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PAKISTAN

Technical report: Consultation in environmental toxicology related to pesticides in Pakistan*

Prepared for the Government of Pakistan
by the United Nations Industrial Development Organization,
acting as executive agency for the United Nations Development Programme

Based on the work of A. Calderbank, consultant
in environmental toxicology

Backstopping officer: B. Sugavanam, Chemical Industries Branch

United Nations Industrial Development Organization
Vienna

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ABSTRACT

Title: Consultation in environmental toxicology related to pesticides in Pakistan (DP/RAS/85/023)

Objective: A one man month assignment to advise on **(a)** the facilities available and new facilities required for monitoring environmental pollution due to pesticides. **(b)** safety measures to protect the environment during manufacture, storage, distribution and use of pesticides in Pakistan.

Conclusions: **(a)** There are no facilities designed specifically to monitor environmental pollution of pesticides, or indeed any other potential environmental pollutants in Pakistan. Consequently it is impossible to say whether or not there is a problem in the country. Although those pesticides which give greater concern, namely the chlorinated hydrocarbon class, are being gradually replaced by more environmentally acceptable products, nevertheless use of pesticides in Pakistan is still growing rapidly and new poducts are continually being introduced. It is consequently recommended that a new "Ecotoxicology Centre" be established within the control of PARC and located at the National Agricultural Research Centre (NARC), Islamabad. This laboratory, which would be capable of studying potential environmental problems related to pesticide use in Pakistan, should be supported by at least four laboratories, one in each of the provinces, which would be mainly responsible for monitoring pesticide residues in plants, animals, soil and water and assisting the central laboratory in local ecological field studies. These laboratories should not become involved in pesticide quality control. This function involves different issues and analytical techniques, and should remain the responsibility of Plant Protection Laboratories of the four Provincial Governments. Nor should they become involved in obtaining routine crop residue data for registration purposes. This work should also be carried out by the Plant Protection Laboratories and coordinated by a new Pesticide Regulatory Department of MINFA.

(b) Existing Pakistan regulations related to pesticide manufacture, storage, distribution and use are perfectly adequate in the letter of the law but they are not enforced. Those in authority know what needs to be done but there is a lack of manpower and resource to ensure the Ordinance and

Rules are obeyed and the proper procedures followed. It is consequently necessary for the Federal Government to authorise, and the provincial governments to provide, the necessary inspectors and back-up resource in analytical facilities for product quality control, and crop residue determination. Unfortunately the regulations do not apply to pesticides for domestic use. Measures also need to be taken to define and control pesticides for specific use in the domestic situation.

The requirements for the registration of all new pesticidal products needs to be modified and additional resource made available for a proper technical appraisal of the data submitted by commercial companies. The more toxic pesticides, which have a record of being hazardous to use, should be placed in a restricted category and only sold to and used by, trained operators. Inspection would be necessary to ensure this restriction was followed. A separate Pesticide Regulatory Department within the MINFA should be formed with special responsibilities for registration matters.

There is a surprising lack of basic knowledge of pesticides at all levels. Agricultural Universities should be encouraged to provide more space in their plant protection and related courses on aspects of pesticide chemistry and use. NARC should also devote more of its resource to pesticide behaviour and field use. The Field Assistant Training Institutes should devote more time to pesticides, particularly practical aspects such as application and safety matters. Industry should be encouraged to provide more help with training courses.

RECOMMENDATIONS

Remit (a)

1. An "Ecotoxicology Centre" should be established under the control of the Pakistan Agricultural Research Council, Crop Sciences Division, Crop Protection Research Director and located at NARC, Islamabad. The central laboratory should be supported by smaller setallite laboratories in the four Provinces.

2. International funding (UNDP or other source) should be provided for technical assistance involving laboratories and equipment, training and expert advice.

3. Training for appropriate postgraduate staff should be arranged at local Institutes and abroad in Industry and Government Laboratories. These would be mainly 3-6 months periods of on-the-job training to provide practical experience.

4. One scientist should be trained in Good Laboratory Practice (GLP) procedures, maximum 3 months, in industry and/or an appropriate course abroad.

5. Once the laboratory is established UNIDO should provide experienced practicing scientists from abroad to advise and demonstrate techniques and procedures.

Remit (b)

6. The Federal Government provide the resource and manpower needed to fully implement the Ordinance of 1971 and Rules of 1973, relating to pesticides, viz

   (i) for survellance of premises, products, crops and procedures

   (ii) for the registration process

7. New legislation and monitoring procedures should be introduced for controlling the introduction, distribution and sale of pesticides intended for the domestic market.

8. A new Pesticide Regulatory Department needs to be created and the registration procedure revised

   (i) to provide a better technical review of data

   (ii) to classify pesticides into restricted or non-restricted categories.

(iii) to require a letter of authorisation from the owner of the basic toxicology data submitted in support of the application

(iv) to provide a more flexible system for the procurement of efficacy (and crop residue) data

9. Training and teaching in the chemistry and use of pesticides should be emphasised more strongly in Plant Protection and other related courses at Agricultural Universities throughout the country.

10. There should be more emphasis on pesticide research at Universities, NARC and affiliated institutes.

11. More extension officers, who are better trained in the understanding and practical use of pesticides, should be provided. The two year, and shorter courses, at the Field Assistant Training Institutes need to be revised to include more training in the practical and safe use of pesticides.

12. Industry should be encouraged, through PAPA, to provide experienced people to instruct in the safe use of pesticides- mainly to extension officers and farmers - via these Provincial Training Institutes.

ABBREVIATIONS

a.i.	Active Ingredient
APTAC	Agricultural Pesticides Technical Advisory Committee
CIBC	Commonwealth Institute of Biological Control (Now PARC-CIBC Station)
CDRI	Crop Disease Research Institute
FAO	Food and Agricultural Organisation
GIFAP	International Group of National Associations of Pesticide Manufacturers
GLC	Gas Liquid Chromatography
GLP	Good Laboratory Practice
HPLC	High Performance Liquid Chromatography
IPM	Integrated Pest Management
IAEA	International Atomic Energy Agency
MINFA	Ministry of Food, Agriculture and Cooperatives
NARC	National Agricultural Research Centre
NIH	National Institute of Health
NIFA	Nuclear Institute for Food and Agriculture
NIAB	Nuclear Institute for Agriculture and Biology
NWFP	North West Frontier Province
ODNRI	Overseas Development Natural Resources Institute
PARC	Pakistan Agricultural Research Council
PAPA	Pakistan Agricultural Pesticides Association
PFI	Pakistan Forestry Institute
PCSIR	Pakistan Council for Scientific and Industrial Research
RENPAP	Regional Network on Pesticides for Asia and the Pacific
RRI	Rice Research Institute

TOKTEN	Transfer of Know-how Through Expatriate Nationals
UNDP	United Nations Development Programme
UNIDO	United Nations Industrial Development Organisation
WHO	World Health Organisation

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I. INTRODUCTION

The use of synthetic pesticides during the past 40 years has undoubtedly been of great benefit to mankind and helped to sustain the rapidly growing world population. However, incidents arising from the improper use of these chemicals, and accidents during manufacture, storage and transport, has created much concern in the minds of the public, as well as those in authority. There is no doubt that pesticides, which are biologically active compounds, if improperly used, or without sufficient knowledge of their side effects, could harm man, animals and the environment. Problems tend to be greater in the developing nations because of their relatively higher dependence on insecticides (compared with herbicides and fungicides) and older products which are generally more acutely toxic. Furthermore farmers in the developing countries are less likely to understand the hazards involved in careless use of these products. The demand for pesticides in developing countries is expected to increase by more than 50% within the next 5 years. Consequently it is imperative that more attention is given to ensuring their safe and proper use, if increasing problems are to be avoided.

In 1982 UNIDO established a regional network of countries in Asia and the Pacific area to consider the production, marketing and control of pesticides in this area (RENPAP) and progress up to 1985 was reported by Cecilia Gaston (Ref. 1). Continuation of the RENPAP project was recommended at a Project Management Committee meeting in Dec 1987 (Ref. 4). During this meeting a revised Work Plan was drawn up (Appendix II of Ref. 4) showing that a number of countries were interested in obtaining help through consultancy or training in the general area of environmental toxicology. Pakistan had previously requested consultancy help in this field for Nov/Dec 1986.

The description of the assignment (1 month) is that the consultant, with the help of the National Co-ordinator (Mr Umah Kahn Baloch, Director of Crop Protection Division Research, PARC, Pakistan), will:

1. Advise on measures to be taken to monitor environmental impact of pesticides during production, storage, distribution and application.

2. Assess the facilities available in the country to control the effects of pesticides on non-target organisms, ground, river, rain and drinking waters.

3. Advise Government counterparts on precautionary steps to be taken to reduce environmental pollution due to excessive use of pesticides.

4. Advise on the safe disposal of unused pesticides and empty containers.

5. Recommend laboratory facilities to carry out environmental monitoring of pesticide movements.

6. Submit a report on findings and recommendations.

This remit can be divided into two distinct parts or areas, viz

(a) Measures to monitor environmental pollution of pes- pesticides and the laboratory facilities which would be required (items 2, 3 and 5) and

(b) Safety to the environment during manufacture, storage transport and use of pesticides (items 1 and 4).

The subject of registration and safety aspects of pesticides use in Pakistan has been the subject of previous consultancy visits. The first was by Dr Sadar (Ref. 6) in 1980, under a UNDP scheme using Pakistani experts living abroad (TOKTEN), who described some of the problems and recommended visits from high ranking Pakistani officals to Canada to discuss manpower training needs and to examine the Canadian system. This was followed by Dr Jamali (Ref. 5) who visited Pakistan in 1981 and concluded that not enough had been done to regulate the use of pesticides as laid down by the Ordinance of 1971 and Rules of 1973 (Refs. 12 and 13) and proposed to establish a Regulatory Agency within the Federal Ministry of Food and Agriculture.

Dr Turk also visited Pakistan in 1983, under the TOKTEN scheme, and made recommendations for the more effective and safer use of pesticides in Pakistan (Ref. 9). This assignment was virtually the same as part (b) above of the current assignment. Few of his recommendations have been implemented.

After a second visit from Dr Sadar in 1986, the establishment of an Environmental Toxicology Centre in Pakistan was recommended (Ref. 7). The subject of environmental toxicology is very broad and can cover a multitude of systems and pollutants, as well as pesticides, and because of the complexity of the issues raised by Dr Sadar, none of his recommendations have so far been implemented.

Consequently from the point of view of fulfilling part (a) of the present remit it was felt prudent to carefully consider what could be built up on the expertise and facilities already available in the country. If a small centre for monitoring pesticide use and ecological effects (Ecotoxicology Centre) could be established, it would be the foundation for developing experience and trained personnel from which a broader based environmental monitoring system could be developed in the future. From little acorns mighty oaks do grow!

II. CURRENT STATUS OF PESTICIDE CONTROL AND SAFETY IN PAKISTAN

A. Registration

Registration and sale of pesticides in Pakistan is in theory controlled by the Pakistan Pesticide Ordinance of 1971 (Ref. 12) and Rules of 1973 (Ref. 13). These laws set out the regulations relating to the import, manufacture, formulation, sale, distribution and use of pesticides, and they are administered by the Plant Protection Department of the Ministry of Food, Agriculture and Cooperatives through the APTAC. The aim is to ensure that farmers and users of pesticides are provided with effective and safe products and that health risks to the people involved in manufacture, to local residents and also to those who apply the products are minimised. The ordinance also aims to promote the proper use of pesticides so that the population is not put unduly at risk from excessive residues in food crops.

