VECTOR BIOLOGY & CONTROL

Vector Biology & Control Project
1611 North Kent Street, Suite 503
Arlington, Virginia 22209
(703) 527-6500

Telex 248812 (MSCI UR)
Cable MSCI Washington, D.C.

ENVIRONMENTAL ASSESSMENT OF THE PAKISTAN MALARIA CONTROL II PROJECT EXTENSION

No.: 391-0472

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT
MISSION TO PAKISTAN
ISLAMABAD, PAKISTAN

AUGUST, 1988

AR-099

Managed by Medical Service Corporation International
under contract to the U.S. Agency for International Development

TABLE OF CONTENTS

		Page
	ACKNOWLEDGEMENTS	i
	LIST OF ACRONYMS AND ABBREVIATIONS	ii
1.0	EXECUTIVE SUMMARY	1
2.0	APPLICABLE ENVIRONMENTAL PROCEDURES AND PURPOSE OF ASSESSMENT	3
	2.1 A.I.D. Environmental Procedures	3
	2.2 Government of Pakistan Pesticide Legislation	3
	2.3 Previous Environmental Assessments and Need for Current Assessment	3
	2.4 Conditions Precedent to Disbursement, and Covenants	4
3.0	SCOPING PROCESS	5
	3.1 Conduct of Environmental Assessment	5
4.0	ANALYSIS OF ALTERNATIVES TO THE PROPOSED PROJECT	6
	4.1 No Action (Discontinue Existing Program)	6
	4.2 Use of Alternative Insecticides and/or Environmental Management Malaria Control Methods	6
	4.2.1 Description	6
	4.2.2 Presumed Environmental Impacts	7
	4.3 Malaria Control Through Chemotherapy Alone	7
	4.4 Conclusion	8
5.0	PROJECT DESCRIPTION	9
	5.1 Background, Goal, Purpose and Outputs	9
	5.1.1 Background	9
	5.1.2 Impact of Agricultural and Engineering Activities on Incidence of Malaria	10
	5.1.2.1 Pesticides	10
	5.1.2.2 Dams	11
	5.1.2.3 Irrigation	11
	5.1.2.4 Farm Productivity	11
	5.1.3 Project Goals, Purpose and Output	12
	5.2 Other Donor Activities	12
	5.2.1 World Health Organization	13

a

TABLE OF CONTENTS cont.

		Page
	5.2.2 United Nations Children's Emergency Fund	13
	5.2.3 Government of Japan	13
	5.2.4 United Nations High Commission for Refugees	13
5.3	Affected Environment	13
	5.3.1 Land Utilization and Agricultural Resources	13
	5.3.2 Forestry Resources	14
	5.3.3 Parks and Protected Areas	14
	5.3.4 Rare and Endangered Species	14
	5.3.5 Human Population	14
6.0	PESTICIDE USE ASSESSMENT	16
6.1	U.S. EPA Registration Status of the Selected Insecticides	16
	6.1.1 Malathion	16
	6.1.2 Fenitrothion (Sumithion)	16
6.2	Basis for Selection of Insecticides	17
6.3	Integrated Pest Management and Malaria Control in Pakistan	18
6.4	Application Methods and Equipment	19
6.5	Acute and Long-term Environmental/Toxicological Hazards	19
	6.5.1 Malathion	19
	6.5.2 Fenitrothion	20
6.6	Efficacy of Selected Insecticides for Mosquito Control	20
6.7	Effect of Selected Insecticides on Non-target Organisms and Natural Environment	23
6.8	Conditions Under Which Insecticides Are to Be Used	23
6.9	Availability and Effectiveness of Other Insecticides and/or Nonchemical Control Measures	24
6.10	Ability of the Government of Pakistan to Regulate or Control the Distribution, Storage, Use and Disposal of Pesticides	24
6.11	Provision for Training Malaria Control Insecticide Users	26
6.12	Provision for Monitoring the Use and Efficacy of the Selected Insecticides	26

b

TABLE OF CONTENTS cont.

	Page
7.0 ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION	28
7.1 Unavoidable Adverse Environmental Impacts	28
7.2 The Relationship Between Short-term Impacts and Long-term Productivity	28
7.3 Irreversible or Irretrievable Commitments of Resources	28
8.0 ENVIRONMENTAL IMPACT MITIGATION PLAN	30
8.1 Priorities	30
8.2 Safety Protocols	30
8.2.1 Protection	30
8.2.1.1 Spray Uniforms	30
8.2.1.2 Householders	31
8.2.1.3 Overexposure	32
8.2.1.3.1 Monitoring	32
8.2.1.3.2 Treatment	32
8.2.1.4 Transport, Storage, Disposal	32
8.2.1.5 Safety Training	33
8.2.1.6 Accident Contingency Consultant	33
8.2.2 Research	34
8.2.3 Monitoring Project Performance and Compliance	34
8.2.4 Cooperative/Coordinated Planning	35
9.0 LIST OF PREPARERS	36
10.0 REFERENCES	37

TABLES

1 SUMMARY OF ENVIRONMENTAL FATE ATTRIBUTES OF MALATHION AND FENITROTHION	21
2 SUMMARY OF TOXICOLOGICAL ATTRIBUTES OF MALATHION AND FENITROTHION	22

ANNEXES

A - PERSONS CONTACTED	38
B - SCOPING STATEMENT	42
C - PESTICIDE LABEL - (MALATHION AND SUMITHION)	46
D - SLIDE POSITIVITY RATE AND ANNUAL PARASITE INCIDENCES (API) 1975-1986	49

C

TABLE OF CONTENTS cont.

	Page
ANNEXES	
E - PROCUREMENT OF INSECTICIDES BY THE MALARIA ERADICATION/CONTROL PROGRAM - PAKISTAN (1961-1988)	50
F - USAID HOUSE SPRAYING OBSERVATION FORMS	51
G - ESTIMATED COSTS OF RECOMMENDATIONS	53
H - USAID MALARIA INFORMATION CARD	60
I - ENVIRONMENTAL CONSIDERATIONS AND CRITERIA REVIEW - INSECTICIDES	62
J - FIELD SURVEYS OF EXPOSURE TO PESTICIDES STANDARD PROTOCOL	64
FIGURES	
1 SPRAY TEAM IN NORTHWEST FRONTIER PROVINCE WEARING UNIFORMS AND TURBANS PROVIDED BY DOMC	78
2 SPRAYMAN IN LOCALITY NEAR PESHAWAR SPRAYING WALLS OF A BEDROOM	79
3 MIXER PREPARING SUSPENSION OF MALATHION WDP TO FILL SPRAY TANKS OF SPRAYMAN	80
4 HOUSEHOLDERS' BELONGINGS AND FURNITURE REMOVED FROM HOUSE IN PREPARATION FOR SPRAYING	81
5 INSECTICIDE STORE-ROOM IN A VILLAGE OF THE PUNJAB PROVINCE	82

Authors

Jesse H. Hobbs, Sc.D., is a medical entomologist and technical consultant for the Vector Biology & Control Project. Dr. Hobbs' areas of expertise include malariology, vector biology and control, project management, logistics, testing and safe use of pesticides and training in all of the above areas.

