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REGIONAL NETWORK ON PESTICIDES FOR ASIA AND THE PACIFIC

DP/RAS/85/023

PAKISTAN

Technical report: An Ecotoxicology Research  
Centre in Pakistan\*

Prepared for the Government of Pakistan  
by the United Nations Industrial Development Organization,  
acting as executing 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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\* This document has not been edited.

**ABSTRACT**

Title: An Ecotoxicology Research Centre for pesticides in Pakistan (DP/RAS/85/023)

Objectives: A one month assignment to assess the help and facilities needed to establish laboratories in Pakistan with the function of monitoring the fate and effects of the use of pesticides in Pakistan - as recommended in UNIDO consultant report DP/ID/SER.A/1043.

Conclusions: To meet the demands of society and protect the health of people and environment of Pakistan from the possible harm caused by the widespread and increasing use of pesticides there, it is necessary to establish an Ecotoxicology Centre to measure and evaluate the potential hazards.

Such a facility will take about 3 years to establish and to make the necessary impact would need a minimum of 57 personnel (47 scientists and 10 non-technical. It will cost approximately US\$ 1.68 million, of which \$ 0.7 million would be required from foreign resources. Much of the government contribution is in terms of laboratory buildings which are already available.

A UNDP Project Formulation Framework and Project Document have been prepared.

### RECOMMENDATIONS

1. Funding for the establishment of an 'Ecotoxicology Centre', with supporting laboratories in two of the provinces of Pakistan, be approved, essentially as set out in the Project Formulation Framework and Project Document.
2. Further expansion of these facilities in the future should take place at the provincial laboratories (in the heart of the agriculture areas) rather than at the centre, which would still act as the co-ordinator, source of expertise in new techniques, equipment and information and data handling.
3. Mr U K Baloch, currently Director of Crop Protection, PARC be appointed Director of the new facilities and to act as National Project Coordinator.

## I INTRODUCTION

The use of pesticides in Pakistan has increased very significantly (about 10 fold) in the past decade and last year about 4,000 tons of active ingredients (almost 90% insecticides) was applied to the land of Pakistan. At present there is no system or facilities in the country to monitor what happens to these chemicals after they have been applied and exerted their intended biological effect. Most are applied to food crops. What happens to them? Are they degraded or do they accumulate in soil or ecosystems? Can they have harmful effects on the health of man, farm animals, natural biological processes or wildlife? Major pesticide companies submit relevant toxicological and environmental data when new products are being registered, but this is largely laboratory derived data. Similar information on older products, largely used in Pakistan because they are cheaper, often do not have this information. Pakistan has extremes of climate - heat, irradiation humidity, rainfall; soil conditions from arid to irrigated and a tremendous variety of crops with associated environmental conditions. The fate and side effects of these pesticides needs to be evaluated under these variable practical situations to ensure overall safety and that a long term problem will not be created for future generations.

Following a consultancy visit in June 1988 (Report DP/ID/SER.A/1043. August 1988) recommendations were made that a new Ecotoxicology Centre be established within the control of PARC and located at the NARC, Islamabad and should be supported by at least four smaller laboratories in the Provinces. The Central Laboratory to be equipped and organised to study potential environmental and health problems related to pesticide use in Pakistan. The laboratories in the Provinces will monitor local pesticide residues in plants, animals, soil and water and assist the centre in carrying out local ecological field studies.

The recommendations of the report were accepted by UNIDO who proposed that foreign support for establishment of the laboratories in terms of equipment, training and expert advice should be provided.

A recent Project Management Committee meeting RENPAP (November 1989) endorsed this proposal and further suggested that the Ecotoxicology Centre in Pakistan could form a model to be followed by other countries of the region and used as a centre of expertise and training.

The present (return) assignment is to prepare a Project Formulation Framework and assist in preparing a Project Document for consideration by the Pakistan Government and foreign partner to enable the necessary funding to be made available.

This will involve assessing in detail the commitment and the contribution from the Government in terms of providing laboratory space, civil works and personnel necessary to establish and maintain these facilities and the expert consultancy and training requirements. Further, to take into account the activities, budgetary inputs in local and foreign currency needed to achieve the objectives. The job description is reproduced as Annex-I.