Although the Ordinance, and Rules to enforce it, are clear and mainly adequate for the purpose, nevertheless there are serious problems and grave concern throughout the country simply because the Ordinance is not enforced and there is no surveillance at all (Ref . 9). Furthermore there is no provision in the Regulations to control the introduction of pesticides into the domestic market.

The present system of obtaining registration for new products is to obtain approval of the Agricultural Pesticide Technical Advisory Committee (APTAC). [See chart in Visit Notes (13) Annex III.] Members of the Committee consist mainly of high ranking members of government, universities and other institutes. There is also a sub-committee which advises the main committee but it is said to be comprised mainly of experts in plant breeding and other agriculturists who have little knowlegde of pesticides.

Although efficacy trials are normally carried out and analysis for quality control, very little other internal data is generated by the Provincial authorities. It is widely believed that the data submitted by the registrant is not reviewed in any detail, although 3 or more years can elapse between application and approval - mainly the period needed for 2 seasons efficacy data and quality control analysis.

In the report of his consultancy visit Dr turk (Ref. 9) strongly recommended that a proper data review system be established. It goes without saying that review of the technical data should be by technical experts, who would then make their recommendations to APTAC via the subcommittee.

There are many complaints that too much time is spent evaluating efficacy of different companies' products which have the same active ingredient and may not differ too much in formulation composition; furthermore that the efficacy trials are poorly carried out. (Visit Notes (14), Annex III). The cost (to the Company) of carrying out this work plus quality analysis of the product is Rs 5000. There are other registration fees making the total cost to the registrant about 700 US dollars.

B. Type of Agriculture and Products Used

About one quarter (20 million hectares) of the total land area of Pakistan is cultivated. Of this agricultural land about 14 million hectares are irrigated, mainly within the great Indus River System.

Agriculture is the most important sector in the country's economy. Farmers mostly have small holdings (less than 2 ha) and consequently around 60% of the population is involved, or employed in agriculture. Thus a large proportion of the farms are too small to benefit from crop specialisation and modern inputs such as mechanisation. The bigger farms (above 10 ha) comprise about 13% of the cultivated area and they concentrate largely on the export earning crops, cotton and rice. It is on these larger farms where the bulk of the pesticides are used. Because of the varied climate and facilities for irrigation the conditions are suitable for crops grown under conditions ranging from temperate to tropical eg. potatoes and apples in the upper regions and cotton and tropical fruit in the hotter zones. The major crops are cotton, rice, wheat, sugar cane, maize, soya and fruit.

Of the pesticides used, insecticides comprise by far the greater proportion, although there is a growing use of herbicides on the larger farms (Table 1). Insecticides are also generally the most acutely toxic and consequently present the greatest hazard in use. A complete list of registered products, supplying companies and price list, effective July 1986, is provided by Agriculture Department Punjab, Lahore and reproduced as Annex III of Ref. 10.

Although the insecticides in greatest use tend to be the organophosphates there is a tendency for the generally less hazardous pyrethroids to grow in popularity and sale (Table 2). Unfortunately they are more expensive and already represent 60% of the total costs of imports.

TABLE 1. Use of Pesticides in Pakistan (Data taken from Ref. 10)

M/Tons - a.i.

Type	1981	1986
Insecticides	734	3841
Fungicides	132	260
Herbicides	34	128
Acaricides	2	62
Nematicides	9	-
Rodenticides	1	4
Fumigants	3	9
Totals	**915**	**4304**

TABLE 2. Relative Proportion of Insecticides Sold in Pakistan 1984-1987 (taken from Ref. 25)

Type of Insecticide	% of total pesticide sales p.a.		
	1984	1986	1987
Organophosphates	54	54	49
Pyrethroids	8	21	30
Chlorinated hydrocarbons	14	9	5
Carbamates	9	2	2
Other products (acaricides, herbicides etc)	15	15	14

Because of the small farms, Pakistani farmers will use simple backpack and hand held spraying equipment and typically with bare legs and feet. Protective clothing, eg. gloves, are not used even for mixing and handling the concentrate. Consequently maximum exposure of some quite toxic insecticides to a high proportion of farmers can be expected. The problems are compounded because almost all the rural population is illiterate and cannot understand the hazards of pesticides even when explained to them. Most are unable to read labels or follow simple instructions so that farmers have to rely heavily on the advice given to them by the distributor (see Visit Notes 15). Extension officers seem to play a minor and ineffective role regarding advice to farmers about the correct use of pesticides.

Farmers inexperienced in pesticide use, as well as people from the domestic sector, could in theory obtain even the most toxic of the products on the market; the only deterrent seems to be the cost involved in purchase and advice from the dealer. Some of these and related problems are described in more detail in earlier consultancy reports (Refs. 5, 6, 7, 9) and other reviews (Refs. 8 and 24) - but see Visit Notes (15), Annex III.

C. Manufacture, Sale and Distribution

The status of manufacture of pesticides in Pakistan has been adequately described by Dr Szabo (Ref. 2). The only active ingredients manufactured in the country are DDT and BHC (23% gamma). Both plants were shut down in 1980, although it was recommended by Dr Szabo that they be recommissioned. This recommendation may well need review in the light of current developments with the pyrethroids.

There are about a dozen formulation plants in the country but many products are still imported already formulated. It seems surprising with so much need for good quality pesticides and the shortage of foreign currency that more attention is not given to local manufacture - or part manufacture from imported intermediates.

Many health problems relate to the operation of the local formulation plants and the sale and distribution of the products. Some of these have been highlighted by Dr Szabo (Ref. 2) and Dr Turk (Ref. 10), and mainly refer to possible inhalation exposure risks, the lack of adequate means of disposal of waste or unused material, no arrangements for safety precautions with local authorities in the case of fire and no written instructions to drivers of vehicles carrying hazardous products.

In the event, the safety precautions are well laid out in the Ordinance of 1971 but again very few steps have been taken to inspect premises and to ensure proper safety measures have been taken.

No proper checks are made to ensure pesticides are not stored and transported alongside food commodities. Although pesticide dealers are registered, there are 2800 of them and few inspections or checks for quality control are made, despite many instances of adulteration.

No distinction is made between the domestic and the professional user market with regard to the type and relative hazard of the products sold, although container labels are now colour coded according to toxicity classification. Indeed the current law does not specifically relate to pesticides for domestic use and in theory any unregistered products could be sold into the domestic market!

The label also shows the date of manufacture and expiry (2 years shelf life) but there are only occasional quality checks of products in the market and usually following a complaint to an extension officer or the police. The label also shows the cost of the product which may be sold with discount after the expiry date (Visit Notes 15, Annex III).

Several incidents resulting in fatalities from lack of attention to elementary safety precautions have been instanced by Balloch (Ref. 8). These would have been unlikely to occur if proper arrangements had been taken to implement the provisions of the Pesticide Ordinance Act, Section 29 for the safety of workers. Pesticides, such as toxaphene, dieldrin and endrin, which are allegedly banned in Pakistan, are still sold and used for certain outlets.

D. Pesticide Residues and Environmental Hazards

Residues in Food

Although pesticide residues on food crops are less likely to represent a potential hazard to man compared with that arising from the improper sale, distribution and use, nevertheless little information is available on which to assess the situation. There are no regular and properly conducted pesticide residue surveys of foodstuffs nor residue trials on new products submitted for registration. The data submitted by the manufacture in the registration document may bear little relevance to the practical situation in Pakistan.

An FAO sponsored food survey conducted in Pakistan (and other Developing Countries) in 1982/83 (See Visit Notes (2) Annex III) suggested that there was no significant problem. Indeed the potential hazards from bacterial contamination of food were far greater. Chlorinated hydrocarbon pesticide and organophosphate residues were monitored but the sampling procedures left much to be desired. It is clear that the use of chlorinated hydrocarbon pesticides is declining and this will inevitably lead to lower residues of these more persistent compounds, as has occured in the western world. Nevertheless, the situation needs to be monitored on a regular basis, not only for this group and the organophosphates, but for other active ingredients which are starting to be more heavily used.

Large safety factors are normally involved in relating the maximum residue limits (MRLS) of pesticides to the WHO calculated Acceptable Daily Intakes (ADIS) of pesticides in the daily diet. However, several special factors operate in Pakistan and presumably in other developing countries, viz

(i) A high proportion of the population is involved in farming and many of these will be exposed and absorb significant doses of the same pesticides whilst applying them, especially since they wear no protective clothing.

(ii) Because of the illiteracy problem it is widely believed that pesticides may be applied excessively and to crops which were not intended to be treated. This point is difficult to substantiate since no surveillance or checking is made.

(iii) A family will often consume mostly home grown produce and consequently dietary dilution factors may not apply.

(iv) Food, notably wheat grain, has to be stored for months on small farms. The farmer needs to preserve his crop during these months against insect and rodent attack. Some products - not intended for post harvest treatment - are used. It has indeed been reported* that metallic mercury mixed with sand is occasionally applied to preserve grain during storage! The same farmer will often use some of this grain for his own and family's consumption.

(v) Farm stock may also be receiving higher than normal pesticide residues because of consumption of home grown forage. This practice could provide an additional source of residue intake (namely in meat, milk and eggs) for the farmer and his family.

Regretably no information is available regarding local (on the farm) pesticide food residues, on which to base a reliable assesment of the magnitude of the total dietary intake of pesticide residues, nor on the amounts of the same pesticides which may be absorbed systemically whilst applying them.

Pesticide residues in food for export can also have a serious economic effect if they are above the Codex MRL value or the national tolerance value designated by the importing country. For example EI Salvador lost more than $1 million because its meat for export contained unacceptably high residues of DDT (Ref. 23, p 118). These high residues arose from catle feeding on DDT treated pasture and being fed cotton meal from DDT treated cotton fields.

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* Mr R A Boxall, ODNRI, personal communication

Environment

The hazards to human life from environmental pollution of pesticides must be considered insignificant in relation to the potential hazards arising from their misuse, as discussed in Section C. One hears of incidences of livestock deaths allegedly from them accidentally consuming recently sprayed crops, pasture subject to drift of pesticide from an adjacent field or grass beneath treated fruit trees etc. Occasionally one hears of fish deaths that are attributed to pesticides. Otherwise the incidents of authentic environmental problems appear to be few. The immediate requirements for subsistence today clearly take precedence over the considerations of long-term trends. Nevertheless there is an increasing concern about environmental deterioration by scientific and political leaders in Pakistan.

At present, there is no system or facilities for monitoring the environmental effects of pesticides and not even for measuring the amounts of pesticides which are present in the environment of Pakistan. The inability to monitor the present situation and to fully understand what the impact to the environment will be from newly introduced products is a problem which, if not corrected, will magnify in the future.

During the registration process a manufacturer usually provides data on the fate of a new pesticide in the environnment, its fate in soil, water and air and the effect it is likely to have on non-target organisms, aquatic life, soil processes and organisms etc. Much of this data, however, is likely to depend on local environmental factors. Pakistan has extremes of climate, heat, irradiation , humidity, rainfall, soil conditions from arid to irrigated, a tremendous variety of crops with associated environmental conditions. It is consequently essential that the facilities and wherewithall be developed to assess the fate of pesticides in the specific and relevant environments which occur in Pakistan and furthermore to be able to monitor the effects these pesticides are likely to have on non-target organisms in these situations. It is important that a bank of country knowledge and scientific expertise be developed in the pesticide area which could at some future date provide the expertise to monitor other potential environmental pollutants.

