

Environmental Toxicology Assessment

Edited by

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Environmental Toxicology Assessment

Preface

Mervyn L. Richardson

The preservation of the species, *Homo sapiens*, on our planet earth is now more than ever dependent on the environment. The exploitation of our natural environment (air, soil and water) cannot continue unabated if the health of mankind and that of future generations is to be maintained. Environmental toxicology is concerned predominantly with the harmful effects of substances in the natural environment including effects on populations and ecosystems.

During my missions for the United Nations' agencies in Asia and in Central and Eastern Europe, I observed at first hand some of the horrendous consequences of man's activities and the disruptions to the natural environment and the resultant consequences to human health.

Through World Aid agencies remediation work in a number of countries is already in hand. Hence, it is particularly gratifying that this volume contains chapters from the Islamic Republic of Pakistan, including the inaugural address from her President on the occasion of the opening of the Ecotoxicology Research Centre on 27 March 1994 in Islamabad. This is supported by the address from the Federal Minister for Food, Agriculture and Livestock and the address welcoming delegates to the workshop which corresponded to the opening of the Centre by the Chairman of the Pakistan Agricultural Research Centre followed by a statement from the United Nations Industrial Development Organization representative. These laboratories were funded by the United Nations Development Programme in conjunction with DANIDA and will serve the requirements for the South-East Asian Region. This programme is due to the foresight and continuing work of the United Nations Industrial Development Organization in Vienna.

Chapters from internationally eminent scientists who delivered papers at the Islamabad workshop include those by Vollner, Sugavanam, Baloch, Masud, Wyn Ellis, with myself presenting the plenary lecture which, in turn, is the basis of my introductory chapter. The role of pesticide application in developing countries is of paramount importance and this is stressed in a number of chapters.

This volume includes new and exciting ecotoxicological techniques such as Microbic's chronic toxicity test, the umu-C assay and research on DNA probes, etc. Some of the effects of man's pillage of the environment are referred to in the two case studies by the Croatian authors, one on the environmental toxicological effects of explosives (used in warfare), the other relating to 500 years of pollution from mercury mining.

The chapters written by scientists from 12 countries stress how international scientific collaboration is proceeding. Whilst many of the ravages caused to the environment will require expensive remediation processes, it should be remembered

that *prevention is better than cure* – a statement made by Bernardino Ramazzini (1663–1714).

Toxicology, in a variety of specialized and primitive forms, has been part of the history of man; one of the earliest reference works being the Ebers papyrus (~1500 BC).

In Rome, poisoning seemed to take on epidemic proportions in ~400 BC, in addition to the environmental toxicology problems assigned to lead leaching into piped drinking water supplies.

The pragmatic assessment of the toxicology of chemicals, whether man-made or natural, in the environment and their consequences, is of concern to everyone. This volume addresses many of the current problems and details corrective means. Only by means of proper environmental toxicology assessments can a nation's economic future be guaranteed.

As is common with multi-author works, some overlap between chapter content is inevitable. These were reduced to a minimum during editing except on those occasions where it was deemed that overlap would enhance the topic.

The Editor is indebted to Taylor & Francis for their support, especially to Janie Curtis, who had the vision to promote this topical subject. Great appreciation is also expressed to Pauline A. Sim of Gascoigne Secretarial Services, High Wycombe, who retyped the whole book and attended to all administrative matters. Sincere thanks must be extended to my wife Beryl for her general support and who patiently tolerated the editing of this volume, the mountains of paper, faxing of whole chapters and telephone calls on a global basis at all hours of the day and night.

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'At all times, people and the capacities of ecosystems to support life is at the center of the focus of Environmentally Sustainable Development. The existence of acute poverty in the World and the degradation and contamination of ecosystems are related critical issues and essential concerns in environmentally sustainable development.'

The World Bank Annual Report 1994, p. 42



THE ISLAMIC REPUBLIC OF PAKISTAN

Farooq Ahmad Khan Leghari

ISLAMABAD

**Inaugural Address by Sardar Farooq Ahmed Khan Laghari
President of Islamic Republic of Pakistan**

Workshop on Ecotoxicology, Islamabad, Pakistan, March 27—31, 1994

Mr. Minister, Excellencies, Distinguished Delegates, Ladies and Gentlemen!