## II PROJECT FINDINGS AND DISCUSSION

### A Itinerary

Two weeks were spent in Pakistan using Pakistan Agricultural Research Council (PARC), Islamabad as duty station.

#### Return visits were made to:

National Agricultural Research Centre (NARC), Islamabad  
NWFP Agricultural University, Peshawar

#### Discussions were held with:

Mr Harold Dickherber	-	Agric Development Officer - USAID
Dr Bill C Wright	-	Manager Agric Research & Technical Project of USAID - Winrock
Prof Muhammad Haif Quazi	-	Head, Crop Sciences Div, PARC
*Mr Umar Khan Baloch	-	Director, Crop Protection, PARC
Mr Mohammad Mumtaz	-	Deputy Director (Pesticide), PARC
Prof Nural Islam Mian	-	PRO Vice Chancellor and Dean of Plant Sciences, NWFP Agri Univ, Peshawar
Dr Naseer Hussain	-	Chairman, Plant Protection, NWFP Agri Univ, Peshawar
Dr Said Khan Khalil	-	Assoc Prof Plant Protection, NWFP Agri Univ, Peshawar
Dr Everett Edington and others	-	Teaching Specialist (TIPAN Project, USAID)
Mr John Holden	-	Senior Ind Dev Field Adviser (SIDFA), UNIDO, Islamabad
Dr Chaudhry Inayatullah	-	Director, Pest Management and Ento (PSO), NARC, Islamabad
Dr A Jabbar	-	Head, Toxicology (SSO), NARC, Islamabad
and others		

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\* National Coordinator

**B** Laboratories - Locations - Local Support

**(a)** Central Laboratory

There are many advantages in having the central laboratory located at NARC, Islamabad, some of which were detailed in the August 1988 visit report.

- (i) NARC is already a centre for agricultural sciences with many areas of common interest eg soil microbiology, entomology, honey bee expertise, mammalian 'pests' etc.
- (ii) Share of back-up facilities such as technical library, information handling, training centre and technical support.
- (iii) Qualified scientists and technicians would be readily available.
- (iv) Ample laboratory space available and suitable with minimum modification.
- (v) High level of interest and support from staff members.
- (vi) Some relevant analytical and other equipment.

A discussion on the best facility and location to site the central laboratory was later held at the US Agency for International Development (USAID) headquarters with Mr Harold Dickherber. The latter wholeheartedly supported the overall project and some discussion was held as to the best place to locate the main laboratory.

He suggested several places and Institutes other than NARC, to start the project, viz NIH, Nuclear Institute (Faisalabad), Agricultural University (Faisalabad, Peshawar) but not run as a university project - all of which have been considered by the author and rejected for various reasons.

The advantages of NARC as a site (listed above) in my view outweigh any disadvantages, which should be capable of being overcome by proper planning, selection of staff and management control.

My recommendations -

- 1/ That the Ecotoxicology Centre should belong to MINFA under the control of PARC (as stated previously).
- 2/ Laboratory space be acquired at NARC (rented if necessary), but the project should be separately managed and not become part of NARC's research

portfolio.

- 3/ If possible existing staff from NARC be recruited for the Ecotoxicology Laboratory, so that the total number of Government employees is not increased.

This would necessitate cutting back on some of the existing NARC projects and/or reducing support levels.

**(b) Provincial Laboratories**

These would best be located close to the heart of the agricultural areas of each Province. The sites recommended are given below. In all cases the laboratories would be located at an agricultural university or government research institutes to take advantage of related crop protection expertise, resource and facilities, as described for the central laboratory.

The NWFP Agricultural University at Peshawar is an ideal location in the North West Frontier Province. This is a very fertile agricultural area with a variety of crops requiring less irrigation than other areas. There is much interest and support for the project from staff members in the Plant Protection Department of the Faculty of Crop Sciences and from other departments. The PRO - Vice Chancellor and Dean of the faculty (Prof Nural Islam Mian) was also highly supportive.

There is a large building programme underway supported (\$20m) by USAID (part of TIPAN\*) which will provide administrative offices, library and modern communications and training centre as well as new laboratories for plant sciences. I was assured that some of the laboratory space allocated for plant protection would be made available for the proposed Ecotoxicology project. The building is scheduled to be completed by mid 1991.