Hiram G. Larew, Ph.D., is a research entomologist in A.I.D's Bureau for Science and Technology, Office of Agriculture, Pest Management. Dr. Larew's areas of expertise include agricultural pest management, agricultural research, safe use of pesticides and alternatives to pesticides.

Acknowledgements

Preparation of this document was sponsored by the Vector Biology & Control Project under Contract No. DPE-5948-C-00-5044-00 to Medical Service Corporation International, Arlington, Virginia, U.S.A., for the Agency for International Development, Office of Health, Bureau of Science and Technology.

The EA team gratefully acknowledges the assistance of the following people who contributed to the conduct of this EA: Dr. Rifaq Ismail, Mr. Babar Hussain, Dr. Ray Martin, Dr. Andrew Arata, and staff of VBC, Dr. Clive Shiff, Dr. Dennis Long, Mr. Glenn Rutanen-Whaley, Mr. John Morgan, Mr. Ajaz Ahmad and Mr. Raja Mumtaz.

LIST OF ACRONYMS AND ABBREVIATIONS

ACD	Active Case Detection
A.I.D.	Agency for International Development
API	Annual Parasite Incidence
ARD	Agricultural and Rural Development (Division, A.I.D./ Pakistan)
CD	Communicable Disease
CICP	Consortium for International Crop Protection
DOMC	Directorate of Malaria Control
EA	Environmental Assessment
EC	Emulsifiable Concentrate
EE	Energy and Environment (Division, A.I.D./Pakistan)
EPA	Environmental Protection Agency
GOP	Government of Pakistan
HPN	Health, Population and Nutrition (Division, A.I.D./ Pakistan)
IEE	Initial Environmental Examination
IPM	Integrated Pest Management
MCP	Malaria Control Program
MT	Metric Ton
NIMRT	National Institute of Malaria Research and Training
NMCP	National Malaria Control Program
NWFP	North West Frontier Province
OP	Organophosphate
PACD	Project Assistance Completion Date
PCD	Passive Case Detection
PID	Project Identification Document
PP	Project Paper
RHC	Rural Health Center
TVA	Tennessee Valley Authority
ULV	Ultra Low Volume
UNHCR	United Nations High Commission for Refugees
UNICEF	United Nations International Children's Emergency Fund
USAID	United States Agency for International Development
VBC	Vector Biology & Control Project
WHO	World Health Organization
WDP	Water Dispersible Powder
WP	Wettable Powder

1.0 EXECUTIVE SUMMARY

USAID/Pakistan intends to continue to support malaria control efforts in the Islamic Republic of Pakistan for a 4-year extension of the Malaria Control Project II. USAID's assistance will include funds for the purchase of insecticides, spray equipment, and safety gear. The extension will, at the same time, emphasize adoption of malaria survey procedures which should lead to more focused insecticide applications, which in turn should decrease the overall amount of pesticides needed in follow-on projects (5.0).

This environmental assessment (EA) was prepared as a critical element of the project design, in compliance with A.I.D.'s Environmental Procedures 22 CFR 216. The EA identifies and analyzes the health/safety and environmental issues specific to the proposed project. The requirement for this EA stems from both the need to update the findings of previous programmatic and national assessments as well as from the increased concerns for worker safety and environmental protection associated with the possible use of more toxic insecticides in the Malaria Control Project II extension (2.0).

The preferred alternative among candidate technical approaches was determined to be chemical (insecticide) control managed in a judicious and safe manner (4.0).

The anticipated negative impacts of project extension pesticides are considered minimal and will be mitigated by continued safe transport, use, storage and disposal. Human exposure to pesticides remains the more critical area of concern (5.3, 7.0).

The following insecticides should be approved for A.I.D.-funded procurement and/or use in the Pakistan Malaria Control II Project extension: malathion and fenitrothion. Approval for use of pyrethroids and larvicides should be subject to review (6.0).

The GOP has in place a strong institutional structure, developed over several years, for managing malaria control operations. Both malathion and fenitrothion have been safely and successfully employed by the national malaria control program since 1982. With relatively few improvements, the program will continue to operate safely and in full compliance with A.I.D. environmental procedures (Section 6.0).

Recommended mitigative measures include provisions for:

1. adequate types and numbers of protective uniforms for spray squads,

2. additional test kits for monitoring worker exposure,

3. a continuation of safety training,

4. an accident contingency short-term consultant to provide guidance on pesticide handling,

5. research directed at minimizing worker exposure, and

6. participation by malaria specialists in agricultural and engineering projects in order to minimize increases in malaria and the subsequent use of pesticides (8.0).

2.0 APPLICABLE ENVIRONMENTAL PROCEDURES AND PURPOSE OF ASSESSMENT

The Malaria Control II Project Extension will provide technical advisory services, commodities, equipment and insecticides to assist the GOP in controlling malaria. The findings of this EA are an important element of project design in that they indicate ways of improving the already in place pesticide safety procedures.

This section describes the procedures under which the EA was conducted, why the EA was necessary, and project conditionalities already in place that address safe use of pesticides.

2.1 A.I.D. Environmental Procedures

It is A.I.D.'s policy to ensure that environmental consequences of A.I.D.-financed activities are identified and considered by A.I.D. and the host country before the decision to proceed with the project is made, and that appropriate safeguards and mitigative actions are adopted. This policy is stated and discussed in title 22 of the Code of Federal Regulations, Part 216, "A.I.D. Environmental Procedures" (22 CFR 216).

This EA of pesticide usage in the Malaria Control II Project Extension is based on the requirements of 22 CFR 216.3(b), "Pesticide Procedures." The EA identifies and evaluates probable environmental impacts of the proposed usages, provides recommended mitigative actions to minimize negative impacts, and examines the probable impacts and feasibilities of alternative approaches to malaria control.

2.2 Government of Pakistan Pesticide Legislation

The Pesticide Ordinance of 1971 and the rules adopted for implementing the Ordinance (1973) provide the GOP with ample authority to regulate most all aspects of the sale and use of pesticides including registration, import, cancellation, and adulteration. The Ordinance and its rules do not, however, include regulations regarding environmental impact or worker health and safety aspects of pesticide use. No such regulations are known to exist.