If a major incident were to occur in Pakistan similar to the Sandoz/Rhine incident, or the accident involving dioxin contamination of soil at Serveso, there would be no adequate expertise or facilities to deal with the problem.

III. IMPROVING PESTICIDE CONTROL AND SAFETY IN PAKISTAN

A. Registration

The procedure for registering pesticides in Pakistan needs to be improved. This can only be achieved if more trained manpower is made available to make proper technical assessments of the data submitted.

There is virtually no technical review of the data mainly because of the shortage of technical experts who could be specifically assigned to the task. The only reviews carried out are on efficacy data and formulation analysis, and as a part time occupation of members of the sub committee of ABTAC. In Japan there are 64 scientists in the Agricultural Chemicals Inspection Service (ACIS) devoted solely to this data review system (Appendix II of Ref. 3).

The procedure which is proposed below is designed to fill present gaps in the system, to make it more difficult for "me-too" registrations and to provide for a more critical field evaluation and data review system. The overall effects should be to reduce the numbers of products registered each year, although not necessarily lengthening the period for registration of successful products. A new department "Pesticide Registration Department" of the MINFA should be created with sole responsibilities for the registration process.

Registration Petition Review

Stage I Petition scrutiny - Five major areas. Is the necessary information all there?

1. Product Chemistry:

   (a) Nature of active ingredient and impurities
   (b) Nature of formulation and quality control

2. Toxicology*:

   (a) Basic toxicology of a.i.: Has there been a favourable review by a competent regulatory authority or by JMPR?

   If so when?

   Has new data been generated in the last 15 years. If so, who is the owner of the data?

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* See Section (b) which follows

In the case of a relatively new pesticide a certificate that the product has been successfully registered in a country having a competent regulatory authority.

In the case of all products, including old products with relatively new (within last 15 years) toxicology data, a certificate from the owner of the data, that the intending registrant may use the data for registration in Pakistan.

(b) Acute toxicity of the formulation/labelling

Acute oral and dermal (rat)
Skin and eye irritation (rabbit)
Skin sensitisation

Is the data there?

Is the label adequate?

3. Efficacy data:

Has efficacy data been submitted?
Where were the trials conducted?
Is the formulation very similar to one tested previously in Pakistan?

4. Residue data:
As for efficacy (3).

5. Environmental Fate and Effects

Same questions as for basic toxicology (2a).

If all the data is present and the appropriate certificates submitted then the petition may proceed to Stage II.

Stage II This is a technical assessment of the data provided, with decisions on the new data that needs to be generated in Pakistan.

1(a) Scrutiny of source of a.i. and any potential problems from toxic impurities

(b) Is the formulation similar to any others currently registered in Pakistan? If so, how similar?

2. Does the formulation need to go into the "Restricted Class"?

3. If the formulation is different from any previously registered -

(a) Without efficacy data from another country - carry out 2 years efficacy trials in two Provinces, as current practice

(b) With substantial efficacy trials in a country/crop situation comparable to intended use in Pakistan - carry out 1 years efficacy trials.

(c) If the formulation is very similar to a product registered in Pakistan - it may not be necessary to do any field trials. This circumstance could arise when a manufacturer may need to change a minor inert ingredient in the formulation, because of supply or other problems.

4. Similar remarks apply to the generation of crop residue data, as above for efficacy.

5. Have previous reviews of environmental data disclosed any potential problems?

What special circumstances in the crop/climate/fauna and flora of Pakistan might be different and affect the behaviour and fate of the pesticide?

Are any special checks needed for Pakistan?

Stage III This is the practical work required to generate data in Pakistan, depending on Stage II Technical review. viz

1. Quality control analysis and analytical method check.

2. Efficacy trials, 2, 1 or 0 years.

3. Residue data, 2, 1 or 0 years.

4. Local environmental data if needed.

It is suggested that industry could generate some of the above data under the surveileance and monitoring of the Provincial Departments of Plant Protection, or in the case of environmental data (NARC Ecotoxicology Centre). This is the normal procedure in the UK and USA (Ref. 28).

Stage IV Follow the current procedure of review of the data and recommendations through the Provinceal and Federal Sub and Advisory Committees.

It is recommended that

1. Part of the costs of the more stringent review is recovered by charging a more realistic (higher) registration fee.

2. In the efficacy trials more attention is paid to selecting the most appropriate (most efficacious) standard, which the new product must match, or be sufficiently close and possessing additional benefits.

Mammalian Toxicology

Toxicology is a complex and highly specialised and sophisticated subject. I would not suggest that the data on the chronic toxicology of the active ingredient be reviewed in detail since I suspect that there is not the necessary expertise within Pakistan to do so. This particular problem will not be solved by sending scientists on toxicology courses, such as the MSc courses offered in Canada and the UK (Ref. 7).

Such courses are only for the generalist. The necessary in-depth knowledge, with the ability to interpret the results of animal data can only be obtained with time and by specialists. Thus one needs interpretation in depth by specialists in a number of fields eg. veterinary pathology, pharmacokinetics, genotoxicity, neurotoxicity etc. It has been said that toxicology can be learned in two lessons but each lesson takes ten years!

The only solution for a developing country which does not possess this expertise is to insist that the Company requesting registration submits a summary of the toxicological data together with a certificate showing that a competent regulatory authority has already registered the product and has reviewed the full data with favourable results. Any adverse comments they may have had should be appended. In this respect a favourable JMPR review would suffice.

It would of course be in order for a Company to submit a product for registration in Pakistan whilst it is still under toxicological review in another country (or by the JMPR), in the expectation that by the time efficacy and other trials had been completed in Pakistan, the results of the toxicological review would be available.

It is unrealistic to expect that the product should first be registered in the country of origin since the product may not be used there because of different cropping situations.

This seems to be the only realistic solution until Pakistan is able to develop its own expertise in the toxicology area.

The above remarks apply mainly to chronic (long term feeding studies), mutagenicity, teratogenicity, neurotoxicity, pharmacokinetics and other studies on the active ingredient. They do not apply to the acute studies on the formulated products for sale in Pakistan. Such toxicity studies do not need review by an expert toxicologist but by somebody with a minimum of experience in the subject. A local review is essential - Most important

tests are:

(a) Acute oral and dermal LD_{50} values (usually rat)

(b) Skin and eye irritation (rabbit)

(c) Skin sensitisation (guinea pig)

The results of such studies are important since they are used to decide whether the product is likely or not to pose a hazard to operators and others who handle the undiluted formulation and consequently into which toxicity category (restricted or otherwise) to place the product.

Crop Residue Analysis

Several laboratories have already been set up in the Provinces, and others are planned, for carrying out crop residue analysis from registation trials on new products.

Most of these are under the control of the Provincial Plant Protection Departments of the Ministry of Agriculture.

There is a danger, however, of this initiative getting out of hand since other laboratories, eg. The Pest Management Research Institute, Karachi (Visit Notes 11), which comes under the control of PARC and various Agricultural University Departments eg. at Faisalabad (Visit Notes 8) are also planning residue analysis work. It will become increasingly difficult to control the situation and maintain proper standards and records if several organisations are involved.

Responsibilities should be clearly defined. In my view the work should be organised by the new Pesticide Registration Department so that the work could be properly controlled and coordinated.

PARC, with its Ecotoxicology Centre and Provincial laboratories, would carry out any environmental studies on new products for registration only on request or following discussions with the reviewer (Stage 2) of the environmental registration package. Normally their remit is to monitor the environment for adverse effects of major products already registered and in greatest use in Pakistan.

Similarly their involvement in crop residue analysis is mainly concerned with monitoring the current situation on produce from farms and the market place for residues of pesticides in common and greatest use.

Furthermore the techniques involved in this type of residue analysis are quite different from those involved in supervised trials. In the latter case the product used is known and the methods of analysis usually specific for that compound. When

analysing crops for monitoring purposes the history of crop treatment is usually unknown and the residues unknown qualitatively as well as quantitatively. Consequently it is important not to confuse the two techniques or the objectives involved.

In order to comply with the above organisational strategy the Pesticide Laboratory of the Pest Management Research Institute could ideally become the Sind Province laboratory satellite of the PARC Ecotoxicology Centre. In this eventuality it would need to adopt new technical objectives to conform with those of the Ecotoxicology Centre. Thus in the long term, when other facilities became available, it would need to stop its involvement in quality control and crop residue analysis for registration purposes.

B. Manufacture, Sale, Distribution and Use

There would be relatively few problems in Pakistan if the Ordinance of 1971 and Rules published in 1973 (Refs. 12 and 13) were strictly enforced. This can only be done by providing a team of trained inspectors to monitor the situation throughout the country and to enforce and strengthen the regulations where necessary. Consequently the single most important recommendation must be that the Federal Government provide the manpower and funding for this to happen.

The responsible authorities, administrators and scientists, in Pakistan know full well what is required to ensure that safety standards are met. These have been adequately listed in previous consultancy reports, notably that from Dr Turk (Ref. 9). Guidelines are also described in three FAO documents concerned with Distribution and Use of Pesticides (Ref. 15), Registration and Control of Pesticides (Ref. 16) and Good Labelling Practice for Pesticides (Ref. 17). They are also very clearly outlined in two important GIFAP booklets relating to formulation, packing, storage and transport of pesticides (REf. 20) and the safe and effective use of pesticides (Ref. 21).

Despite previous recommendations and the voluminous literature on the subject it is perhaps worthwhile emphasising here some of the more important points and some related matters, not previously raised.

1. The duties of the inspectors appointed to enforce the Pesticide Ordinance and Rules should be quite separate from those of the extension officers and preferably they should be under different administrative control.

   The extension officers will be fully involved in advising and training farmers and ensuring that the procedure for registering pesticides functions properly (see below). It

is suggested that the team of inspectors should rightly respond to the Department of Crop Protection of the Ministry of Food, Agriculture and Cooperatives.

2. Formulation manufacturing facilities in Pakistan should be inspected carefully, particularly to ensure that local residents will not be put at risk in the event of an accident or fire at the plant. Furthermore, in such an event, that there are adequate safeguards to ensure that local waterways will not become contaminated. In the event of new manufacturing facilities every effort should be made to install the factory at a safe distance from local residents (Ref. 20).

   Furthermore, in obtaining a licence for the facility, the manufacturer (or importer of the a.i.) should provide a guarantee of liability in the case of accidents resulting in harm to humans or the environment. This will help to ensure that the factory is efficiently and safely managed.

3. Pesticides should be labelled according to a restricted or non-restricted (Agricultural and Commercial or Domestic) category. This would be done during the registration process. The more toxic products, or those with greater potential hazard, would be restricted, presently they are colour coded red or blue. The classification of pesticides according to their toxicological profiles and appropriate labelling is discussed by Turk (Ref. 9) and in more detail by WHO (Ref. 18) and FAO (Ref. 17).

4. Those pesticides in the restricted category should only be sold by those holding a licence and to professional operators or farmers who have permits. Permits would be granted only to those who have been trained in the use of more hazardous products.

5. Pesticides should not be stored or transported with food-stuffs. The drivers of vehicles carrying pesticides should have a "card" with instructions (provided by the manufacturing company) on how best to deal with spillage or leakage of the material in the event of an accident (Emergency Procedure).