Funding of scientific equipment to start up this laboratory (approximately \$ 0.12 m) may also be obtainable from USAID (This needs to be confirmed).

The Agricultural University at Faisalabad, in Punjab, is also conveniently located close to the major cotton growing areas and other irrigated crops. Laboratory space for the project is available at the university, which is close to the Plant Protection Institute and also the Ayub Agricultural Research Institute. The Nuclear Institute for

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\* Transformation and Integration of the Provincial Agricultural Network



Agriculture and Biology, which utilises radiochemical techniques and is involved in several pesticide research projects, is also located at Faisalabad (see August 1988 visit report).

The Sind Agricultural University at Tandojam, close to Hyderabad, is a good location for the Sind Provincial Laboratory. Although there is related work in progress at the Pest Management Research Institute and the HEJ Research Institute of Chemistry, both located at Karachi, it was felt that Karachi is too far from the major agricultural areas of Sind and that Hyderabad is better situated in this respect.

The PARC Agricultural Research Institute, Sariab, Quetta is a convenient site for placing the Ecotoxicology Laboratory in Baluchistan province. This is again in the agricultural area of the province. Although I was not able to visit this Institute, I was advised that laboratory space may be made available there and the project has local support.

<u>Province</u>	<u>Location</u>	<u>Agriculture</u>
<b>NWFP</b>	NWFP Agricultural Univ., Peshawar	Mixed - vegetables, sugar, tobacco, rice. Mainly non-irrigated
<b>Punjab</b>	Univ of Agriculture, Faisalabad	Cotton, rice, sugarcane, maize, vegetables - much irrigation
<b>Sind</b>	Sind Agricultural Univ., Tandojam, Hyderabad	As for Punjab
<b>Baluch-istan</b>	Agricultural Research Institute, Sariab, Quetta	Fruit, cereals, vegetables Flat irrigation. Water pumped from deep canal system

At the start of the project, in order to keep costs to a minimum, it is proposed that only two provincial laboratories are developed. This will enable experience to be gained whilst keeping costs down. The first two sites selected should probably be in NWFP and Punjab. The other two provinces could be provided with laboratories during an expansion phase later.

### C Implementation Arrangements

Once the project is approved and funds made available it is proposed that the Director of the new enterprise should be appointed immediately. He will then be able to organise building requirements and laboratory modifications, negotiate for facilities in the Provinces, recruit staff, arrange for training courses and visits of foreign experts.

It is further proposed that Mr U K Baloch be appointed as the Director and in the 3 year development phase become the Project Manager. He is well qualified for this position and function for the following reasons.

- (i) He initiated the project and has a broad understanding of the technical requirements, having been on related study tours abroad.
- (ii) He is already a Director (Plant Protection) at PARC with a knowledge of national procedures and personnel at the cooperating institutes/university departments.
- (iii) He is familiar with UNDP/UN Agencies, procedures and personnel. He is currently National Coordinator for two UNDP sponsored Regional Network projects and also Project Manager for an FAO and World Bank project.

This would eliminate the need for a long term UNIDO expert (Chief Technical Advisor) who could be replaced by an expert (Ecotoxicologist) visiting for shorter periods and providing a project monitoring/progress service (say 6 instead of 24 man months).

The second major advantage of this arrangement is that a full time National Project Manager would be able to reduce considerably the risks of delays to the project (see below).

Alternatively the project could be allocated to Mr Baloch, along with the other commitments in his present job. However, it is felt that this added burden would be too great for him to manage even with the help of a UNIDO technical advisor. Consequently it is proposed that Mr Baloch be appointed as Project Manager to run the project on a full time basis. He would continue as Director of the Ecotoxicology Centre in government (PARC) employment at the end of the project development phase.

The most serious problem in establishing the project will be to gain government acceptance of funding the project once established after the 3 year development period. This will be made easier if it is possible to recruit existing scientists already in government employment. This in turn will involve arguing for the value of the project and establishing its priority over some of the existing NARC Projects.