2.3 Previous Assessments and Need for Current Assessment and Need for Current Assessment

At the time of initial project authorization in 1982, USAID prepared an initial environmental examination (IEE) which recommended a negative determination based on the conclusions of a previously prepared programmatic Environmental Impact Statement for use of insecticides in malaria control projects worldwide, as

well as on the results of earlier environmental studies of USAID-assisted malaria control programs in other Asian and Latin American countries. The requirement for the current EA stems from both the need to update the findings of the previous studies as well as from continued concerns for environmental protection and worker health and safety associated with possible use of higher toxicity insecticides such as fenitrothion in the Malaria Control II Project Extension.

2.4 Conditions Precedent to Disbursement, and Covenants

The Project Paper (PP) for the Malaria Control II Project Extension contains specific conditions regarding pesticide usage in the extension that must be annually addressed by the appropriate Pakistan agency before disbursement of funds for purchase of pesticides can be made (page 116 of PP). If satisfied, these conditions will help ensure that pesticides are used effectively, ordered in appropriate quantities, and used as part of an integrated approach to malaria management.

Project covenants (page 119 of PP) require that the grantee annually assures A.I.D. that pesticides are being used safely and that pesticide quality is monitored.

This EA should assist both A.I.D. and the GOP in the monitoring and fulfilling these conditions and covenants.

3.0 SCOPING PROCESS

A.I.D. Environmental Procedures, 22 CFR 216.3(a)(4), describe the scoping process to be used in identifying the significant issues to be addressed in the EA. Critical elements of the scoping process include: a determination of the scope and significance of the issues to be analyzed in the EA, and identification of and elimination from detailed study of those issues that are not significant or have been covered by earlier environmental reviews.

Based upon both field visits and meetings with GOP, A.I.D., VBC, and personnel involved in the MCP, the EA team prepared a scoping statement according to 22 CFR 216.3(a)(4) (a)-(d) which was submitted in draft to USAID at the conclusion of the field work. The scoping statement is included in Annex B of this EA.

3.1 Conduct of Environmental Assessment

This environmental assessment was performed by Dr. Jesse Hobbs and Dr. Hiram Larew (see Section 9.0 for qualifications).

The effort consisted of a 2-day briefing (July 19-20, 1988) in Washington, a 21-day in-country visit (July 31-August 20) and a 3-day debriefing (August 22-24) session in Washington.

The briefing and debriefing sessions were held with staff from AID/ST/H, VBC and AID/ANE/PD/ENV, AID/ST/AGR, and AID/ST/FENR.

The in-country trip included interviews with staff from the HPN and E&E offices of USAID/Islamabad, and numerous GOP officials (see Annex A). During the trip, the EA team visited the Punjab Province for 4 days (August 5-8) and inspected 3 district malaria control spray operations (Gujranwala, Sheikhupura and Lahore Districts). The team also visited the North West Frontier Province (NWFP) for 2 days (August 10-11) and saw 1 operations, both in the Peshawar District. Storage facilities and health units were also visited.

4.0 ANALYSIS OF ALTERNATIVES TO THE PROPOSED PROJECT

4.1 No Action (Discontinue Existing Program)

The Malaria Control II Project Extension is consistent with A.I.D. strategy and will have a significant positive effect on other A.I.D. projects. It directly supports A.I.D.'s effort to (1) overcome low agricultural productivity, and (2) reduce the high rates of infant and child mortality. The development of this project is crucial to A.I.D.'s goal of reducing reliance on insecticides as the primary instrument of malaria control and the complete integration of malaria control activities within the framework of the general health services.

The discontinuation of the present program would not only be inappropriate but prejudicial to the public health of Pakistan. Through the cooperative efforts of A.I.D. and GOP, malaria will be reduced to low and manageable levels. Without these control efforts, parts of Pakistan would undoubtedly return to a condition of high malaria endemicity with devastating periodic epidemics.

4.2 Use of Alternative Insecticides and/or Environmental Management Malaria Control Methods

4.2.1 Description

The use of residual insecticides for house spraying, beginning with DDT in the early 1960s, has served very well in Pakistan for the control of malaria. With the appearance of DDT resistance in malaria vectors in the mid 1970s, houses were sprayed with HCH in limited areas. In the mid 1970s, the Malaria Eradication Program changed its operation to the use of malathion in all malarious areas with satisfactory results in terms of reduction of malaria transmission. With the detection of malathion resistance in one of the vectors, *An. stephensi*, in the early 1980s, some limited spraying was carried out with fenitrothion, another organophosphate insecticide. Malathion, however, remains the insecticide of choice in house spraying in malarious localities, and has continued to be effective in rapidly reducing transmission. A system of entomological and epidemiological monitoring is in place and functioning to indicate when a substitute insecticide, such as fenitrothion, is required. It is planned that the change to fenitrothion be made only in localities where resistance to malathion, as registered by the WHO diagnostic test, exceeds 40 per cent, and the incidence of malaria exceeds the norm for the localities.

Should it be necessary to change to another alternative insecticide in the future, due to a high resistance in the vectors to fenitrothion and malathion, substitutes in the

carbamate group of insecticides would be available for use. Both bendiocarb (Ficam) and propoxur (Baygon) have been field tested in Pakistan, and it is felt that they would be alternative insecticides to use should the need arise.

The environmental management approach to malaria control through improved water management and permanent engineering works of drainage and filling have not been considered viable or economic substitutes for residual house spraying in the malarious areas of rural Pakistan, mainly because of the vast extent of static water collections during the rainy season, and the scattered nature of the many small villages. These methods, however, are appropriate and cost effective in urban areas and should be considered in future projects of urban malaria control.

Bacillus thuringiensis israelensis, a microbial insecticide, has proven in recent years to be a highly effective larvicide for the control of malaria vectors, particularly in situations where breeding places are restricted in size, and near concentrations of houses. The use of this material will be evaluated in the future for its appropriateness in selected malarious localities.

4.2.2 Presumed Environmental Impact

The presumed environmental impact of the alternative insecticides would be no greater in degree than the currently used intradomiciliary insecticides. They would be applied to inside wall surfaces, at low dosages, in a manner consistent with long term practices.

4.3 Malaria Control Through Chemotherapy Alone

Malaria control through chemotherapy alone is already in practice in the low malaria incidence and low risk areas in Pakistan. House spraying is withdrawn when the annual parasite incidence is reduced to 2 cases per 1000 population, and from localities where falciparum malaria has disappeared. Spraying in 1988 was carried out in 63 districts or tribal agencies, but not in all localities of these districts. In the unsprayed localities, malaria is dealt with by case detection and radical treatment.