6. Methods for the disposal of unwanted pesticides and used containers are fully described by Cusack et al (Ref. 24) and in the GIFAP booklet (Ref. 21).

   Provided the pesticide has not deteriorated significantly (determined by quality control analysis) the safest way of disposal is to use it in the recommended manner. Otherwise disposal should be by incineration or burying in lined pits. Used containers should always be made unusable by puncturing them prior to disposal.

C. Training

(a) Safety

Pakistan, like many of the developing countries, has a special problem in that there are many small farms (less than 2 ha) and the farmers in the more rural areas cannot read and follow simple instructions. Training these people remains a key step in introducing countrywide safety standards in the use of pesticides. The burden in carrying out this training rests with the government extension officers. It is they who are in closest touch with the farming community and it is they who should be offering the farmer advice on his crop and pest problems and how most effectively to deal with them. A key element in this advice should be which products to use and when and how to handle them safely.

Consequently it is essential that the extension officer be properly trained himself. There are many Institutes in every Province of Pakistan which specialise in training these people (see Visit Notes 8 and 9, Annex III). Mostly they are two year courses and since the intakes are non-gaduate school leavers much of the time is spent in providing a broad understanding of agriculture, crop and animal husbandry and the like. Little time is left for a basic teaching of pesticides and how to handle and use them safely.

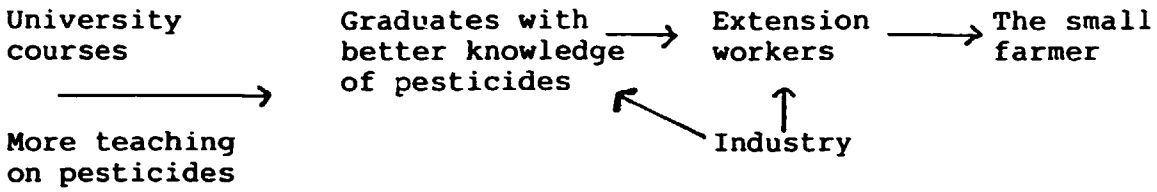
The major manufacturing companies can do much to help here, by providing experienced people to visit the Institutes and give the students advice and demonstrations in safety. University staff also provide additional advisory support on the courses but in my view not enough is done in teaching the basic chemistry and use of pesticides.

This deficiency extends to the Plant Protection Courses in the major Agricultural Universities which I visited (Annex III). Generally only a small part of the curiculum in most of the degree courses is devoted to pesticide chemistry and use. There is a fundamental lack of knowledge amongst those at graduate level, who have the responsibility for teaching, of the basic properties and differences between products.

It is not surprising therefore that I received many complaints that there were too many products on the market, and farmers - and extension workers were confused.

Having the same active ingredient sold by different manufacturers in a different formulation and with a different brand name is not a bad thing, and one which occurs with almost any other product from washing powder to medicines - generally it stimulates healthy competition and keeps prices down.

What is really needed is a better understanding of what is in these formulations and what is the nature and content of its active ingredient. Everything comes back to University Teaching Courses and the need to amend the curiculum in those concerned with plant protection on the subject of pesticides. Training may thus be shown as involving the following processes.



(b) Technical

Regarding the technical training of specialists in the areas of pesticide analysis, ecological effects, environmental chemistry and field trial techniques, there is already a good deal of expertise at various Universities and Institutes scattered around the country.

Much could perhaps be done by some of these, such as NIAB (Faisalabad) and the Pest Management Research Institute, Pesticide Laboratory (Karachi) to help instruct and train others.

People can also be sent on specialised courses abroad. Some of the major pesticide companies such as Shell, ICI, Ciba Geigy and Baeyer already take foreign graduates from government institutes for periods of training (usually 3 to 6 months) on various topics, such as field trials with pesticides, crop and environmental residue analysis and in other areas. This type of on-the-job training is most valuable in providing the right sort of practical experience. The trainees would also benefit from working according to the principles of Good Laboratory Practice (GLP) which has become essential if the data generated on new pesticides are to be accepted by Regulatory Agencies in Europe, the USA and Japan.

More advantage should be taken of the opportunity of working in the laboratories of the major companies because they have the greatest experience and in-depth knowledge of this type of work. This will provide more lasting benefit to the country than sending agricultural graduates to universities abroad to carry out research on fundamental aspects, such as plant genetics, biochemistry and other long term research projects - as the predominance of graduate training is presently orientated.

D. Environmental Control and Monitoring

(a) Objectives

There is, at present, no facility in the country for effectively monitoring the impact of pesticide use on the environment of Pakistan. Until this is done, and analytical and ecological work caried out, it will be impossible to assess what the magnitude of the problem is, or indeed if a problem exists at all. Furthermore there is no centre of environmental expertise to make technical assessments of data relating to the fate and effects of pesticides in the environment on which to base recommendations related to registration submissions, or to alert government to potential problems.

It is consequently recommended that a central laboratory with the necessary technical expertise be established in Pakistan, supported by satellite laboratories in the Provinces, mainly to carry out local residue analysis work on crops, animals, soil and water and local ecological studies.

This centre of environmental expertise and know-how, developed on pesticides, would form the core of experts and knowledge from which a more extensive organisation could develop in the future as more experience and trained personnel were acquired. It would also form the base from which to develop a broader organisation capable of monitoring the environmental effects of pollutants other than pesticides.

With the support of laboratories in the Provinces its function would be to survey and monitor pesticide residues in crops and in the environment and to evaluate their effects on the ecosystem.

It is not envisagd that this laboratory (or its satellites) should be involved in routine crop residue analysis for registration purposes - this function should remain the responsibility of the Plant Protection Laboratories of the Ministry of Agriculture, along with the efficacy evaluation (see Registration, Section A).

(b) Facilities and expertise needed

The manpower needs are shown diagramatically in Annex V, with approximate grades and most appropriate disciplines. The totals are as shown

				Totals
Joint Director				1
Central Laboratory		Provincial Laboratories*		
PSO	4	-		4
SSO	12	8	(2 x 4)	20
SO	12	16	(4 x 4)	28
L. Asst.	12	16	(4 x 4)	28
Non Tech.	7	12	(3 x 4)	19
				100

* Although these are shown evenly spread between the Provinces it may well be that moe resource is placed in the Punjab relative to the other Provinces.

It is envisaged that the main work carried out by the laboratories in the Provinces will be residue analysis of crops, animals, soil and water from local situations. They will be supported and advised by the Central Laboratory, which should also be a repository for all the locally generated data.

Ecological work in the Provinces should be run and organised from the Centre. The role of the Provincial laboratory in ecological work will be to assist in selecting suitable sites, for on-the-spot assessments, taking samples and generally assisting the Centre with the experimental work. Each laboratory (minimum of 1000 sq ft) should have ample cold storage space for samples awaiting analysis, offices and other facilities - say 2000 sq ft total.

It is assumed that much of the technical support services for the Central Labortory will be available on the site selected for its location (see below). This includes services such as statistics, library and information. No provision has been made for these services, except photocopying.

It will , however, be necessary to provide an archive for storage of records, data etc. and a person to provide Quality Assurance. It is essential that the laboratories work according to principles of Good Laboratory Practice (GLP) if the data generated is to be accepted in Western countries. A scientist whose full time involvement is Quality Assurance and Archiving will ensure this is done.

A provision has been made for a small metabolism section in the Central Laboratory to study the fate of pesticides in the environment. This type of work is normally carried out by industry, but the data needs to be reviewed by competent experts, who are working in this field.

Furthermore the behaviour of pesticides under the specific environmental conditions in Pakistan may need to be checked. Hence it is necessary to develop expertise and experience in this area.

This involves the use of radiolabelled techniques and all the sophisticated equipment, such as scintillation counters with computer, automatic oxidiser as well as the usual analytical instruments with radioactivity detectors. It would represent a major expenditure to equip a laboratory for radioactive isotope work. Such equipment and expertise is available at NIAB, Faisalabad - all except a GLC linked to mass spectrometer, a service for which is available at HEJ Research Institute, Karachi. Facilities for doing radiotracer work are also available at the Quaid-i-Azam University, Islamabad. It may be possible to rent or utilise facilities there for the time being to avoid excessive expenditure at the start of the project, but in the long term the Ecotoxicology Centre would need to be fully equipped for radioisotope work.

The facilities should include laboratories to handle the work shown in the chart (Annex VI).

I would suggest about 3000 sq ft will be needed for residue analysis, about 2000 sq ft for metabolism with about 1000 sq ft devoted to the other 3 Sections. With associated instrument rooms, storage cold room, archive, dark room, insect rearing room and offices, a minimum of approximately 12000 sq ft would be needed, plus 1000 sq ft of glasshouse (see Annex VI).

The major instrument and other significant requirements are shown in Annex VII.

(c) Location

The Central Ecotoxicology Laboratory would best be located at Islamabad on the same site as the National Agricultural Research Centre (NARC) and should be under the same administrative control, namely Pakistan Agricultural Research Council (PARC).

The main advantages of this arrangement is as follows:

1. There is already a core of biological expertise at NARC, namely in the Entomology Department (Toxicology and Environmental Monitoring and Ecology) in Microbiology (Nitrogen fixation); there is experience of insect predators and a honeybee research unit in the Natural Resouces Division. There is also some analytical expertise and equipment in the biological sections eg. Weed Science, which is ill-placed there. Some re-organisation of people and projects would be necessary (see Visit Notes 4, Annex III). Reorganisation of projects might also free some laboratory space to accommodate part of the proposed Ecotoxicology

Centre.

2. Staff in the new facility will be able to use the administrative and back-up facilities of NARC particularly with regard to technical service of equipment, library and information services.

3. The staff will also have the opportunity of interaction with many other scientists of inter disciplinary nature - not possible on an isolated site.

4. The Quaid-i-Azam post graduate university is close-by and the Biology Faculty has many research projects in common with the proposed new facility including one on fish toxicity. It would also offer the possibility of (eg. scintillation counters) and as a training ground and source of graduates.

5. Islamabad has good communications with the rest of the country. It is the ideal centre to develop and store a bank of information on residues and environmental effects of pesticides. It could then act as a centre for advice on likely environmental impact of new products and provide a technical review of the environmental data package submitted for registration purposes.

(d) Special training needs

The main training needs will be in the area of residue analysis methodology - both for the Central Laboratory and those in the Provinces. There will also be a need to acquire expertise in metabolism work with radiolabelled compounds.

There is some expertise within the country in both areas, at NIAB (Faisalabad) and the HEJ Research Institute of Chemistry (Karachi). The best experience, however, is within Western Industry and several of the major companies will accept graduates for periods of technical training (3-6 months should be adequate). It is also most important that they will also acquire more vigorous and effective methods of working there, because work in these fields is carried out by industry using GLP procedures.

It is absolutely vital that such methods of working are adopted by the Ecotoxicology Centre and its satellite laboratories.

Proposals for 3-6 months on-the-job technical training.

Type		Place		Numbers
Residue analysis	-	Industry	-	as many as will be accepted
	-	Western Gov. Labs		Ditto
	-	NIAB, HEJ	-	Ditto
Metabolism	-	Industry	)	
(Plant/Soil)	-	Western Gov. Labs	)	Two
	-	NIAB	-	Same two
Ecology	-	Industry	-	Two
Soil and Water (fish)				
Good Laboratory Practice	-	Industry or special GLP course abroad	-	One

Once the laboratories have been established further training can be obtained from consultancy visits by practicing scientists (from Western Government Institutes) who should spend most of their time instructing staff at the Ecotoxicology Centre in Islamabad.