There already exists a small Environmental Toxicology Section within the Entomology Research Laboratories at NARC, concerned with environmental pollution problems of pesticides. However, the section lacks the right expertise, training and resource to carry out its remit effectively. It is proposed that this section forms the nucleus of the new Ecotoxicology Centre, which should then recruit further suitable scientists from existing projects and expand into existing laboratory space at NARC. There is also a Weed Science Section which is involved in analysing herbicide residues in soil (see Visit note No 4. Annex III of Report DP/ID/SERA/1403). Although there is GLC equipment there is again lack of adequate expertise and integration into a proper pesticide pollution programme. This unit, together with the equipment could be profitably absorbed into the new Ecotoxicology Centre.

Broadly it is expected that establishment of the laboratories into a properly functioning unit will take about 3 years. A rough bar chart showing the approximate timing of the activities, needed to achieve the immediate objective indicated in the Project Formulation Framework, is given in Annex-VII.

It is expected that initially little or no new buildings will be required, but that existing laboratory space can be suitably modified. Nevertheless a sum (Rs 6.2m) is included for construction/sub-contracts which includes the amount that the required buildings would have cost to construct (at Rs 300/sq ft), glasshouse facilities and modification work as indicated in sub-section E3 below.

Details of training needs are given in Annex V. Most of the training will need to be done abroad but some expertise is available nationally at the Institutes indicated and maximum use should be made of this.

A list of visiting experts considered advisable, together with their job descriptions is provided in Annex-VI.

The chief technical adviser will be the Ecotoxicologist and 6 missions of one month each have been allocated (see Annex-VII). In the first mission he will advise the Project Manager on the planning and design of the laboratories and assist in manpower planning and more explicit training requirements.

During the second mission he will monitor progress of the project and re-assess manpower planning, training, equipment and experts who will visit during the later phases of the project. The later missions will be concerned with overall monitoring of progress of the project and helping resolve difficulties. He will assist in finalising procedures and performance requirements and advise on practical aspects of operations. He will also help to plan the initial research programmes of the new facility.

Most of the equipment required are standard items - costs are given in Annex III. It is recommended that major sophisticated

scientific equipment be purchased from reliable sources who provide a servicing facility in the country.

#### D Future Suggestions

On completion of the project, when all staff are in place, the annual operational costs are estimated to be Rs. 9.57 million (1993). This will be a recurring and increasing (inflationary) cost to be met by the Pakistan Government.

It is proposed that as the value of the work of the Ecotoxicology Centre is appreciated that increases in resource will be needed. The present plan provides for very minimal facilities in the Provinces. In the expansion phase it is recommended that facilities be created at the other two Provinces [see section B (b)] and additional resources be put into these provincial laboratories, whilst the central laboratory remains at or about its project recommended level.

Assuming that the central laboratory is established in existing NARC laboratories it is suggested that improved, purpose - built laboratories will be needed for the Ecotoxicology Centre in the future. It may eventually be necessary to equip it with GLC-mass spectrometry and NMR for metabolite identification, a facility which is presently available at the HEJ Chemistry Research Institute, Karachi, for identification of chemicals isolated from natural sources.

Care will be needed once the Ecotoxicology Centre is established that research programmes are geared to resolving practical environmental pollution problems which affect specific areas of the country. There will be a temptation to pursue scientifically interesting topics of academic value only and this should be resisted by firm management control.

#### E Budget Provisions

##### 1 Summary

	<u>Initial Input</u> Rupees (Rs 20 = US\$ 1)	<u>UNDP Input</u> US Dollars
Personnel/operational costs	11.55	160,000
Sub-contracts	6.20	-
Training	0.66	174,000
Equipment	1.10	346,000
Miscellaneous	0.14	20,000
<b>Totals</b>	<b>19.55</b>	<b>700,000</b> (Rs 14.00 m)

Rate of Exchange, appr. Rs 20 = US\$ 1.00

Total Project costs Rs 33.55 m = US\$ 1.68 m

2 Staff and Operational Costs (Government Contributions)

- (a) Salary figures (1989) for various grades of staff and officers plus additional normal payments such as house rent, medical, transport, research and Ph.D. contingencies were derived from a published table (Annex IV, Table 1).

The figures for the personnel required in this project are reproduced in Annex-IV. Total payments for the requisite number of staff for 1990 are calculated on the assumption of a 10% inflation factor. Similarly for 1991 and 1992.