The objective of antimalarial drug therapy is not only the prompt clinical cure of malaria patients, but also the reduction of the infective reservoir. When the objectives are met enabling the efficient treatment of malaria cases, the combined case detection and treatment activities may serve as a useful malaria control method, particularly in areas where the malariogenic potential is not high.

4.4 Conclusion

Based upon consideration of currently available options, the EA team believes that the ongoing MCP, which uses residual house spray insecticides in combination with chemotherapy, is the most balanced approach to environmentally acceptable, economic, and efficient malaria control. The EA team encourages research at NIMRT into biological and environmental management methods of vector control.

5.0 PROJECT DESCRIPTION

5.1 Background, Goals, Purpose and Outputs

5.1.1 Background

Malaria has historically been a major health problem in areas now included in Pakistan. Periodic severe epidemics with high mortalities have occurred in the past, particularly in the Punjab and in Sind. In the years prior to 1961, malaria infected an estimated 7 million people, causing some 100,000 deaths annually. Diverse topography, varying demographic situations and population movements were all contributing factors to this high level of endemicity.

With the discovery of long acting insecticides, such as DDT in the early 1940s, a new strategy of malaria control became feasible in many countries, including Pakistan. This strategy was based on the intradomiciliary application of residual insecticides at regular intervals.

A.I.D. began assisting the GOP in anti-malaria work in 1961, as a part of the global malaria eradication program. This assistance was terminated in 1970, when the Pakistan program appeared close to success.

A resurgence of the disease occurred, however, and malaria reached epidemic proportions with an estimated 10 million cases in 1974. This public health emergency led to a resumption of A.I.D. assistance in a new program designated the Malaria Control Program (MCP). It was designed to control the epidemic and bring the incidence of the disease to a manageable level. With the malaria vector having become resistant to DDT, it was necessary to change to malathion in the house spraying program. Results were spectacular, and, as in the 1960s a 99 percent reduction in malaria cases was achieved. (Annex D).

The major achievement of the 1975-80 MCP, the reduction of the API to less than 0.5 cases per 1000 population, was short-lived. By 1981 there were clear indications of increasing malaria transmission (Annex D). This deterioration may have been caused, in part, by the sudden influx of Afghan refugees who brought with them a large reservoir of malaria. In 1981 there were an estimated 2 million refugees, and by May 1988 there were more than 3 million.

To assist the GOP in maintaining an API of 0.5 or less, the Malaria Control II Project was approved in May 1982. The major objective was to contain and further reduce the incidence of malaria by expanding the capacity of the Federal, Provincial and municipal health services to control malaria and transform MCP

from a vertically organized program to an integrated program using a selective mix of vector control measures and a better balance between active and passive case detection.

In 1987, USAID/Pakistan recommended an extension of the Malaria Control II Project, with a project assistance completion date (PACD) of September, 1992. This extension will build on the success of Malaria Control II, but put a stronger emphasis on institutional building, particularly on the adoption of passive case detection and treatment of malaria cases by the general health services.

5.1.2 Impact of Agricultural and Engineering Activities on Incidence of Malaria

Agricultural and engineering programs are normally conducted separately from and without regard to malaria control programs. Program designers in each field are not usually sensitive to the impacts that activities in one sector have on another. The impacts, however, are striking. Four are described below.

5.1.2.1 Pesticides. The use of insecticides in agricultural pest management schemes may lead to pesticide resistance in mosquitoes before the pesticides are ever used in an NMCP, or may hasten development of resistance. "Pre-resistance" in anopheline mosquitoes caused by application of agricultural pesticides has been documented in Africa, Central America and Asia (WHO, 1986).

In Pakistan a wide variety of pesticides are used in agriculture over large areas. For example, in 1987, 3000 MT of organophosphate, carbamates, chlorinated hydrocarbons and pyrethroids were imported for use on 10 million hectares of crops in the Punjab. About 80 per cent of these were applied to cotton. In the NWFP, 10,000 hectares of sugarcane are aerially sprayed each year with a variety of insecticides.

Most all of the sprayed farm lands are irrigated. Irrigation systems may provide breeding habitats for mosquitoes. By spraying crops, farmers are also spraying mosquitoes either directly, or indirectly by run off into irrigation canals.

Susceptibility trials conducted during 1988 in the Punjab indicate that both *An. culicifacies* and *An. stephensi*, known malaria vectors, are tolerant to fenitrothion in several districts. This OP was used in a limited way for 3 years in MCP in the early 1980s, but it has been used only in agricultural programs since 1984. The steps leading to tolerance in this case are not clear, but agricultural use has most likely contributed to it. The fallout of such tolerance is critical; the option of using fenitrothion (Georghiou, 1986), one of the few insecticides available to MCPs, may have been compromised in the Punjab before it was ever fully used in the MCP.

Similar cases of "pre-resistance" have led certain countries, such as Sri Lanka, to reserve certain pesticides for use only in public health programs. Use in agricultural programs has been banned.

5.1.2.2 Dams. Damming projects, a favorite in the quest for energy self-sufficiency, by design, bring running water to a standstill and thus may provide vast areas year round of potential mosquito breeding habitats where there once were few if any.

Dams, on the other hand, facilitate flood control activities and may thus decrease the periodic outbreaks of malaria caused by increased breeding pools that result from floods. There are 7 major, and several smaller dams in Pakistan.

More research is needed before cause and effects can be ascribed to the relationship between dams and malaria, but in the meantime, proposals to construct dams in areas of high malariogenic potential should be studied carefully by both engineers and public health specialists. Methods used by the Tennessee Valley Authority for managing dam water levels to decrease mosquito infestations should be considered (TVA, 1940).

5.1.2.3 Irrigation. Irrigation schemes are often the first step in turning nonarable land to farms. In many developing countries, the most common method of irrigation is by canals or channels that distribute water to, and sometimes, through the field. There are 30,000 miles of irrigation channels in Pakistan.

Actively used, well maintained (weed-free) irrigation canals are not active breeding grounds for mosquitoes; actively moving water or channels that are drained frequently do not provide the stable aquatic environment needed for mosquito development.

If, however, as is often the case, canals become clogged with vegetation or are damaged and leak into standing side pools, the created environment may be a perfect mosquito habitat. Lining canals with brick may help decrease mosquito infestations.

Design of irrigation schemes should be a joint effort between engineers and public health specialists. Malariologists may be able to suggest methods of design, such as brick lining, that would decrease the likelihood of canals serving as mosquito habitats. And as with dams, the malariogenic potential of an area should be considered when irrigation systems are proposed.