The Central Laboratory will eventually be in a position to provide training needs for the Provincial Laboratories and for other environmental laboratories which may be needed at a later date throughout Pakistan.

ANNEX I

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ANNEX I

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ANNEX II

ITINERARY

ANNEX II

ITINERARY OF DR ALAN CALDERBANK, CONSULTAN IN ENVIRONMENTAL TOXICOLOGY RELATED TO PESTICIDES

9 June - 8 July 1988

Fri	10 June	Briefing, Vienna
Sat	11 June	Travel to Pakistan
Sun	12 June	Arrived Islamabad - Stay in Holiday Inn
		- Mr Umar Khan Baloch, Director of Research (Crop Protection) PARC - Briefing
		- Mr Mohammad Mumtaz, Dy. Director (Pesticide) PARC
Mon	13 June	Visited National Agricultural Research Centre (NARC)
		- Dr Muhammad Yousaf Chaudhri Member (Crop Sciences) PARC
		- Visited UNIDO/UNDP, Islamabad (Mr Ogbewe Mariere, JPO)
Tues	14 June	Discussions at PARC HQ, Islamabad
Wed	15 June	Visited Quaid-i-Azam University (Professor M.H. Qazi, Head Faculty of Biological Sciences)
		- National Institute of Health (NIH), Islamabad (Dr A Ghafur, Director)
Thurs	16 June	Visited PARC-CIBC Station (Biological Control) Rawalpindi (Dr A Ikram Mohyuddin, Entomologist-in-Charge)
Frid	17 June	Free
Sat	18 June	Visited Cereal Diseases Research Institute (CDRI), Murree
Sun	19 June	Visited NARC Plant Protection Labs (Dr C Inayatullah, PSO and Dr A Jabbar, SSO)

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Mon	20 June	Visited UNDP, Islamabad (Mr Watts, Resident Representative) - Environment & Urban Affairs Divison (Mr Shamsul Haq, Joint Secretary) - Economic Affairs Division (Mr Ghafur Mirza, Joint Secretary)
Tues	21 June	Nuclear Institute for Food & Agriculture, Peshawar (Dr Ismail, Director) - Agricultural Research Institute, Tarnab (Mr M Mohibullah, Plant Pathologist)
Wed	22 June	Visited NWFP Agricultural University, Peshawar (Dr Naseer Hussain, Professor, Dr Jahangir Khattak, Professor Dr Sher Akbar, Professor and Dr Mohammad Siddique, Director) - Pakistan Forest Institute, Peshawar (Mr M Ismail Chaudhri, Director of Entomology)
Thurs	23 June	Discussions at PARC HQ, Islamabad
Fri	24 June	Free
Sat	25 June	Travelled to Faisalabad, Hotel Serina
Sun	26 June	Visited University of Agriculture, Faisalabad (Dr M Rafiq Khan, Dean and Dr Manzoor Ahmad, Assoc Professor) - Ayub Agricultural Research Institute - Plant Protection Institute
Mon	27 June	Visited Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad (Dr SH Mujtaba Naqvi, Director) - Travelled to Karachi - Taj Mahal Hotel

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Tues	28 June	Pesticides Research Laboratory, Karachi (Mr MMH Baig, PSO)
		- H.E.J. Institute of Chemistry, University of Karachi (Dr ZH Zaidi Professor)
Wed	29 June	Jaffer Bros. Ltd, Karachi (Mr John Chandler, General Manager)
		- Pakistan Agricultural Pesticides Association (PAPA) (Mr Tahreem Malik, President)
		- Plant Protection Department, Malir Halt (Dr A Kafi, Director)
		- Travelled to Islamabad
Thurs	30 June	UNIDO, Islamabad
		- PARC HQ, Islamabad
Fri	1 July)	
Sat	2 July)	Reading/Report preparation
Sun	3 July)	
Mon	4 July	PARC HQ, Discussions of the report
Tues	5 July	Lahore/Rice Research Institute
		- Rice growing area and pesticide distributers accompanied by Mr Tahreem Malik, President PAPA
Wed	6 July	UNIDO, Islamabad
		- PARC HQ, Islamabad - discussions
Thurs	7 July	Travelled to Vienna
Frid	8 July	Debriefing, Vienna

Notes of visits are in ANNEX III

ANNEX III

VISIT NOTES

Visit Notes (1): Quaid-i-Azam University, Islamabad
15 June 1988

Accompanied by: Umar Khan Baloch, PARC

Discussion with: Professor MH Qazi, Chairman (Head) of Biology Faculty

Dr MN Chaudhri, Assistant Professor and Specialist in Plant Taxonomy

Dr M Arslan, Geneticist

General

This is a post graduate university with courses leading to MSc, M Phil and PhD degrees, all a minimum of 2 years, the PhD usually taking longer. There are 7 faculties: Biology, Chemistry, Physics, Mathematics, Earth Sciences, Computer Sciences and Social Sciences. The MSc is a purely teaching course in which 16 courses must be taken and passed. In the Biology Faculty, which we were shown, 6 of the courses, viz. genetics, biochemistry, cell biology, ecology, evaluation and statistics are compulsory.

There are 40 MSc students, the top half of whom have scholarships. Generally there is a high level of subsidy. There are 150 doing higher research degrees (M Phil or Ph D) and 26 Faculty Staff, most engaged in, or controlling research work.

Biology Laboratories

These were well planned and extremely well equipped. Electron Microscope Jeol (Jem-100 sx), phase contrast, UV and many visible light microscopes of varying sophistication.

Analytical equipment including atomic absorption, infra red, UV, GLC and HPLC.

A working cold room, 4°C and a large storage cold room -20°C. Facilities for tissue and cell culture (plant and animal), lamminar flow cabinets, electrophoresis equipment, freezing microtome, facilities for radioactive synthesis (fume cupboard) and measurement - 2 modern Beckmann scintillation counters. Media automatic filling equipment, microorganism fermentation laboratory, a large laboratory with fish tanks.

A variety of research topics underway included topics in:

Molecular genetics - monkey studies and plant ecology.
Soil microbiology - N_2 fixation
fungal enzymes
association with plants

Fermentation
Fish biology
Plant taxonomy - Endangered flora

An impressive list of flora with specimens is held in the Faculty - with contacts in USA (Nat. Science Foundation) and UK (Kew & British Museum). There were no entomology research projects.

Clearly the Biology Faculty has the sort of excellent facilities needed for environmental science work including studying the fate of chemicals in plants, soil and water and the impact of chemicals on soil processes, and on plant, animal and aquatic ecology.

Visit Notes (2): National Institute of Health (NIH), Islamabad
15 June 1988

Accompanied by: Umar Khan Baloch, PARC

Discussions with: Dr A Ghafur, Director

Dr Motiur Rehman Khan, Chief Nutrition Division

Mr Maqsood Ahmed, Scientific Officer

This is a practical (medical aid) health unit, with laboratories, rather than administration. The Nutrition Division is concerned with food additives, food and water contaminants and related biochemical research.

The analytical laboratories are equipped for the analysis of trace metals, food additives, including colouring matters and preservatives, as well as pesticide residues. Water and food is checked for microbiological contamination. Water is also analysed for inorganic elements and associated anions. Although the staff members appeared to be competent analysts, the laboratory equipment would need up-grading if NIH was to be involved in more extensive and regular pesticide residue analysis.

Pesticide residue analysis is not carried out routinely for monitoring purposes but only on a specific project allocation. The last major pesticide project was a Government and FAO sponsored monitoring study carried out in 1982/83 and the NIH results were reported in 1984 (Food Contamination Study and Control in Asia and Far East, Report RAS/078/NOR).

The overall FAO project also involved monitoring studies in India, Nepal and Sri Lanka. In Pakistan, 6 laboratories were selected for the study, namely NIH, Islamabad; PCSIR Laboratories, Lahore; PCSIR Laboratories, Peshawar; Government Public Analyst, Lahore; Plant Protection Institute, Faisalabad and Biochemistry Dept. of the Jinnah Postgraduate Medical Centre, Karachi. Due to administrative and other problems the work was finally carried out at the first two centres.

The report referenced above describes the NIH work only. The results were discussed with Mr Ahmed, one of the scientists involved.

The food was analysed for pesticide residues, metal contaminants, aflatoxins and microbial contaminants. Six major classes of food were screened and they included raw, cooked, processed, repacked and imported, collected from various areas of Pakistan.

The results for pesticide residues showed there to be no significant problem for those pesticides analysed and most heavily used in Pakistan (viz. from the chlorinated hydrocarbon and organophosphate groups). Residues commonly found were DDT, Dieldrin, HCB and Methyl Parathion. Occasional residues of Dieldrin and HCB exceeded the codex recommended maximum residue limits (MRLs). However, large safety factors are normally involved because of processing and dilution with other non-pesticide residue bearing food so that ADIs would be unlikely to be exceeded in the actual dietary intake. Nevertheless the study was unsatisfactory as the source of the food items was mixed and unspecified in the report. Greater thought and planning would need to be put into this aspect in any further residue monitoring study.

Food items, notably raw grains, pulses, condiments, spices, vegetables, fruits and fish were analysed for lead, cadmium, nickel, mercury and arsenic. This limited study seemed to show that most of the metals present in the food were below WHO published acceptable levels.

Cereal, maize, pulses, condiments and sweetening agents were analysed for aflatoxin. 6% of the samples (maize and red chillies) were found to be contaminated, with 4 samples of maize being above the WHO limit of 30 ug/kg.

Obviously aflatoxin levels (and other mycotoxins) in food can vary year to year according to environmental factors and farming practice. It is consequently difficult to draw conclusions from this particular limited study, except that it indicates that problems could occur in the future and a regular monitoring program for the common mycotoxins should be set up.

Dairy products, meat, poultry, eggs, fish, vegetables, bread, water, soft drinks and other items were analysed for microbial contamination.

Over 40% of the food items were found to be contaminated. Common organisms were of fecal origin and included Escherichia coli (48%), Staphylococcus enterdis (20%), Clostridium perfringens (13%) - surprisingly no Salmmonella nor Shingela were found. E. coli is not always pathogenic but can cause diarrhoea and be enterotoxigenic. Many spores of Clostridium perfringens survive cooking. From this limited survey it is clear that bacterial contamination of food is a more serious problem than pesticide residue contamination, and one that can only be corrected by better food hygiene and inspection.

Visit Notes (3): Commonwealth Institute of Biological Control (CIBC), Rawalpindi
16 June 1988

Accompanied by: Mr Mohammad Mumtaz, PARC

Discussions with: Dr A Ikram Mohyuddin, Head of the Institute

Dr Riaz Mahmood, Entomologist

The Institute is now affiliated to the Pakistan Agricultural Research Council and is renamed PARC-CIBC Station, CAB International Institute of Biological Control. It is part of an international Group of Institutes (Director, Dr DJ Greathead) in Kenya, Malaysia, Trinidad, Switzerland and England (Imperial College, Silwood Park) as well as Rawalpindi.

The Rawalpindi Institute is concentrating on Integrated Pest Management (IPM) schemes for controlling pests of mango, apple and sugar-cane. A management scheme for controlling the 3 major pests (scale insects, fruit flies and mealy bugs) which was developed there is interesting, because it nicely demonstrates the use of different techniques for the 3 pests, viz. introducing parasites of scale insects, which survive in the absence of insecticidal sprays. Pheromone for the fruit fly and mealy bugs are controlled by cultivating or disturbing the soil at the foot of the trees, where the eggs are laid. It was also discovered here that the eggs and larvae of an important parasite of pyrilla attacking sugarcane, were destroyed during the common practice of burning the cane trash.