The figures are given as millions of rupees rounded off to two places of decimals.

Because of the slow build-up of staff over the three year period and because many will be attending courses abroad, calculations of annual costs are based on the following estimates.

1990 (year 1)	20%
1991 (year 2)	40%
1992 (year 3)	80%

- (b) Additional operating costs - for communications, transportation, utilities, durable goods and other services and overheads - have been taken as 35% of the total operating costs. Thus total operating costs compose salaries etc. (65%), additional services and overheads (35%).

On this basis the 1990-1992 staff/operation costs in the three year development phase of the project have been estimated to be Rs 11.55 million (Annex-IV, Table 2). After completion of the project, assuming all staff in place the annual (1993) staff/operational costs are calculated to be Rs 9.57 m.

3 Subcontracts

Estimated as: Government contribution Rs 6.2 million  
Breakdown of Government contribution<sup>+</sup>  
New construction calculated at Rs 300/sq ft (\$ 15/sq ft)

		<u>Rs million</u>	
NARC - New Buildings	12,000 sq ft	3.60)	Buildings
Provinces	2500 x 2 = 5,000 " "	1.50)	already available
Glasshouse		0.10	
Other major items*		<u>1.00</u>	
	<b>Total</b>	<b>6.20</b>	
		====	

- \*(i) Existing laboratory modification, provision of fume cupboards etc.
- (ii) Fitting gas lines and other specialised services
- (iii) Provision of outdoor artificial ponds etc.
- (iv) Construction of field lysimeters or other outside model soil system
- (v) Research sub-contracts

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<sup>+</sup> If existing laboratory space is mainly utilised it would reduce the actual Government contribution considerably (by Rs 5.1 m)

- ANNEX**
- I Job Description**
  - II Ecotoxicology Centre Organisation**
  - III Equipment**
  - IV Salaries/Operational Costs**
  - V Training**
  - VI UNIDO Experts and Their Job Descriptions**
  - VII Timing of Activities**



UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

**JOB DESCRIPTION**

DP/RAS/85/023/II-80

- Post title**            **Consultant in Environmental Toxicology Related to Pesticides (return mission)**
- Duration**            **One month**
- Date required**       **July-August 1989**
- Duty station**        **Vienna/Islamabad**
- Purpose of project**    **To provide technical assistance to the Asia and the Pacific region in the safe development and use of pesticides.**
- Duties**                **The consultant with the help of the National co-ordinator will:**
- take into account the report submitted by him and discuss in detail with the project counterparts regarding the facilities needed to establish an eco-toxicology laboratory.
  - assess the type of contribution by the Government in cash and kind (eg civil works, utilities etc) that should be taken into account to prepare a "Project Formulation Framework"(PFF) according to the standard UNDP/UNIDO format.
  - take into account the activities, budgetary inputs in local and foreign currency needed to achieve the desired outputs.
  - assess the consultant/training needs of the counterpart organization in establishing the eco-toxicology laboratory
  - assist UNIDO in preparing the project document for submission to UNDP/Islamabad for consideration under the next country programme.

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Applications and communications regarding this Job Description should be sent to:  
Project Personnel Recruitment Section, Industrial Operations Division  
UNIDO, VIENNA INTERNATIONAL CENTRE, P.O. Box 300, Vienna, Austria



**Qualifications** Chemist, bio-chemist or environmentalist with extensive experience in the study of Xenobiotics in the environment with special emphasis on pesticides. He should be familiar with international rules and regulations regarding the registration and toxicology of pesticides.

**Language** English

**Background  
Information:**

The Regional Network was established in 1982 through a project executed by UNIDO (DP/RAS/82/006). The initial phase of the project which was the first of its kind implemented in the region, attempted to develop a lasting co-operative system in Asia involving Government institutions and bodies dealing with pesticides at all levels of the national economy. On behalf of member Governments the project was managed by the Regional Project co-ordinator who had been assigned by the Government of the Philippines at the Fertilizer and Pesticide Authority in Manila. Members of the Network were Afghanistan, Bangladesh, India, Indonesia, the Republic of Korea, Pakistan, Sri Lanka, the Philippines and Thailand.