5.1.2.4 Farm Productivity. Farm productivity in developing countries relies heavily on vigorous human labor. Malaria debilitates. The work force availability and vitality will be affected by malaria.

When projecting agricultural output, planners must factor in disease incidence. Clearly, agricultural planners have a stake in and should take an interest in the success of NMCP.

5.1.3 Project Goals, Purpose and Output

The specific purpose of the project is to assist the GOP to continue to further reduce the incidence of malaria in the country, maintaining malaria incidence at a level where it does not constitute a major health problem, and to train a cadre of technical personnel to sustain the control program without, or with only minimal requirements for external assistance.

Specific objectives include:

1. Support of the GOP malaria control objectives to:

   a. Maintain an API at or below 0.5 cases per thousand.

   b. Contain the infections of P. falciparum malaria to less than 20% of all cases of malaria in Pakistan.

   c. Improve the malaria surveillance system through increasing the proportion and number of slides collected through a passive case detection (PCD) system to 70% of the total (i.e., passive and active) numbers of slides collected for the detection of malaria cases in Pakistan.

   d. Reduce household spraying to less than 20% of all houses in the country by determining foci for spray on sound current epidemiological data; attainment of greater than 95% spray coverage of the targeted housing.

2. Initiate and assist operational research at NIMRT, targeting operational problems identified by the Directorate of Malaria Control and/or provincial programs.

5.2 Other Donor Activities

Other donors who have assisted the Pakistan MCP are WHO, the Japanese Government, UNICEF and UNHCR. These donor contributions have been primarily for commodities, training, and technical assistance, while the GOP provides the local cost support required for such contributions. Anticipated future contributions are:

5.2.1 World Health Organization

The WHO representative in Islamabad stated that WHO has a two-year malaria budget of $300,000 for training, supplies and evaluation support. WHO/Geneva has a technical capability and information base that may be utilized on occasions. WHO has been providing long and short term technical assistance, training fellowships and commodities including transport. In the past two years, however, WHO did not have funding for long term malaria advisory services to the Pakistan MCP.

5.2.2 United Nations Children's Emergency Fund (UNICEF)

In the 1975-1980 period UNICEF provided anti-malaria drugs. UNICEF is no longer participating in malaria programs.

5.2.3 Government of Japan

Except for some insecticide in 1982, the Japanese Government gave no assistance during the first phase of Malaria Control II. The DOMC mentions possible assistance in 1988-92 from Japan in the form of fenitrothion and vehicles. To date, however, no commitments have been made or sought.

5.2.4 United Nations High Commission for Refugees (UNHCR)

The UNHCR is operating separate but coordinated malaria control activities in the Afghan camps located in NWFP and Baluchistan. In 1988, there has been increased coordination between USAID, DOMC and UNHCR in planning and implementing the malaria program in the Afghan refugee camps.

To date the Pakistan MCP has been financed in roughly equal halves by A.I.D. (foreign exchange) and GOP (rupee inputs). At present there is no other significant donor.

5.3 Affected Environment

The Islamic Republic of Pakistan lies in south Asia, and is bordered on the east by India and China, on the northwest by Afghanistan, on the southwest by Iran and on the south by the Arabian Sea. Pakistan covers approximately 796,095 square kilometers, including the disputed territories of Jammu and Kashmir. The northern fourth of the country is mountainous with elevations of 4500 m. The southwest is lowland deserts and the central and southeast contain flat, but mesic lowlands. South centrally, the Brahin mountain range rises to approximately 2000 m.

5.3.1 Land Utilization and Agricultural Resources

Most of the agricultural crop and livestock production occur in the eastern and south eastern region of the country with

relatively little production in the mountainous and desert areas. Cotton, wheat, rice and sugarcane are primary crops, with maize, grain, jowar, bajra, barley, tobacco, oilseeds and pulses being secondary in importance. Buffalo, sheep, goats, camels, horses and mules are common livestock. A total of approximately 11 million hectares are under cultivation.

Large coal reserves occur in Sind, Baluchistan and the Punjab.

5.3.2 Forestry Resources

According to an article that appeared in an August, 1988 issue of a Pakistan newspaper, Pakistan presently has 5 percent of its land covered in forests. A plan to reforest vast areas has been proposed by the President with the goal of 25 percent reforestation.

5.3.3 Parks and Protected Areas

Lists of all Pakistan national parks, wildlife sanctuaries and game reserves were assembled in April, 1988 by Dr. Waldemar Albertin, Environmental Advisor, Office of Energy and Environment, USAID/Islamabad.

Pakistan has 7 national parks, 69 wildlife sanctuaries, and 73 game reserves. Parks, sanctuaries and reserves are found in all provinces and vary in size from a few hectares to 2.7 million hectares. A variety of animal wildlife is found in all of these areas.

5.3.4 Rare and Endangered Species

According to a survey completed in April, 1988 by Dr. Waldemar Albertin, Environmental Advisor, Office of Energy and Environment, USAID/Islamabad, 31 species of mammals, 2 species of birds and 5 species of reptiles are presently considered endangered by the Wildlife Enquiry Committee. The International Union for Conservation of Nature and Natural Resources lists 5 additional animal species as threatened with extinction in Pakistan. Each Province contains endangered species.

No information is available on endangered plants or insects.

5.3.5 Human Population

The 1988 population of Pakistan is estimated to be 100 million with the largest concentration of people in the south eastern and north central regions of the country corresponding to

the Indus River Basin. Karachi, Lahore, Peshawar and Islamabad-Rawalpindi are the four major centers of population.

The annual growth rate is approximately 3.0 percent.

6.0 PESTICIDE USE ASSESSMENT

This section addresses the questions listed in A.I.D. Regulation 216.3 (b)(1) regarding the use of insecticides. The focus of this section is on the use of the organophosphate (OP) insecticides malathion and fenitrothion (Sumithion) as residual house sprays aimed at interrupting transmission of malaria by killing infective An. culicifacies, the major mosquito vector of malaria in Pakistan.

In addition to these two OPs, the project extension will provide funds for the purchase of adulticide pyrethroids in the amount of $172,600, and ULV and fogging machines ($900,000) for applying pyrethroids in urban settings. The extension also includes GOP contributions of Rs.2,411,100 for larvicides. The types of pyrethroids and larvicides are not indicated in the PP, and project personnel indicated to the EA team that selection of the materials had not been made. After the specific pesticides to be used are selected, and prior to their procurement, it will be necessary for USAID/Pakistan to prepare an amended EA specifying the intended materials, quantities and use. A format for such an amended EA is provided in Annex I.

