.
- 12) Pulmonary Tuberculosis in glass (bangle) industry of Firozabad -- AK Shrivastava and BN Gupta.
- 13) Ophthalmic morbidity in Glass Workers -- AK Shrivastava and BN Gupta.
- 14) Musculo-skeletal disorders in glass bangle workers in Firozabad -- AK Shrivastava et al.
- 15) Effect of Exposure to Toxic Gas on the Population of Bhopal: Part I--Epidemiological, Clinical, Radiological and Behavioural Studies -- BN Gupta et al.
- 16) Effect of Exposure to Toxic Gas on the Population of Bhopal: Part II -- Respiratory Impairment -- SK Rastogi et al.

Annex.2-List of Publications (contd)

- 17) Effect of Exposure to Toxic Gas on the Population of Bhopal: Part III Assessment of Toxic manifestations in Humans - Haematological and Biochemical Studies -- RC Shrivastava et al.
- 18) Effect of Exposure to Toxic Gas on the Population of Bhopal: Part IV -- Immunological and Chromosomal Studies -- AK Saxena et al.
- 19) A clinical study of Toxic Gas Poisoning in Bhopal -- UK Mishra et al.
- 20) Occupational health problems of Workers in the Unorganized sector -- BN Gupta et al.
- 21) Cardio-respiratory studies on glass bangle workers -- SK Rastogi et al.
- 22) Thermal stress and physiological strain of children exposed to hot environments in a glass bangle factory -- SK Rastogi et al.
- 23) Physiological responses to thermal stress in a glass bangle factory -- SK Rastogi et al.
- 24) Pulmonary function studies among healthy glass bangle workers -- SK Rastogi et al.
- 25) Pulmonary Effects of silica dust in Asymptomatic agate workers -- SK Rastogi et al.
- 26) Prevalence of respiratory impairment in asbestos workers -- SK Rastogi et al.
- 27) Diurnal pulmonary function variability in healthy workers -- SK Rastogi et al.
- 28) Study of Respiratory impairment among pesticide sprayers in Mango plantations -- SK Rastogi et al.
- 29) Abstract of "A study of chronic bronchitis among Brassware workers" -- SK Rastogi et al.
- 30) Environmental Impact Assessment of Eastern Ghats(Koraput) in relation to Water Quality and Health Status Studies -- AK Shrivastava et al.
- 31) Environmental Pollution - A Threat to our Existence -- BN Gupta.
- 32) Noise Pollution - the Indian Scene -- AK Shrivastava and BN Gupta.
- 33) Respiratory Morbidity in agate workers - A Case Study of Khambhat, Gujarat.
- 34) Plight of Glass Bangle workers - A Study of Morbidity and socio-economic conditions of workers in glass bangle industry at Firozabad -- 1984.
- 35) Scientific Report (Annual Report) ITRC, 1987-89.
- 36) Environmental effects of silica dust in Metalware industries in UP (with special reference to Moradabad) 1989.
- 37) Occupational and Environmental Risks of Specific Relevance to Women -- PN Vishwanathan and Farhat N Jaffery.
- 38) Occupational and Environmental Toxicological Problems of Developing Countries -- PN Vishwanathan and Virendra Misra.
- 39) Occupational and Environmental Problems in Rural Communities -- PN Vishwanathan.
- 40) Effect of Environmental Pollutants on Wildlife - A Survey -- SD Pandey, Virendra Mishra and PN Vishwanathan.
- 41) Non-permitted colours in food and their toxicity -- SK Khanna et al.
- 42) Use of synthetic dyes in eatables of rural areas -- SK Khanna et al.
- 43) Trend of adulteration of Mustard oil in rural markets of Uttar Pradesh, SK Khanna et al.

- 44) An outbreak of Tricresyl Phosphate Poisoning (TCP) in Calcutta -- AK Shrivastva, Mukul Das, and SK Khanna.
- 45) Mobile water testing laboratory for quality and safety of rural drinking water.
- 46) Portable water analysis kit for rural areas.
- 47) Bacteriological quality of drinking water in rural India Bhattacharjee et al.
- 48) Seasonal distribution of aeromonas hydrophila in river water and isolation from river fish -- SP Pathak et al.
- 49) Seasonal variation in the metal tolerance of aerobic heterotrophic bacteria in river Gomati water -- SP Pathak et al.
- 50) Bibliography on Industrial and Environmental Health.
- 51) Occupational Health Aspects of Textile and Allied Industries -An Overview with a Bibliography.
- 52) Pollution Problems in Pulp and Paper Industry (Bibliography).
- 53) Monitoring of Air, Water and Food Samples and Assessment of Human Exposure in Chembur, Bombay - A Proposal.
- 54) Monitoring of Air, Water and Food Samples and Assessment of Human Exposure in Kanpur - A Proposal.

Annex.2-List of Publications concluded

Annexure III

Viewpoint of the Principal Investigator on Tribal Health

The Tribal Research Institutes of Orissa and Bihar have done considerable thinking and good research in the field of Tribal Health falling within our area of interest. The principal investigator has been very closely associated with the Tribal Research Institute, Bhubaneswar (Orissa), where he started the tribal health cell in the Institute and initiated interdisciplinary studies using research methodologies from both medical and social sciences. He has also been associated with many of the tribal health projects/studies in the country, over the past 15 years.

While conducting studies on tribal health in the depths of various tribal areas/pockets of India, many a times, he had contended the conventional methodological and conceptual approaches to the study, which were usually based on western reference models, (clinical or at best anthropological studies) often leading to presentation of a fragmented and materially distorted account of the social reality in the tribal situation. He attempted to make the social reality as the starting point for alternative research methods/approaches in this field. The entire methodological edifice in his studies was built around an integrated concept of the way of life, through a unified analytical system and Tribal Health was always viewed in a holistic perspective where (a) effects of environment; (b) behavioural pattern and life styles; (c) health care delivery and (d) hereditary and genetic determinants made up the totality of the health status of the tribals. This approach helped to a degree to develop deeper insights into key issues concerning all aspects of Tribal Health.

It would not be out of place to refer to differentiation of "inner" and "outer" conditions as propagated in the theories of health and illness among some of the primitive tribal groups. The inner condition refers to a situation that makes an individual susceptible to illness while the outer condition refers to "the thing" that takes advantage of this susceptibility. In these theories of illness causation, it is believed that the outer condition is the configuration of natural phenomenon, diet, supernatural entities and germs which may cause illness when the individual is susceptible. On the other hand the inner susceptibility is determined by innate mystical qualities (?) as well as by attributes that change in conformity with events in the individual's life, actions, and ultimately social behaviour. Tribal theories of illness causation are therefore, non-discrete and cannot be understood without recognising that they are not only interrelated but actually interdigitate. If we try to look deep into these intricacies, we find that this is a more holistic and comprehensive way of thinking and relating all factors involved in the actual causes of health and illness and emphasizes an eco-system perspective that considers the physical, biological, and cultural components. The most important lesson learnt during the one and half decades of tribal health research experience was that this eco-system approach recognised that there is no single cause of a disease and there may be an

immediate, clinically detectable stimulus for disease such as a bacteria, virus, or an intestinal parasite, but disease itself was ultimately due to a chain of factors related to eco-systemic imbalances.

This was perhaps the stimulus which triggered, some years ago, the Principal Investigator's early works on tribal health. One such study carried out in Orissa recognised the fact that the tribal children in tribal belts where natural resource depletion had disturbed the ecological balance suffered acute malnutrition. This is just one example. There are many more studies conducted in the field of Tribal Health which try to establish linkages with the deterioration of a natural ecosystem and its adverse impact on health status of the tribals.