Due to benefits accrued in the project it was extended to 2nd phase under DP/RAS/85/023 and India took over the Regional co-ordinator position. Recently China also joined the network.

The activities of the project comprised expert consultations, workshop, study tours, fellowships, and technical advisory services rendered by experts from within and outside the region. A supplementary function of the Network was the creation of active sub-networks covering specific subject of common interest to member countries, such as data collection and exchange of information. In particular, the exchange of experience was being promoted through the implementation of various project activities relating to registration requirement, quality control, pesticide residues, toxicology, pesticide trade and tariff regulations etc.

ECOTOXICOLOGY RESEARCH ORGANISATION

Director (PARC)							
Central Laboratory (NARC)				Quality Assurance	Provincial Laboratories (see next sheet)	Total staff Director 1	
Analytical (Plants, soil, water)	Environmental Chemistry	Aquatic & Terrestrial Ecology	Wildlife, Beneficial Species				
PSO	1	1	1	-	2	6	
SSO		3	1	1	2	9	
SO	2	4	2	-	4	13	
JSO	1	2	1	1	2	8	
Lab. Asst.	2	2	1	-	4	10	
<b>Analytical Chemists</b>		<b>Chemists, biochemist or Soil Scientists skilled in radio- tracer techniques</b>	<b>Aquatic biologist &amp; Microbiologists</b>	<b>Zoologist, &amp; Entomologists</b>	<b>Chemist or Biologist (GLP)</b>	<b>Technical staff</b>	<b>47</b>
		<u>Non-Technical</u>	<b>Secretaries</b>	<b>Central</b>	<b>Provinces</b>		
			<b>Clerk/Typists</b>	1	-		
			<b>Drivers</b>	3	2		10
				2	2		
						<b>Total staff</b>	<b>57</b>

PROVINCIAL LABORATORY (in each Province)

	Analysis	Ecology	Non-Technical	Total
PSO	-	1	-	1
SSO	1	-	-	1
SO	1	1	-	2
JSO	1	1	-	2
L. Asstt.	1	-	-	1
			Typist/Clerk	1
			Driver	1
				<u>9</u>

\* Each Provincial Laboratory 2000 sq ft

ANNEX III

Instruments and Equipment

<u>Item</u>	<u>Centre</u>	<u>Provinces</u>	<u>Total</u>	<u>Cost (US\$)</u>
1 GLC with two detectors and gas generators	1	1	2	60,000
2 HPLC with UV detector	2	1	3	60,000
3 UV/Visible spectrophotometer	2	1	3	50,000
4 Accurate balances	1	1	2	10,000
5 UV/Visible light microscopes	1	1	2	8,000
6 Deep-freezer	2	1	3	15,000
7 Computerised scintillation counter	1	-	1	30,000
8 Automatic sample	1	-	1	10,000
9 TLC radioactivity scanner (4 plate)	1	-	1	30,000
10 Fish dynamic exposure system	1	-	1	5,000
11 Office equipment				<u>18,000</u>
			<b>Sub-total</b>	<b>296,000</b>

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

Centrifuges, shakers, macerators, TLC equipment, water baths, incubators, ovens, rotary evaporators, vacuum pumps, autoclaves, refrigerators, cameras/binoculars, PH meters, rough balances, soil incubation equipment and miscellaneous

**Total** 346,000  
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ANNEX IV

Salaries/Operational Costs

**TABLE 1** Gross Annual Payment to Officer and Staff (Rupees)

	<u>1989</u>	<u>Numbers</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>
Driver	20,300	4	89,000			
Typist	30,500	5	168,000			
Secretary	50,500	1	56,000			
Lab Asst	22,000	10	242,000			
JSO	50,500	8	444,000			
SO	93,000	13	1,330,000			
SSO	105,000	9	1,040,000			
PSO	155,000	6	1,023,000			
Director	254,000	<u>1</u>	<u>280,000</u>			
<b>Total</b>		<b>57</b>	<b>4,672,000</b>			
		==	=====			
Million Rs Rounded off to 3 figures			4.67	5.14	5.65	6.22