6.1 U.S. EPA Registration Status of the Selected Insecticides

6.1.1 Malathion

Malathion is a widely used OP insecticide which is registered by the United States Environmental Protection Agency (EPA). Malathion used in the extension will be 50 percent water dispersible powder (WDP), formulated for residual house spray application. The pesticide will be manufactured by U.S. firms. A copy of the malathion 50 WP label is included in Annex C of this report.

6.1.2 Fenitrothion (Sumithion)

Fenitrothion, an OP insecticide, is registered with the EPA under various numbers depending upon the formulation. Fenitrothion is manufactured under the trade name Sumithion by Sumitomo Chemical Company Ltd. of Japan. The active ingredient is o-o-Dimethyl o-(4-nitro-m-tolyl) phosphorothioate. A copy of the Sumithion 40 WP label is included in Annex C of this report. This wettable powder is the most commonly used fenitrothion formulation in malaria control programs worldwide. A technical manual fully describing the use of fenitrothion (Sumithion), its formulations, toxicity, environmental fate, safety precautions, etc., is on file at VBC and USAID/Islamabad/HPN.

The material in a 40% wettable powder formulation (specially designed and packaged for residual wall spraying) is registered by the EPA (EPA Reg. No.39398-9). A 50% EC (emulsifiable concentrate) used for residual wall spraying of painted walls is also registered (EPA Reg. No. 39398-2).

6.2 Basis for Selection of Insecticides

Although DDT was the insecticide used in the early years of the Malaria Eradication Program, malathion spraying was substituted where widespread resistance to DDT was detected in the 1970s. Susceptibility tests carried out by the DOMC in 1987 and 1988 clearly indicate that there is no prospect in sight that DDT will be of use in anopheline mosquito control in Pakistan in the foreseeable future.

Malathion has traditionally been considered the chemical of choice as an alternative for indoor residual application due to its low mammalian toxicity, relatively low cost compared with other nonchlorinated insecticides and most importantly, due to the unique mechanism of resistance to it. This mechanism, based on the enzyme carboxylesterase, is highly specific for malathion. Thus, insects becoming resistant to it by this means are not cross-resistant to other insecticides.

In the early 1980s, evidence, based on the WHO susceptibility test, began to accumulate that certain populations of An. stephensi, a proven malaria vector in parts of Pakistan, were developing resistance to malathion. Fenitrothion was considered to be the logical alternative insecticide for house spraying, but it was important for reasons dealing with cross-resistance and worker/population safety that the transition to fenitrothion be gradual, and that it be made only where there was clear evidence of substantial resistance to malathion.

In view of the importance of establishing sound criteria for the change to spraying of fenitrothion, USAID/Pakistan contracted a world authority on insecticide resistance in mosquitoes, Dr. George Georghiou of the University of California at Riverside, to analyze the available data and make recommendations. Georghiou (1986) made the following recommendations:

a. The insecticide fenitrothion may be phased gradually into the malaria control program on a district by district basis where there is clear evidence that high malathion resistance in An. stephensi is prevalent.

b. The criteria for replacement of malathion will be (1) 60 percent or less average mortality of An. stephensi in susceptibility tests conducted in several localities

during the preceding two years according to the standard WHO procedures, and (2) an unacceptably high level of malaria transmission relative to the norm for the district.

c. In view of their ability to conduct spray operations with relative efficiency, the replacement of malathion by fenitrothion in 1987 should be considered only for districts of the Punjab Province. In subsequent years, individual districts in other provinces may also be considered (i.e., NWFP in 1988, Sind in 1989 and Baluchistan in 1990).

d. Since fenitrothion possesses higher toxicity to mammals than malathion, districts changing to fenitrothion must intensify their staff training program at all levels on the safe use of this insecticide, in addition to exercising increased field supervision during spray operations.

6.3 Integrated Pest Management and Malaria Control in Pakistan

Integrated Pest Management (IPM), as used in agriculture, leads to a reduction in the use of synthetic pesticides for two reasons. One is that pesticides are used only when a predetermined threshold level of pest incidence or crop damage is exceeded. Below the threshold, no pesticides are applied because their cost would not be recovered in increased profits. The other reason is that all useful nonpesticidal methods of control are brought to bear to keep pest populations below the threshold.

Determination of a threshold level requires considerable field study. Field monitoring also is required on a continuous basis so that the level of infestation can be determined. Thus, IPM is generally a training and labor intensive method.

The proposed project uses an IPM approach to effect malaria control. For example, DOMC project personnel will base their decision to use or not use insecticides on whether infections in a locality exceed an API threshold of 2.0 for *Plasmodium vivax* or when any *P. falciparum* (a more deadly agent) is detected. Thus, the project will use responsive spraying based on epidemiological data, not broad-scale preventative spraying.

The project will use chemotherapy to help maintain low APIs. This alternative to pesticide control of the vector has proven useful in Pakistan and elsewhere in decreasing malaria morbidity and mortality.

No other alternatives to pesticides, such as source reduction or biological controls, are contemplated for use in the extended project, but research in these areas is to be conducted.

In the last 3 years, the quantity of pesticide used has been reduced from a recent peak of 3,700 MT in 1985 to 1,200 MT in 1988 (Annex E). The program has moved from one in which attempts were made to spray all localities, to one in which only 20 percent of all localities are now sprayed. Use of an API threshold has undoubtedly contributed to this decrease.

It is clear, however, that the amount of pesticides used is also weather dependent. Nineteen eighty-six and 1987 were very dry years in Pakistan and surely contributed to decreased APIs, and thus, a decreased need for pesticides. With the heavy rains in 1988, the pressure to use more pesticides, and to ignore API thresholds ("spray everywhere") may increase.

6.4 Application Methods and Equipment

The insecticides will be applied to the inside wall surface of houses by the use of portable hand pressure sprayers (Fig. 2). The objective is to achieve a total coverage of all inside wall surfaces. Spraymen are trained to control the movement of the lance, and the distance of the nozzle tip from the wall to ensure the delivery of the correct dosage to the wall. Pump pressure is maintained by a specified number of strokes per pump charge. Training in the correct spraying technique, and filling and pressurizing the pump, is given to all spraymen at the start of the spraying season.

The only spraying equipment to be used in this project is the Hudson X-pert sprayer (4 gallon capacity) fitted with a T-JET 8002 hardened stainless steel nozzle tip that delivers a flat, fan-shaped spray pattern.

6.5 Acute and Long-term Environmental and Toxicological Hazards

6.5.1 Malathion

The acute and long-term environmental and toxicological hazards of malathion are summarized in Tables 1 and 2, respectively. They have recently been thoroughly reviewed as part of the Environmental Impact Statement on the Mediterranean Fruit Fly eradication program in Guatemala (CICP, 1988).