A PhD student there was studying the life cycles and plant habitat relations of 3 different species of heliothis. Attempts were being made to culture the "Russian aphid" a growing problem on wheat in the USA, but so far not in Pakistan. Dr Ikram felt the Institute could be of greater assistance to farmers (in saving money spent on pesticides) but was acutely short of project funding.

Visit Notes (4): National Agricultural Research Centre, Islamabad
15 and 19 June 1988

Accompanied by: Mr Mohammad Mumtaz

Discussions with:
Dr C Inayatullah (Entomology)
Dr A Jabbar (Toxicology)
Dr I Ahmad (Crop Diseases)
Dr Z Hameed Hashmi (Equipment & Maintenance)
Mr N Ahmed Chaudhry, Pest Warning & Quality
Dr Muzzafer (Soil Microbiology) (Multan)
plus others.

The Research Centre was opened in 1984. There are a total 331 graduate staff, 51 of whom have PhD and several absent abroad on PhD courses. There is a good library with subscriptions to, or donations for the key journals and an information service.

Main activities are research, technical support and administrative sevices.

Most time was spent in the Crop Sciences Division.

The Entomology Section (Dr Inayatullah) is split into 5 units, Host Plant Interaction, Computer Modelling (forecasting), Toxicology and Environmental Protectin, Integrated Pest Management and Ecology and Behaviour.

The Toxicology Unit (Dr Jabbar) is concerned with resistance, non-target organisms, pollution,alternative pest control agents. The Ecology Unit (Dr Martin) is concerned with the ecology of major insect pests of fruit and vegetables and control measures.

Soil Microbiology (Dr Muzzafer) is involved in soil fertility (Nitrification), water stress and organic matter recycling. The last in association with Soil Physics, also concerned with soil salinity problems.

The Food Nutrition Group provides a service in determining protein in cereals (also amino acid analysis) oil quality of oilseed and advises farmers regarding quality. There is equipment for milling of wheat grain (100 g sample minimum) and for baking and also dehusking and polishing rice.

Weed Science mainly concerned with weeds of cereals (most serious carthemus oxa-cantha, Johnson grass and wild oat). Also carry out residue analysis in soil for herbicide residues (GLC available).

Cytogenetics Unit started 1 year ago. Attempting development of rust resistant wheat, drought resistance, seedless fruit and improved oil-seed crops. Tissue culture being used to obtain salt tolerance in wheat and virus free potato stock.

The laboratories were generally well equipped, the major instruments being serviced centrally by a group of engineers under Dr Hameed Hashmi. Amongst the major pieces of equipment were 2 electron microscopes - transmission and scanning (Jeol), 2 GLC (electron capture and flame ionization), 1 HPLC (UV detector), Beckman automatic amino acid analyzer, NMR oil seed analyzer (non-destructive), lamina flow cabinets, microscopes etc.

There is a Training Institute on the site as well as separate Institutes for Animal Sciences, Farm Machinery and Natural Resources, Water Management and Honeybee research are among the topics covered by the Natural Resources Institute.

It was clear from this visit and discussions with staff that there are a number of scientists with the required training and expertise to form the nucleus of a new department within Plant Sciences Division which could be responsible for Ecotoxicological work. At the moment the expertise is spread across several of the existing departments, as is the scientific equipment.

Visit Notes (5): Environment & Urban Affairs Division
Economic Affairs Division
20 June 1988

Accompanied by: Mr Umar Khan Baloch

Discussions with: Mr Shamsul Haq (Environment)

Mr Ghafur Mirza (Economic Affairs)

The project and current thinking was outlined at the meetings in both Divisions.

Mr Shamsul Haq thought there was a need for better control of pesticides during manufacture, sale and distribution and better labelling and instruction for farmers. He thought pesticides banned in the manufacturing country should be banned in Pakistan. The problems involved in this approach, namely relative risk and benefits, were discussed in some detail.

In discussions of the present assignment he expressed the view that the investigatory laboratory (Ecotoxicology) would be best attached to PARC and probably located in Islamabad. This certainly accorded with current thinking.

Mr Shamsul Haq was also concerned about the import into Pakistan of other (non-pesticidal) chemicals and the lack of adequate control or monitoring. The development of such control (notification) procedures in Europe and USA was outlined.

In the meeting with Mr Ghafur Mirza the relationship of the present project with the preceding proposals (Dr Sadar, Canada) were discussed. It was emphasised firstly that the proposals following the current review would be more practically orientated in terms of actual expertise, equipment, training needed to get a small unit operating. A larger, more sophisticated structure could be developed slowly if sufficient need arose and once the relevant expertise and understanding had developed.

Secondly, that the Environmental Affairs Division had concluded that such an operating (Ecotoxicology) unit would best be attached to the PARC organisation.

He told us that, at that monent, the Canadian proposals had not been progressed because of the complexity of the issues and uncertainty of where (in which Division/Ministry) the responsibilities for it should lie.

We agreed that it would be better to await the recommendations from the current project before going further. These could be made during the final few days of the assignment in Pakistan.

Visit Notes (6): Agricultural Research Institute (ARI) and Nuclear Institute for Food & Agriculture (NIFA), Tarnab, Peshawar
21 June 1988

Accompanied by: Mr Umar Khan Baloch

ARI: Discussion with: Mr Mohibullah, Plant Pathologist

One of the oldest Agricultural Institutes in the country - established around 1930. Mainly directed to solving practical farming problems. Assistance to farmers in disease indentification, soil analysis. There is a limited amount of analytical equipment in the soil chemistry and an insect museum, Apart from some work on the Mexican beetle and resistant varieties (fruit and vegetables), most of the work is field orientated; entomology, plant pathology, botany, statistics and horticulture sections. There is little work here related to pesticides.

NIFA: Director: Dr Mohammad Ismail
Head of Entomology: Mr Sana Ullah Khattak

The institute is one of 3 such research centres attached to the Pakistan Atomic Energy Commission and was completed as recently as 1982. There is a brochure available, and an Annual Report is published. 30 scientists with supporting staff of 80. Research is in 4 main divisions; Food Science, Mutation Breeding, Entomology and Soil Science.

Food Science problems include radiation techniques for preserving grain, inhibiting sprouting of potatoes and onions, food engineering, solar dehydration. Food analysis (eg.. automatic amino acid analyser).

Entomological work is with fruit fly control (Pheromone traps), male sterility techniques and termite control in sugarcane (8000 acres of sugarcane destroyed by termites in the Mardan district). Endrin (supposedly banned) and Lorsban have been used in erradication programmes.

Soil Science work includes studying nitrogen fixation - soya bean and sugar-beet - attempts to innoculate alternative strains of bacteria. The analytical laboratory is well equipped for trace metal and other types of soil analysis.

Mutation Breeding - Seed radiation to provide improved varieties of wheat (shorter stem, rust resistance and higher yielding), mung bean, chickpea. Tissue culture with potato coleoptiles - aim to provide virus free stock.

There was an efficient technical service unit providing engineering, woodwork and glassware repair and construction facilities, as well as a library with approximately 80 relevant journals taken. Although some of the work has evolved into non-nuclear, this is because the staff (eg. entomologists) are available and knowledgeable in the particular local problems. The institute tends to address itself specifically to the local problems and farming needs of the province (NWFP).

About 200 students have carried through PhD studies at the Institute since its inauguration 5 years ago. The establishment is very well run and directed with excellently qualified staff and facilities.

Visit Notes (7): NWFP Agricultural University, and Pakistan Forest Institute, Peshawar
22 June 1988

Accompanied by: Mr Umar Khan Baloch

Discussions with: Professor Hanif Qazi

Dr Naseer Hussain (Chairman Plant Protection Dept)

Mr Mohammad Siddiq - Director of Research

Dr Said K Khalil, Assoc. Professor Plant Protection

Dr JK Khattak, Soil Science

Dr Ismail Chaudhry, Director, Entomology, Forest Institute

The University is mainly concerned with teaching and the facilities and equipment in the laboratories for research was inadequate. There were the basic instruments in the Soil Chemistry Department and some clinical (blood) analysis and automatic amino acid analysis equipment in the Chemistry laboratory servicing the Food Nutrition Department.

Mr Siddiq is responsible for coordinating the research projects related to agriculture throughout the province. A project on environmental pollution of pesticides had been proposed (but not approved for 1988) - it may receive approval for 1989. Otherwise there are few projects related to pesticides.

According to Dr Khalil it is still possible to buy banned pesticides in Pakistan (eg. Endrin, Toxaphene, Parathion). Farmers are mainly small holders (max. 5 acres) and often with no idea how to use pesticides; even the quantities and how to mix to give the proper spray concentration. There is no check on what is used and how it is used. He said that farmers were sold any product which they were told by the local dealer would be effective - products may be on the shelf for years without checks. The main problem was lack of education and control. He thought that environmental matters were of little significance compared with controlling the sale, distribution and use of pesticides on the farm.

Dr Chaudhry (Forestry) used pesticides (eg. Dimlin) to control leaf eating insects in the nursery plantations (1/20 of total plantation in a 20 year felling cycle). This serves to control the pest population which is found mostly on the seedlings and younger trees. Felled logs are treated with Dieldrin to control powder - post beettles.

Visit Notes (8): University of Agriculture, Faisalabad
26 June 1988

Discussion with: Dr M Rafiq Khan, Dean

Dr Manzoor-ul-Haq, Prof. Entomology

Dr Rana Zahoor Qamar, Director, Agric. Training Institute

The university started its life in 1907 as an Agricultural College - then the only one of its kind on the sub-continent. In 1961 it was made a University - Presently 4500 students and over 400 teaching staff (1/4 with PhD mostly from abroad).

There are 4 broad areas of teaching, viz. Agriculture, Animal Husbandry, Veterinary and Agricultural Engineering. Research is carried out leading to MSc (2 years) and PhD (a further 2-4 years). M Phil is provided in the basic sciences.

Some recently acquired expensive equipment (atomic absorption, GLC and spectrophotometer "Perkin Elmer") was sitting in a laboratory waiting for the supplier to explain how to use it. It had been acquired in order to carry out pesticide and trace metal analysis for human safety evaluation.

I was interested to meet there, by chance, Dr Rana Zahoor Qamar, Director of an Agricultural Training Institute at Salgadla (?) about 60 miles from Faisalabad. This institute runs a 2 year agricultural training course leading to a diploma. Intake are mainly matriculated students (10 years schooling) and the diplomates usually take jobs as extension officers. The institute also runs refresher courses of 2-8 weeks with some farmers. Various people are invited to give talks, including representatives from PAPA, Universities and PARC. Safety aspects are a small part of all these courses. There are 3 such Training Institutes in Punjab and similar Institutes in the other Provinces.

Visit Notes (9): Plant Protection Institute, Faisalabad and Ayub Agricultural Research Institute, Faisalabad
26 June 1988

Accompanied by: Dr M Ahmad, Agric. Univ.

Discussions with: Mr Siddique (PPI) (The Director is Dr MA Halimi)

Both Institutes, attached to Punjab Plant Protection Dept, Ministry of Agriculture, are involved in efficacy trials on new pesticides for registration purposes.