**TABLE 2** Staff and Operational Costs

Assume 20%, 40% and 80% of total staff costs for year 1, 2 and 3 respectively

Million Rs				
<u>Year</u>		<u>Gross Payment</u>	<u>Operation Costs</u>	<u>Total</u>
1	4.67 (20%)	0.934	0.503	1.44
2	5.14 (40%)	2.056	1.107	3.16
3	5.65 (60%)	4.52	2.43	6.95
<b>3 Years Total</b>				<b>11.55</b>

1993 Full operation costs  
(all staff in place)

6.22 + 3.35 = Rs 9.57 m

Training Programme

<u>Training</u>	<u>Man Months</u>	
	<u>Foreign</u>	<u>Local</u>
1. Analytical (plants, soil, water) Trace (residue) analysis of pesticides and metabolites using sophisticated equipment (GLC, HPL, TLC and associated detectors)	12 (4x3 months)	12* (4x3 months)
2. Environmental chemistry and the use of radiochemical techniques. Degradation in plants, soil and water. Adsorption and desorption of pesticides in soil. Fish accumulation.	12 (3x4 months)	9+ (3x3 months)
3. Aquatic ecology. Techniques (static and flow through) for fish and aquatic organisms toxicity. Reproduction studies etc. Outdoor pond experimentation.	6 (2x3 months)	-
4. Soil Science Isolation of macro and micro organisms from soil. Measurement of soil processes (respiration, nitrification and organic-C decomp).	6 (2x3 months)	6+ (2x3 months)
5. Mass spectrometry and NMR - sophisticated physical techniques for identification of metabolites	3 (1x3 months)	6++ (1x6 months)
6. Quality Assurance + GLP Demonstration of GLPs and use of protocols, standard operating procedures, archiving of data and quality assurance checking	2 (1x2 months)	-
<b>Totals</b>	<b>41</b>	<b>33</b>

Foreign Study Tour 1  
Director or senior colleague to  
visit laboratories - preferably  
industrial - carrying out ecotoxi-  
cology and environmental chemistry  
studies on pesticides.

Overall training costs \$  
41 mm at \$ 4000/mm = 164,000  
1 mm (Study tour) @ \$ 10,000 = 10,000  
**Total foreign training = 174,000**

Local training 33 man months to be met by government of Pakistan  
- approx Rs 0.66 million

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- \* Plant Protection Institutes (Karachi, Faisalabad etc)
  - + Nuclear Institute for Agriculture and Biology (Faisalabad)
  - ++ HEJ Institute of Chemistry (Karachi)

ANNEX VI

Tentative Workplan

	<u>Start</u> (months after approval)	<u>Finish</u> (months after approval)
1. Project approval and appointment of Director (Project Manager)	0	3
2. Assign Chief Technical Advisor (CTA)	0	6
3. Negotiate for Laboratory space at NRC	0	6
4. Negotiate for personnel and recruit (Phase 1)	3	6
5. Obtain approval for use of laboratory for radiotracer work	3	9
6. Plan laboratory modifications	3	6
7. Arrange for training (Phase 1)	6	18
8. Negotiate for laboratory space at two provincial centres	6	12
9. Plan laboratory modifications at provincial labs	9	12
10. Order equipment	12	24
11. Recruiting (Phase 2)	12	18
12. Arrange for training (Phase 2)	18	30
13. Plan glasshouse at NARC	21	24
14. Recruiting (Phase 3)	24	36
15. Assign consultants	21	24
16. Plan outside (soil and water) system	27	33



TENTATIVE WORK PLAN

Approval

Year Quarter Item	YEAR 1		YEAR 2		YEAR 3	
1. Appoint Director (PM)	NARC	PROVINCIAL				
2. Assign Chief. Technical Advisor	-					
3. Negotiate for lab space	← NARC →	← PROVINCIAL →				
4. Obtain approval to use radioisotopes at NARC	↔					
5. Negotiate for personnel and recruit	↔		↔		↔	
6. Plan laboratory modifications and glasshouse	<u>NARC</u>	<u>PROVINCIAL</u>	<u>GLASSHOUSE</u>			
7. Order equipment	-----		-----			
8. Arrange for training	←-----→		←-----→		←-----→	
9. Assign consultants	←-----→		-----		-----	
10. Plan outside (soil and water) systems			←-----→		-----	