Cliches are distasteful because they are oft repeated, but in renewing my contacts with agricultural scientists I can say that it is a matter of pleasure and great privilege. Pleasure because, I have, and I am in the primary production system and my heredity avocation has been and is agriculture. It is a matter of privilege because one feels that it is with scientific vigor that we can make this world a better place to live in. Today's agenda is very relevant to the one world we have, to the cause of humanity and to our very breathing. Since technological progress is a continuous and never ending process, there is a need and desire to implement this in our part of the world. This present Ecotoxicology Workshop forms part of this new dimension. It has been rather late in starting but I hope that in the years to come it will make up its belated entry through extra vigor and energy.

In 1980 when the shift in the pesticide's sector was made, from the public to private sector, a number of incentives were provided to the multinationals by providing them a level field and a propitious environment. That was carried out in order to ensure that productivity in the agriculture sector increased substantially. The use of pesticides did indeed improve this productivity and an analysis of facts provides substantial evidence. But then, somewhere along the line, the balance was lost and today you see resistance has developed in certain pests where the use of pesticides has been inappropriately high. It is visible in the cotton area, in the Brown hopper population in the rice fields. In using excessive pesticides, we have endangered the balance nature has brought between predators, parasitoids, and parasites. The emergence of white fly as a primary parasite is indicative of this effect.



Although the agriculture sector in Pakistan has made good progress during the last decade but it did not fulfil its promise because of natural calamities. Biotic and abiotic stresses have reduced seriously production of crops which cannot be overcome without adequate research and development efforts. I am informed that generally almost 33% of crop productivity is lost to pest attack. For example, during the year 1993, when cotton crop was victim of cotton leaf curl virus, a decline of 27% in cotton production was experienced, while during 1994, the loss is anticipated to equal 33% of production. The banana crop due to Banana Bunchy top virus has been reduced to almost half. Thus we should focus our attention on change to broaden the base of pest management. We must analyze ecological relationships in our agro-ecosystem which, in turn, will require much more research and supervision directed at development of integrated pest management system with a rational use of pesticides. Allocation of substantial resources has to be made for upgrading research and development infrastructure for crop protection. I am concerned that research findings be transferred to the end-users effectively to bring an effective change.

The environment is to be saved at all cost, and I hope that the toxic residues that have been left in the soil by excessive use of pesticides would be monitored, its impact evaluated and prescriptions provided to regenerate the natural life balance. I am already aware that the adverse effects are manifested in the phased elimination of wildlife in our world. Wildlife provides a very important balance in the natural scheme and we must very jealously protect what has been provided to us by nature.

I must state that the Government of Pakistan accords a very high priority to the issue of safe use of pesticides and trust that you will suggest the needed recommendations and support for follow-up activation.

I understand the Government of Denmark and the United Nations Industrial Development Organization (UNIDO) have helped us in initiating this Institute of Pesticide Ecology of Ecotoxicology Research Centre. This venture has become a challenge for future generations.

I wish to thank all those who initiated the establishment of this Institute. I hope I have contributed in some little way by taking this first step of inaugurating this Institute. I am also pleased to inaugurate this workshop.

I wish you well and God speed! **Pakistan Paendabad**

(Sardar Farooq Ahmed Khan Laghari)



Date 27 March 1994

Nawab Muhammad Yousuf Talpur

**Address by Nawab Muhammad Yousaf Talpur
Federal Minister for Food, Agriculture & Livestock
Islamabad, Pakistan**

Workshop on Ecotoxicology, Islamabad, Pakistan, March 27—31, 1994

Mr. President, Distinguished Delegates, Ladies and Gentlemen

It is my proud privilege to address this gathering of scientists. On behalf of the Government of Pakistan and on my own I extend a hearty welcome to the delegates attending the 'Ecotoxicology Workshop'. Their agenda is relevant to humanity and the environment. This is of significance to the world in general and the developing countries in particular.

Factor productivity analysis would have us believe that the scientific model constitutes the be all and end all of productivity. When this model was being developed in the mid 1960s in Pakistan, it had promise, as yields had been stagnant and population increases were a cause for concern. One component of this model was the use of pesticides — and these were used indiscriminately, thus endangering everyone. The world can ill afford this luxury of a toxic laden world. No matter who is involved or who he is involved, the repercussions are wide ranging.