Main crops involved are cotton and rice, but trials also on vegetables, maize and fruit - predominance of work on insecticides - 30 scientists at Plant Protection Section of Ayub Agriculture Research Institute. The Plant Protection Institute, where most of the time was spent, does laboratory assays on pests using leaves from treated plants comparing the performance of new products with standards, as well as field trials. 70 new products to be tested this year in the field (3 scientists, entomologists) number of products is growing each year. There are well equipped analytical laboratories at the PPI - at the moment used for quality control analysis - a.i. content and formulation properties, mainly for registration purposes. Separate labs for conventional analysis, physical methods, instruments (Hitachi, UV, IR + GLC, Cambridge GLC, Beckman HPLC). Some samples from the market, suspected of being sub-standard, are also submitted for analysis - usually following reports from farmers.

The Institute (PPI) also runs 15 day crop protection training courses mainly for farmers (from medium size 5-10 ha farms) and extension officers - the courses include training in safety. PPI is presently situated in old laboratories but there are plans for a new building of 17,000 sq ft with 1000 sq ft of glasshouse.

When completed the laboratory will continue its present functions but in addition will handle crop residue analysis both for registration and monitoring purposes. It is also intended to carry out environmental analysis (soil and water) - persistence studies.

The Institute will be supported in its work by 2 smaller laboratories, one situated at Multan and the other close to Lahore.

The total cost of the 3 laboratories and new equipment is budgeted at Rs 20 million.

Visit Notes (10): Nuclear Institute for Agriculture & Biology (NIAB)
27 June 1988

Accompnied by: Dr M Ahmad, Agric. Univ. (Assoc. Prof Entomology)

Discussions with: Dr SH Mujtaba Naqvi, Director

Dr Munir Ahmad Bhatti, PSO

Dr Jamil Oureshi, Chemist

Dr Altaz Hussain, Chemist

This institute is a sister institute to that in Tarnab, Peshawar (see Visit Notes 6) and comes under the Pakistan Atomic Energy Commission. It was inaugurated in 1972. Its main achievement was the introduction of a new cotton variety (NIAB-78) which by 1985 accounted for half the area under cotton in Punjab. That year alone it was said to have produced an additional income which completely offset all the expenditure so far incurred on all 3 Nuclear Institutes.

The research activities are reported in "Fifteen years of NIAB" which is its third five year report. Major problems researched are Mutation Breeding, Entomology (integrated approach, grain disinfestation), Biological Chemistry (food irradiation, constituents of aroma of rice, pesticide metabolism and soil bound residues, salt tolerance etc.) Soil Science (nitrogen fixation, nutrition etc.).

Of most interest was the work with ^{14}C and tritium labelled pesticides, some of it sponsored by IAEA and WHO. Malathion and Carbofuran bound resdues in soil (Dr Hussain). Fate of Chlorinated Hydrocarbons in soil. ^{14}C - residues from monocrotophos in meat, milk and related products of livestock. Fate of ^{14}C - Azadrin on treated cotton plants (in field) and analysis of oil and other fractions (Dr Ouresni); studies on a slow-release pesticide formulation in cotton (Dr [Mrs] Farshat Jamil) - work sponsored by industry. The laboratories were extremely well equipped although overcrowded (shortly to move to a large new building). There were 3 scintillation counters, 1 the latest Packard with computer, a Packard automatic oxidiser, numerous GLC with every type of detector, HPLC with UV detector, spectrophotometers, infra-red, Variant atomic absorption etc. The only significant piece of equipment missing was a mass spectrometer linked to GLC for metabolite identification. It was hoped to acquire one (cost $300,000) in the near future. At present samples are sent to Karachi for identification.

Visit Notes (11): Pest Management Research Institute (Pesticide Lab), University Campus, Karachi
28 June 1988

Discussions with: Mr MMH Baig (PSO) and

Mr AR Kazmi (SO)

The laboratory, situated close to the Research Institute of Chemistry, belongs to PARC and does mainly pesticide quality control (chemical analysis and physical measurements) - 5 scientists, biological research in genetic toxicology - 6 scientists and just starting pesticide residue analysis - 3 scientists.

The last is a separate lab from quality control. Analytical equipment comprises GLC, HPLC, UV and IR spectrophotometers. Mr Baig is planning to expand the residue analysis facilities.

He is involved in the registration process for pesticides and is a member of the Advisory Committee (APTAC) and also the technical sub-committee. We discussed the registration process and some of its short-comings.

Mr Baig is mostly concerned that there is little or no policing of the regulations regarding pesticides (a point made several times by others interviewed). Some of the technical committee members are concerned that more formulated mixtures of a.i.'s are being registered, eg. cypermethrin - dimethoate, cypermethrin - monocrotophos, decis - dimethoate, cyfluthrin - metamidaphos etc.

He felt that such mixtures introduced new concerns (a) More likely to cause resistance, (b) Little economic justification and will result in unnecessary use of one of the a.i.'s on frequent occasions, (c) Little is known about possible potentiation of toxicity.

I told him that as far as the last was concerned it was most important to ensure the acute toxicology package (oral, dermal, skin and eye irritation and sensitisation) had been carried out on the actual formulation to be marketed and the data had been properly evaluated. It was not necessary to evaluate the long term (chronic) toxicity of such mixtures.

Visit Notes (12): HEJ Research Institute of Chemistry, Karachi University
28 June 1988

Discussions with: Dr Zafar H Zaidi

The Institute is about 20 years old and under the directorship of Prof Salimuzzaman Siddiqui, who at 91 years old is still active in the laboratory. The co-director is Prof Atta-ur-Rahman an ex-Cambridge fellow. There are about 80 students doing M Phil or Ph D in isolation, structural and synthetc studies on proteins, alkaloids, terpenes, steroids, flavenoids and other pysiologically significant constituents of plant materials and insects. The Institute has a large scale (up to 50 l) synthetic and extraction laboratory, all newly and fully equipped. Helium and nitrogen liguefaction is carried out and the lab has an independent (constant voltage) electricity supply. There are 6 or 7 fully trained technicians (trained abroad) with expertise in handling a tremendous range of sophisticated physical techniques and equipment, viz. 4 NMR spectrometers, 3 Bruker (one 400 MHZ, two 300 MHZ) and one Jeol (60 MHZ). A Bruker 600 MHZ may be procured in the near future.

There are 4 mass spectrometers, 3 of which are double focussing instruments, Varians, linked to 2 computer systems. Gas chromatographs are attached to 2 of the Varians (MAT 112 and MAT 311) to allow GCMS measurements. Other major instruments include an amino acid analyser (Biotronik), amino acid sequencer (Applied Biochem) and several analytical and preparative HPLC, GLC, IR. UV spectrophotometers etc.

Pharmacology equipment has been ordered from a 1 million grant from UK. There is an adjacent animal house (rats, mice, guinea pigs) and simple experiments are carried out to elicit the pharmacological effects of the plant extracts and synthetic compounds.

Most of the funding has come from Germany, Japan and UK.

The Institute has been offering an instrumentation service to all the universities and research organisations in Pakistan - as well as training facilities.

Visit Notes (13): Plant Protection Dept. Min Agric., Karachi
29 June 1988

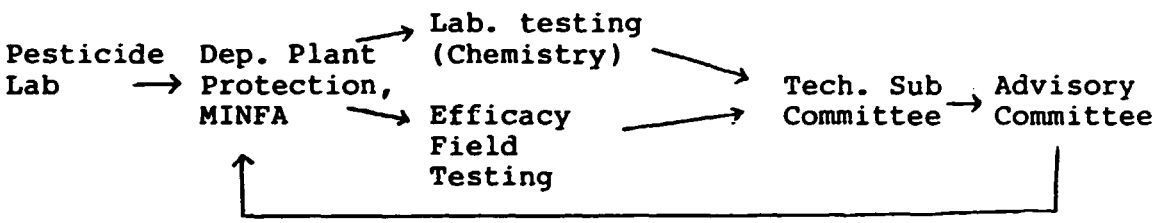
Discussions with: Dr A Kafi (Director)

Dr Kafi is Chairman of the technical sub-committee and Secretary to the Advisory Committee (APTAC) of the Federal Min. Agric. which deals with new pesticide registrations.

He outlined the present system which takes about 3 years and includes 2 years field efficacy trials.

In theory the procedure should take 4 years because products should go for efficacy trials only after checks and quality control analysis of the formulation have been done (because of waiting time this can take up to 1 year). However, most companies arrange with the appropriate institutes for the biological trials to be undertaken whilst the product is awaiting analysis.

There must be a minimum of four efficacy trials, two in different provinces in two season. Within each province there is a technical review. The technical committee reviews the field trial data and makes recommendations to the provincial advisory committee. The committees from the two provinces then report to the main subcommittee, chaired by Dr Kafi. The full procedure is shown schematically thus.



Dr Kafi complained that there was not adequate technical review of the data because the system was inundated with products and there were no people to review the data and too few to carry out field and laboratory work. Because a large number of institutes and University departments were carrying out the field trials there was no proper channel for organising this work and companies tended to make their own contacts and often set up the trials themselves.

Products were being registered if companies presented copies (even summaries) of published toxicology data, regardless of whether they owned the data, or had permission from the originating company to use it (ie. Regardless of whether it was their own industrial property - see Willis, Ref. 19). The problem of proprietary data on old pesticides was discussed in some detail.

We also discussed the special problem of the registration of mixtures of active ingredients (see Visit Notes 11).

Dr Kafi was also concerned that the Pesticide Law was not being properly implemented because of the inadequacy of the monitoring (policing) system eg.

1. Nobody safeguarding the consumer by checking products in the market place - which could be adulterated, diluted, labels changed etc.

2. There are 2800 registered pesticide dealers in Pakistan and many others who are selling pesticides illegally - it is with the latter that the problem largely lies.

3. Inadequate extension service for advising the small farmer.

4. No checks on what the farmer was applying - whether to the crop for which the product was registered or otherwise.

5. No monitoring of residue levels on the food crops.

6. The climate prohibits the use of protective clothing, and gloves etc. can often do more harm than good in these circumstances.

Visit Notes (14): Jaffer Bros (Private) Ltd and ICI (Pakistan) Ltd
29 June 1988

Discussions with: Mr John Chandler (General Manager)

Mr M Ahmed (Entomologist) and

Mr T Malik (Chairman of PAPA)

Jaffer Bros. have the largest number of registered pesticides in Pakistan. They thought too many products were now being registered, one solution suggested was to put an embargo on registering pesticides for 3 years (I can drive - stop issuing driving licences attitude!).

They thought mixtures should not be registered, simply because of the lack of need of the second constituent (a.i.) in many cases and the unjustifiable excess use of it (unecessary food residues and environmental exposure) - point (b), as discussed with Mr Baig (Notes 11).

There was insufficient policing of products in the market and they would welcome more checks on quality.

Poor service to the farmers due to poorly trained extension officers. Field trial work was considered to be poor and standards inadequate.

There should be better control of products imported into the country. Material was coming from Taiwan, Korea, China which was not registered. According to Dr Kafi (later) there are economic considerations - often they are cheaper and if they meet analytical specifications of registered products then there is a strong incentive to permit entry. However, the present quality control methods used in Pakistan would not detect impurities which might be present in significant amount and represent a toxicological hazard. (eg. the problems of using impure malathion some years ago in Pakistan, when several people died and thousands more were affected).