Based upon its relatively low mammalian toxicity and its long history of use in agricultural and public health programs, malathion is considered one of the safer, more benign synthetic pesticides.

Symptoms of overexposure can be treated with intramuscular injections of atropine sulfate. This antidote should be available to project personnel. Blood cholinesterase levels of all personnel who come in frequent contact with malathion should be monitored before and during the spray season to detect any suppression in accordance with WHO recommendations (see Annex J, WHO, 1982).

Accidental or suicidal ingestion of malathion can cause illness or death. Thus, malathion should be stored in a secured location, it should not be provided to householders, and it should be kept away from the public when brought out in bulk for use.

In the mid 1970s, a series of accidental deaths in Pakistan were attributed to a shipment of malathion which was contaminated with a highly toxic by-product, iso-malathion (Baker et al. 1978). Thus, monitoring of product purity is an essential component of safety procedures. Currently, malathion purchased by the project is certified as pure by the manufacturer. Should alternate purchase sources be considered, and/or if contamination of a pesticide lot is suspected, the project should send samples for analysis to the Centers for Disease Control in Atlanta.

6.5.2 Fenitrothion

The environmental and toxicological properties of fenitrothion are summarized in Tables 1 and 2 respectively. The environmental fate of fenitrothion is discussed in detail in Gordon (1981).

Fenitrothion is a more toxic material than is malathion, and thus, all procedures to minimize environmental impact and human exposure ingrained in project personnel for application of malathion must be more strictly and carefully enforced if fenitrothion is used.

6.6 Efficacy of Selected Insecticides for Mosquito Control

Both malathion and fenitrothion are efficient mosquito control insecticides, when applied as residual adulticides inside houses. The anopheline vectors of Pakistan, *An. culicifacies* and *An. stephensi* are known to enter houses at night seeking a blood meal, and rest on inside surfaces of houses for varying periods of time after biting man. Contact with surfaces sprayed with the appropriate insecticide is lethal to potentially infective mosquitoes, thereby breaking the chain of malaria transmission. Residual activity of these compounds varies from 1 to 4 months, depending on the type of wall construction material. House spraying in Pakistan, when properly timed in accordance with the

TABLE 1

SUMMARY OF ENVIRONMENTAL FATE ATTRIBUTES OF MALATHION AND FENITROTHION

PESTICIDE	BIRDS	FISH	OTHER ANIMALS	PLANTS	WATER	SOIL
Malathion	Not toxic	Toxic to small fish, fingerlings.	Toxic to bees.	Toxic to some ornamental plants.	Half-life of 18 days in sterile water.	Half-life of 0.5 days. Does not penetrate or accumulate. Degraded by soil bacteria.
Fenitrothion	Moderately toxic	Toxic	Toxic to bees and livestock, game and wild animals.	Phytotoxic: Brassica spp, flowering and orchard crops should not be applied to grains.	Half-life in river water of 50 hrs. In lake and sea water: 1 day.	Half-life of 12-28 days. Migrates in sandy soils. Inactivated by soil bacteria.

SOURCES: WHO Data Sheet on Pesticides No. 29 and 30.
Sumithion Technical Manual (Sumitomo Chemical Co., Ltd.)

TABLE 2

SUMMARY OF TOXICOLOGICAL ATTRIBUTES OF MALATHION AND FENITROTHION

PESTICIDE	LD^{50} ORAL[1]	LD^{50} DERMAL[1]	CUMULATIVE EFFECT	CUMULATION	INHALATION	CARCINOGENECITY	TERATOGENECITY	NEUROTOXIC
Malathion	2,800	4,500	Depressed cholin. levels.	Does not accumulate in body tissues.	No information	No effect	Teratogenic in chick embryos.	No nerve damage
Fenitrothion	504	3,500	Depressed cholin. levels. Severe may require 30 days recovery.	Does not accumulate in body tissues.	Depressed cholin. levels. 7 days recovery.	No effect	No effect	No nerve damage

[1]Rat, mg/kg.

SOURCE: WHO Data Sheet on Pesticides No. 30.

malaria transmission season, has been demonstrated to markedly reduce transmission of the disease, and in some cases, eliminate it entirely.

Malathion and fenitrothion, have been successfully used in MCPs of many countries for the past 20 years, including A.I.D. assisted malaria control projects in Ecuador, India, Sri Lanka and Pakistan. Both of these compounds have passed successfully through WHO's strict screening procedures, and are cleared for use in malaria control programs, provided that proper use practices are followed.

6.7 Effect of Selected Insecticides on Non-target Organisms and Natural Environment

The effects of both malathion and fenitrothion on non-target organisms and the natural environment are summarized in Table 1.

6.8 Conditions Under Which Insecticides Are to be Used

The insecticides will be applied to the inside wall surfaces of houses by spraymen who have been trained in correct application techniques and safe use practices for those materials. The spray team consists of five spraymen (Fig. 1) and one mixer, all working under a team leader who is the Malaria Supervisor. The mixer stays in a fixed spot in the village, where he measures the insecticide (water wettable powder) directly from the cardboard shipping carton into a mixing bucket, one pump charge at a time. He then adds a small amount of water to make a thick slurry, then adds more water to a line which indicates one pump charge (Fig. 3). Spraymen return to the mixing station for refilling the pumps when necessary throughout the day.

Householders are notified in advance as to when the house is to be sprayed, and what is to be done to prepare the house for spraying. They are told to remove all food from the house and move furniture away from walls (Fig. 4). They are also instructed to remain outside the house for at least one hour after spraying, to then sweep the floors, and to bury the sweepings. Instructions are also given about keeping domestic animals outside during the spraying, and for the waiting period after the spraying.

Spraymen are assigned a predetermined number of houses to spray per day, and their work is frequently checked by the Malaria Supervisor. He, in turn, is periodically supervised by the Malaria Superintendent and the District Medical Officer. Daily records are kept of houses sprayed and insecticides used. Insecticide stocks, in their original shipping cartons, are kept in a locked room in the village (Fig. 5), and access is controlled by the Malaria Supervisor.

A.I.D. has prepared several hundred laminated cards (Annex H) which describe in Urdu the treatment for pesticide poisoning and the dosages for chemotherapy. These have been distributed widely to all levels of malaria workers.