The emergence of pests is of economic importance, e.g. white-fly, jassids, bollworm in cotton, and brown hopper in rice. The natural world of predators, parasitoids and parasites was destroyed. Once again, man had done what he should have guarded — the natural ecological balance.

Several constraints pose challenge to agriculture growth in Pakistan. Pests, insects, diseases and weeds are major calamities which devastate crops. During the last 3 years our agriculture has been in the grip of viral diseases affecting seriously the production of cotton, banana, tomatoes and chillies. Obviously, this is a warning that we have decided to accord a very high priority to the pest management system in general, and safe use of pesticides in particular. Outbreaks of viral diseases are

reported to have assisted the development of resistance in their insect vector hosts (hoppers, white-fly and aphids). The understanding of the dynamics of pesticide residues in the ecosystem is a difficult task. The assessment of their risks must be based on knowledge of complex factors. Pesticides kill indiscriminately, contaminate food, water, soil, micro- and macroorganisms, invertebrates and vertebrates, leaving very persistent residues. This is especially true in African and Asian countries.

We are in the process of establishing facilities for studying the toxic effects of agrochemicals in nature. The establishment of the Ecotoxicology Research Centre in Pakistan is the first step towards promoting our plans. I may add that the Pakistan Government has high priority for sustainable agriculture. A considerable amount of thinking has been given to drawing up requirements in the Task Force report on Agriculture. This Government hopes that structural and directional changes will be developed to make agriculture more meaningful.

Our thanks for establishing these facilities are due to the Government of Denmark, United Nations Industrial Development Organization (UNIDO), and the United Nations Development Programme (UNDP). I hope this support will continue.

I once again thank you all for your participation, particularly the President of Pakistan, the delegates to the workshop, and the Pakistan Agricultural Research Council.

A handwritten signature in black ink, appearing to be 'Nawab Muhammad Yousaf Talpur', with a large loop at the end and a date '30/8' written below it.

(Nawab Muhammad Yousaf Talpur)



Government of Pakistan
Ministry of Food, Agriculture and Cooperatives



Chairman
Pakistan Agricultural Research Council

Islamabad, the 27 March 1994

Welcome Address by Dr. Zafar Altaf

Workshop on Ecotoxicology, Islamabad, Pakistan, March 27–31, 1994

Excellency, the President of the Islamic Republic of Pakistan, Honourable Minister, Distinguished Delegates, Ladies and Gentlemen!

In welcoming your excellency, Mr. President, I am conscious of welcoming someone who has a deep and lasting affection for agriculture and the environment. The current situation in pesticide use, in ecotoxicology is known to you. Surprisingly enough, we had nothing to monitor regarding what was happening in the country. What was the impact of all the toxic materials which we throw around at random? This impact had to be studied. Disturbing news had to be curbed not by ignorance but by a reasonable approach. So this new intervention was considered and in this the Danish Government and UNIDO/UNDP help in establishment of the Ecotoxicology Centre is gratefully acknowledged.

In fact here at National Agricultural Research Centre, this is one of the new interventions that has been made. There have been a number of other areas such as the plant genetics institute, water resources development, horticulture institute, where new interventions have been made. There are now adequate technologies available on the shelf. Scientific endeavor is creating more of technology now than ever before. All it requires is interjection into the macro-economic framework. This would enable some of the variables to move positively.

Excellency, agriculture is at a crossroads. It is time for not only new directions but also new dimensions. It is a time for consideration and striking forth. Vigilance is required at all times whether these are good or bad. But the interventions because of these vigilances at different times are to be different. In cotton the present time will try men's souls. It is time for understanding and deep thought.

Reason, Mr. President, must dictate the logic of institutions. It is the institutional logic that we are putting in place, but it is experience that will make

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this institution work. This experience has been brought forward from international sources. We have initiated the present system, in a miniature form and we hope that in time this will increase in magnitude. The effort, however, for any new intervention to grow and work is exhausting. From unconcerned attitudes to unreasonable rebellions — in short, everything under the sun is accosted. Under such circumstances how is principle to be combined with practice? This present activity is finally coming into its own, after roughly two years of effort, UNIDO/UNDP efforts have substantially helped us in overcoming systemic rigidities.