Mr Malik said industry was starting to help with training and felt that companies could do even more by allowing trained personnel to demonstrate application methods and safety procedures to extension workers and farmers.

He also said that some of the international companies already accept graduates from government and university for periods of training in field methods and other work such as residue analysis. He was sure that any application from the Pakistan government would be favourably received.

Visit Notes (15): Rice Research Institute (RRI) and rice growing area, Lahore
5 July 1988

Accomanied by: Mr Tareem Malik (Chairman PAPA)

Discussions with: Dr Abdul Majid (Director of RRI) and several pesticide distributors.

RRI is situated in the rice growing area close to Lahore. There are about 40 scientists (entomologists, plant pathologists, physiologists etc.) studying the pests, diseases and problems of rice. The Institute is intimately involved with the local farming community and their problems. It was one of the few Institutes in the ccuntry which devotes a significant amount of effort into pesticides and the use of these products for controlling the various pest and disease problems. Insecticide granules applied at the seedling stage is the traditional practice but with the introduction of shorter strawed varieties it is now possible to use machinery for foliar spraying at later stages of growth.

Dr Majid complained that insufficient funds were provided to enable his staff to attend international meetings. Even when the funding is provided from abroad (eg. The International Rice Conferences) they are frequently unable to attend because the invitation usual goes to the Federal Government and by the time it reaches the Provinces and finally the Institute, the registration date has gone, or the meeting has already taken place.

He also expressed concern about pesticide residues in food and the fact that nobody was measuring how much residue was present. He was also concerned about the total lack of environmental studies on pesticides and strongly supported the concept of the establishment of a new laboratory and expertise to study both aspects.

Visits were made to several roadside pesticide dealers in the rice and vegetable growing area, to inspect their premises and to question them about procedures. Conditions were generally a lot better than I had anticipated from reading earlier reports.

I did not come across any shops which sold foodstuffs along with pesticides. The usual procedure is to sell spraying equipment, fertilizer and sometimes seed. The shops tend to be clustered together in groups; thus in one area there were three shops side by side with one across the road, all selling similar products from a variety of manufacturers. Insecticides were the main products - methyl parathion, and several pyrethroids seemed to be widely on display, but also some fungicides and rat poisoned bait (zinc phosphide).

Several distributors told me that it was very rare for retailers selling foodstuff to also sell pesticides. Generally the pesticide distributor specialises in pesticides/fertilizers. Occasionally non-professional retailers who are buying produce (mainly vegetables) from the farmer might occasionally hold a stock of pesticides which they sell back to the farmer - thus acting as a middle man. According to what I was told this was quite rare, since most farmers prefer to go to the authentic pesticide dealers who also provide much technical advice.

According to several dealers they know the farmers well and would not sell a product like methyl parathion to a non-farmer or to someone for domestic use. Most of the dealers attend training courses and farmer meetings - where products are discussed. Many are providing the role of extension officers by advising the farmer what to use, when to use it and how much to use. One actually employs a retired scientist from RRI to provide this technical service - including inspection of the crop and checking the results. Payment is sometimes not made until the results (dead insects) have been seen.

Most admitted that some adulteration of products does take place and illegal procedures - such as refilling an empty pyrethroid container with a DDT or cheaper product. This malpractice would not be carried out by the well established dealers, who have contracts with the major companies, otherwise they would quickly lose the confidence and trust of the farmer and would also lose their agency contract. One agent told me that if the expiry date printed on a label had expired the product might be sold with discount. Products, whose dates have expired, are occasonally returned to the manufacturer (for quality checks). Once a farmer buys a product he invariably uses it fairly quickly - he tends to buy "on need" and not in advance. Previously they used to obtain products on credit - paid when the produce was harvested and sold. Under a new system agreed by all distributors, they have to pay immediate cash for products, so there is now much less holding of stock.

All the dealers confirmed that no special precautions are taken by the farmers when they handle and use the products and there are occasional poisonings and illnesses reported. Granules are applied by bare hand and workers in the paddy fields would have bare feet. There was a recent local incident (non-fatal) involving carbofuran.

ANNEX IV

PROJECT CONCEPT

ANNEX IV

PROJECT CONCEPT

1. Title: The establishment of an "Ecotoxicology Centre" for monitoring environmental pollution due to pesticides in Pakistan.

2. Country: Pakistan

3. Duration: 1-2 years

4. Development objective: The objective is to develop an organisation, laboratories and the necessary expertise to measure and monitor environmental pollution due to pesticides in Pakistan. Once established, such facilities and expertise could be extended to monitor the impact of other potential pollutants on the environment of Pakistan.

5. Immediate objective: To establish a central laboratory "Ecotoxicology Centre" within the PARC organisation and located at the National Agricultural Research Centre, Islamabad. The central laboratory would be supported by four smaller satellite laboratories, one in each of the provinces. Their function would be to monitor pesticide residues in plants, animals, soil and water to study the potential for degradation, persistence, leaching or accumulation. They would also assess the effects of pesticides on non-target organisms, soil fertility, beneficial species, aquatic organisms and wildlife.

6. Background information: See this report and references cited.

7. Outputs expected: The generation of data on pesti-pesticide residues in human food and the environment on which an assessment of potential hazard or future problems can be based. This should also lead to better understanding of the possible long term harmful effects of certain pesticides so that measures can be taken to avoid or limit their use.

   The expertise developed on the environmental aspects of pesticides would be available to advise on specific accidents or incidents involving environmental pollution which might occur in Pakistan in the future.

8. Inputs required (in terms of experts, equipment, training, etc.) and approximate budget:

   (a) Laboratory space and resource needs - Refer to Annexes V and VI.
   [The amount of new building and numbers of new personnel required will depend on what can be utilised from existing facilities and staff, particularly at the NARC Islamabad.]

   (b) Equipment - Refer to Annex VII.

   (c) Experts and training needs - Refer to pp 31-32 - main report.

ANNEX V

ECOTOXICOLOGY RESEARCH ORGANISATION AND MANPOWER

ANNEX V

ECOTOXICOLOGY RESEARCH ORGANISATION

Director (PARC)

CENTRAL LABORATORY*

Joint (Lab) Director + secretary

	Residue Analysis	Metabolism	Soil Ecology	Beneficial Insects	Wildlife	Technical Support	Provincial Laboratories (see next sheet)	Total Staff
								Director 1
PSO	1	1	1	1	-	-	-	4
SSO	4	2	2	1	2	1	8	20
SO	4	2	2	2	2	-	16	28
L.Asst	4	2	2	2	2	-	16	28
	Analytical Chemists	Chemists or Biochemists trained in radiotracer techniques	Micro-biologists & Entomologist	Entomologists	Zoologists	Chemist or biologist	Technical	80
						Secretary/ typist - 3 Clerks - 2 Drivers- 2	Non - Technical 12	19
							TOTAL	100

* Central Laboratory 12,000 sq ft + 1000 sq ft Glasshouse

ANNEX V

PROVINCIAL LABORATORY* (in each Province)

	Residue Analysis	Ecology	Non-Technical
PSO	-	-	-
SSO	1	1	-
SO	3	1	-
L. Asst	2	2	Typist/clerk driver, 3

* Each Provincial Laboratory 2000 sq ft

ANNEX VI

DEFINITION OF WORK AND LABORATORY REQUIREMENTS

ANNEX VI

DEFINITION OF WORK AND LABORATORY REQUIREMENTS

	Central Laboratory	Function	Laboratory Needs
1.	Residue Analysis	Analysis of pesticide residues in plants, animals, soil, water	1. Walk in cold room ($-20^{o}C$) for samples. 2. One sample preparation room - for chopping, cutting, sieving etc. 3. Two processing labs with fume cupboards. 4 Two instrument rooms **Total = 3000 sq ft**
2.	Metabolism (Radiochemical) Section	Use of radiolabelled pesticides to study their fate (degradation) in plants, animals, soil and water Soil leaching studies Photolysis in water and on soil surfaces	1. Main laboratory for radiochemical work 2. Dark room 3. Instrument room 4. Constant temp. room for soil work 5. Glasshouse **Total Lab = 2000 sq ft** **Glasshouse = 1000 sq ft**
3.	Soil Ecology	Effects of pesticides on soil microbiological processes, nitrification, organic matter decompostion . Also on soil fauna microarthropods, earthworms and flora	1. Main laboratory 2. Dark room 3. Instrument room **Total = 1000 sq ft**

ANNEX VI

	Central Laboratory	Function	Laboratory Needs
4.	Beneficial Insects Section	Effects of pesticides on predator insects, honey bees and other non-target or beneficial insects (Lab and field) Acute oral and contact toxicity to bees and field evaluation of bee and predator activity	1. Main laboratory 2. Insect rearing room 3. Outside bee facility 4. Share of glass house **Total = 1000 sq ft**
5.	Wildlife Section	Effects of pesticides on fish and aquatic organisms Accumulation and metabolism studies in association with metabolism section. Birds and small mammals Endangered species	1. Large open laboratory for fish tanks 2. Biological laboratory **Total = 1500 sq ft**
Offices		Archive and Offices for the technical staff secretary/typists clerks and drivers computer, photocopiers Toilets	Technical = 2000 sq ft Not technical support = 1000 sq ft **Total = 3500 sq ft**

Total Space Requirements = 12000 sq ft

Glasshouse = 1000 sq ft

ANNEX VI

Provincial Laboratories

	Section	Function	Laboratory Needs
1.	Residue Analysis	As for Central Laboratory but entirely associated with the Province. To assist the Centre in arranging local trials, collecting, storing and analysing samples	1. Sample preparation room 2. Processing Laboratory 3. Instrument room **Total = 1000 sq ft**
2.	Ecology	To assist the Centre in biological work in the Provinces - mainly field work - on beneficial and non-target species. To collect, identify collate and store specimens and samples eg. soil cores and water	General biological laboratory **Total = 500 sq ft**
3.	Offices	For technical and none technical	**Total = 500 sq ft**

Overall Total in each Province = 2000 sq ft

ANNEX VII

INSTRUMENTS AND EQUIPMENT

ANNEX VII

List of Instruments and Equipment

Items	Number		Totals	Cost
	Centre	Provinces		
1. Vehicle for visiting trial sites and collecting samples	1	4	5	
2. GLC with various detectors	3	4	7	
3. HPLC with UV detector	2	4	6	
4. UV/Visible spectrophotometers	2	4	6	
5. Accurate balances	2	4	6	
6. TLC equipment and and scanners	2	4	6	
7. Spectrofluometer	1	-	1	
8. UV/Visible light microscopes	2	4	6	
9. Infra-red gas analyser	1	-	1	
10. Deep freezes	2	4	6	
11. Fish tanks and large glassware for flow through tests	10	-	10	
12. Fume extraction cupboards	2	4	6	
13. Automatic filling equipment	1	-	1	
14. Soil incubation system	1 set	-	1	
15. Computerised scintillation counter	1	-	1	

ANNEX VII

Items	Number		Total	Cost
	Centre	Provinces		
16. Automatic sample oxidiser	1	-	1	
17. TLC radioactivity scanner	1	-	1	
18. Office Equipment				
Word Processors	1	4	5	
Computer with several VDUs	1	-	1	
Photocopiers	2	4	6	
Electric typewriters	2	4	6	

Standard, less expensive equipment required at all five laboratories includes:

Centrifuges
Shakers
Macerators
Water baths
Incubators
Ovens
Rotary evaporators
Vacuum pumps
Autoclaves
Cameras and attachments
Refrigerators