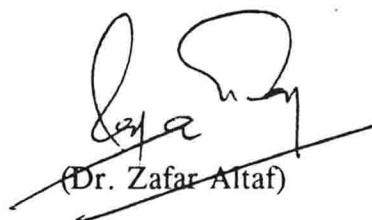
The compulsion of research are not easily understood. Sometimes the time factor and the gestation period is so distant in time, that ordinary minds are unable to comprehend. Much time and effort has been lost in persuading unpersuasive minds. The effort and exhaustion was well worth the end result. But if research is to make a march then the inner discords in research are also to be resolved. For along with ability certain other parameters are to work in harmony. Wherewithal and faith in the scientist would help. But there is something over and above that needs to be put in place. Is it high motivation? The scientist, your excellency, has to pitch against himself. Only then will he transcend his own self. The task is Herculean and yet the cure is in the self.

Our endeavor is to reincarnate the spirit of science. And this spirit of science is not of form but of substance. This spirit is manifest in a fiercely independent belief and attitude system. It is our firm conviction that belief and attitude form the central core to any action plan that we might have. This will only be internalized if the scientist is free of from externalities.

In this effort the workshop organized here in collaboration with UNIDO will be of great help. Not only will it help improve awareness, it will also be able to indicate the many interfaces of this subject. Health, environment, industry, the multiple institutions whose actions will need to be coordinated, will be identified here. A common frame of mind—thought will have to be developed.

The research in this centre will be seminal in nature. Starting from scratch means making marks on snow. Much will depend on how they perform, how they improve the system, how mankind will benefit from this work. The nature of this work in essence will be preventive rather than curative. We are in process, we will never have prescriptions. That is what makes this more challenging.

Mr. President, we are grateful to you for your graciousness in being here with us. On behalf of the scientists I thank you!



(Dr. Zafar Altaf)

Statement from the UNIDO Representative

Workshop on Ecotoxicology, Islamabad, Pakistan, March 27—31, 1994

Balasubramanyan Sugavanam

Your Excellency, the President of the Islamic Republic of Pakistan, the Resident Representative of the United Nations Development Programme, Ladies and Gentlemen

It gives me great pleasure to come to Pakistan to participate in the Ecotoxicology Workshop and on behalf of the Director General of UNIDO, Mr. Mauricio de Maria y Campos I welcome you all to this first Workshop on Ecotoxicology. I would like to express our appreciation and gratitude to the Government of Pakistan, especially to the Ministry of Agriculture for agreeing to host this workshop and for providing all the facilities for the workshop. We are especially honored, Your Excellency, by your gracious presence which clearly indicates the importance given by your Country to this project.

We are all well aware of the fact that there has been a revolution in agriculture in Asia during the last quarter of a century, and many chronic food deficit countries in this region became either self-sufficient or even food exporting countries. In addition, the quality of their agricultural produce, especially rice, perishables and cash crops has improved vastly so as to meet export requirements. This is due to the constructive agricultural policies adopted by the governments of the various countries of the region which paved the way in facilitating application of technologies as they developed. We are well aware that, following the green revolution the supply of fertilizers in the region had improved during the 1960s and the 1970s. Above all, pesticides played a significant role in protecting crop losses due to infestation by pests during pre- and post-harvest stages, and also to improving public health standards.

However, major advances made in the industrialized world during the last two decades and the research and development work carried out in these countries paid high dividends due to the introduction of highly active and more selective pesticides. This decreased drastically the amount of pesticides needed per ha from the kg level to $< 100 \text{ g ha}^{-1}$. These developments also introduced high technology in formulation and application of pesticides. Despite these successes in pushing the frontiers of science and technology, Your Excellency, there is a great concern with regard to safety in the production and use of pesticides. This is more pronounced in the developing countries where many of these advances in technology have yet to make inroads into agriculture. In the majority of cases use of an older generation of

pesticides, outdated methods of application and ineffective methods of disposal are practised and create great concern regarding their negative impacts on the environment. Even with newer pesticides, it is not possible to be fully aware of their effects on the environment. Added to this, increased production and use of other chemicals including fertilizers, has led to many persistent chemicals, their metabolites and heavy metals contaminating the soil, ground and surface waters thereby causing transboundary pollution. All of these problems create the necessity to monitor and follow their fate and effects of these chemicals on the environment. This needs coordination between the industry, the users, the government, the public, governmental and non-governmental organizations, and international organizations. If the benefits of modern technology are to be utilized fully, especially in chemical and allied industries the countries should have the capacity to monitor the movement and the fate of toxic chemicals entering their environment from direct and indirect sources. Additionally, the companies themselves should become transparent regarding their operations within the given limits of confidentiality.

Many developing countries with increased production and consumption of chemicals do not have the capacity to monitor the presence and fate of these chemicals in their ecosystems which could lead to catastrophic effects. For example, some recent news from Ecuador claims that improper and inadequate use of fungicides in banana plantations have ruined the shrimp exporting industry thus affecting the nation's economy. Such a catastrophe could have been averted if the nation had the capacity to monitor the fate of toxic chemicals leaving the source, and could have taken proper precautions in hazard identification, reducing risks and managing acceptable risks.

In this respect UNIDO assisted by UNDP and the Government of Denmark is providing the catalytic effect on a regional and national basis to promote the necessary mechanism to strengthen the capacity in the region for hazard identification, assessment of hazards and eliminate, reduce or mitigate risks associated with toxic chemicals entering the ecosystem either from chemical and allied industries, or due to their use in agriculture or in other outlets. In this we are very thankful to UNDP for their support to the Regional Network on Pesticides for Asia and the Pacific (RENAP), in which various aspects related to safe developments of pesticide production and use are addressed on a regional basis. This is the first time the project has given full support to ecotoxicology and thanks to the long standing efforts of the National Coordinator of RENAP for Pakistan, Dr. Baloch, and the efforts of the Regional Coordinator, Dr. Dhua, support was obtained from the Government of Pakistan, the Government of Denmark and the UNDP. Thanks to their generous contribution in cash and kind, today we are in a position to commence the first stage of the Ecotoxicology Research Centre. In this respect I would like to thank in particular the Pakistan Agricultural Research Council (PARC), for providing the local facilities and highly qualified staff. This Centre has just started and is expected to commence research and development projects during the course of the next couple of years when they will be in a position to assist the other countries of the region in monitoring toxic chemicals in the environment to avert major pollution hazards.

Even though the project has just started, it is pleasing that PARC, even at this early stage of implementation, has agreed to host this workshop with the hope of exchanging ideas and experience as a North—South interaction to promote awareness and action to reduce/eliminate problems associated with toxic chemicals.

The *Aide Memoir* for the workshop stressed the importance of the topic to various ministries, industries and non-governmental organizations and an excellent response, due to the importance of the subject, was obtained. Unfortunately, due to budgetary constraints, a limit had to be placed on participation from member countries.

We are also very fortunate to have international experts who are active in the field who can guide us in discussing various issues, taking into account the requirements of the developing countries of the region. We are also fortunate to have delegates from FAO and GIFAP, and I extend a warm welcome to all participants of this workshop. The purpose of this workshop is to provide a platform to participants from member countries to discuss various aspects related to ecotoxicology and how the UN system could provide the necessary assistance in risk reduction in handling toxic chemicals on the basis of chapter 19 of Agenda 21 dealing with environmentally sound management of chemicals, especially toxic and hazardous chemicals. This workshop will hopefully set the scene to increase the capability of Member Countries in monitoring the movement and the fate of toxic chemicals in their ecosystems. Once again, I sincerely thank the Government of Denmark, the Government of Pakistan and the UNDP for providing the necessary support to bring together experts from the North and the South to discuss the important issues of ecotoxicology. I extend a warm welcome to the country delegates who are representing the member countries of RENPAP and who will all give inputs in guiding the workshop in making recommendations to increase the capability of the region in risk reduction — an essential consideration, due to toxic chemicals entering the ecosystem.

I again thank Your Excellency, the President of the Islamic Republic of Pakistan, for sparing your valuable time to grace this occasion to inaugurate this workshop and open the Ecotoxicology Centre, and also thanks to the Government of Pakistan and especially the project authorities for making this workshop possible. I wish you all fruitful deliberations during this five day workshop.

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