6.9 Availability and Effectiveness of Other Insecticides and/or Nonchemical Control Measures

For reasons already discussed in section 6.2, it is advisable to continue using malathion until such time that it becomes operationally ineffective, and then to gradually phase in the use of fenitrothion. A third line of chemicals, suitable for indoor use, are available, and might be considered for use in the future should fenitrothion fail. Candidates for consideration include bendiocarb, propoxur, pirimophos methyl, and a pyrethroid (possibly Permethrin). These insecticides are available commercially, but any decision to use them in the future should be based on careful analysis of results of field trials carried out in Pakistan, as well as in other countries.

Nonchemical malaria control methods involving source reduction by drainage and improved water management are available and appropriate for use in urban settings. Efforts to introduce nonchemical control measures into rural areas of Pakistan are at present nonexistent, but should be considered for selected localities in the future.

6.10 Ability of the Government of Pakistan to Regulate or Control the Distribution, Storage, Use and Disposal of Pesticides

In the absence of legislation in Pakistan regulating the transport, storage, use and disposal of hazardous materials such as pesticides (see section 2.2), the EA team believes that safety procedures for the extension have been and will continue to be exercised primarily through the GOP's Directorate of Malaria Control and the offices of the Provincial Directors of Health. The following describes the team's findings as they visited ongoing project operations in which malathion is used.

The EA team was unable to visit Karachi where the shipment of malathion is received and unloaded from ship to trucks. In the past, both A.I.D. and DOMC have sent technical officers to oversee the unloading of insecticides in Karachi. This surveillance should continue so that potential problems may be corrected. The pesticide accident contingency consultant could be of assistance in these inspections (See 8.2.1.6).

Contract truckers distribute the pesticides. Each truck carries 7 MT so that approximately 175 trucks were needed to distribute the 1,200 MT of malathion received in 1988. The ability of these truckers to react appropriately if an accident occurs en route should be determined. (See 8.2.1.6).

Thus, the team believes that the distribution system, particularly in regard to safety at the port and en route should continue to be examined.

The system of pesticide distribution to be used in the project will minimize handling and secondary transport. No large provincial or district distribution centers are planned. Instead, pesticides are taken directly from Karachi to a rural health center (RHC) close to the intended site of use. Most RHCs have an empty room available for use which is away from frequented areas. The team visited 3 of these sites in the Punjab. All were secured with locks, solidly constructed, neatly maintained and inventoried. Pesticide boxes were placed on dry floors (usually soil) (Fig. 5), and the rooms were passively ventilated with windows. Rain was prevented from entering by window overhangs and elevated door sills.

Oldest pesticides (at most 1 year old) were used first. In most instances stores are empty much of the year because supplies are depleted in August and not resupplied until March. Only project malathion was stored in these facilities. Otherwise, they were empty.

Small numbers of boxes are removed as needed from the RHC store and are transported by small trucks to the spray site. The team did not see this last leg of transport.

Sometimes 4-5 boxes of pesticides will be stored at the spray site for one week while the village is sprayed. The team saw one of these storage rooms in the NWFP. It was a locked room in an infrequently used "guest house." Two beds were in the storage room, and small amounts of malathion were spilled on the floor. The room had been recently sprayed with malathion - an indication that it was considered a sleeping room.

Wheel barrows were used to move boxes from this store to the mixing area in the village.

The use of project pesticides is discussed in section 6.8.

Disposal of unused pesticides should not be necessary during the project; all pesticides will be used either the year they are purchased or the following year. Amounts of pesticides purchased are, to the extent possible, based upon predicted need (see section 2.3). Thus, supply is matched to use.

Malathion is delivered to the project in plastic lined cardboard boxes. Each box holds about 30 kg of pesticide and measures roughly 80cm X 40cm X 40cm. When empty, the cartons are flattened and burned. Cardboard boxes are more easily disposed of than are metal drums; if fenitrothion is purchased, it should be packaged in cardboard containers.

Rinsate from mixing buckets and spray tanks was sometimes disposed of in dug holes away from water sources, and sometimes into open water/sewage channels that ran through the village.

6.11 Provision for Training of Malaria Control Insecticide Users

Specialized preservice and in-service refresher courses for senior and midlevel provincial and urban health officers (malaria staff and general health staff working on malaria) are provided regularly by NIMRT in Lahore. The courses offered are designed to meet the current malaria control program needs. Preservice courses include 12-14 week courses for physicians, malaria superintendents and entomologists, and 10 week courses for junior field supervisors. A part of the curriculum is instruction in insecticide application technologies, formulations, safe use practices and the use of cholinesterase test kits. In addition, a USAID-financed 3-day workshop is given annually for entomologists, malaria superintendents and health education officers in each province, the subject being safe use of insecticides. The objective is to give refresher training to these trainers, who will in turn give instructions to all malaria supervisors who will serve as spray squad leaders.

When spraymen and mixers are employed for the spraying season each year, they are given a one week training period by the malaria supervisors who will be their squad leader. This training includes proper mixing and spraying techniques, and safety precautions to protect employees as well as householders.

6.12 Provision for Monitoring the Use and Efficacy of the Selected Insecticide

The regular system of supervision of spraying operations within the framework of the Malaria Control Program is described in section 6.8. In addition to this, A.I.D. has its own system of safe use monitoring. A foreign service national employee of HPN has the responsibility of making visits to localities where spraying is going on to check on the insecticide handling and storage practices. These responsibilities are included in this employee's job description. During these site visits he checks spraymen for adequate protective clothing, and the spray equipment for proper maintenance. He also observes and reports on spraying techniques and record keeping. An inspection check list has been developed to assist him in his inspection, and an example of this list is given in Annex F.

As for efficacy of the selected insecticide, the final test for this is whether the API is reduced in a sprayed locality. These values are calculated at the end of each year and may be compared with the API for previous years in the same locality. In addition to this, entomological techniques are available for testing the efficacy of the spray. These include bioassays of

sprayed surfaces, and indoor captures of resting vector mosquitoes before and after spraying. Both of these techniques are routinely employed by the MCP.

7.0 ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

The following section highlights probable impacts of the Malaria Control II Project Extension. Further discussions are found in Sections 6.5 and 6.7 of this EA.

7.1 Unavoidable Adverse Environmental Impacts

Because of the contained nature of the intradomiciliary application of insecticides and the threshold method upon which spray decisions are based, the impact of insecticides on the outdoor environment should be negligible. Indoor spraying may effect the environment if arthropods killed by the sprays indoors are consumed by domestic animals or predators. Sweeping and burying insects killed by insecticides should minimize this possibility. Contamination of water with rinsate from mixing buckets and tanks will be minimized if rinse water is buried in a hole away from water sources.

Impact on humans is unavoidable. Spraymen will be exposed. This EA indicates methods of decreasing such exposure.

7.2 The Relationship Between Short-term Impacts and Long-term Productivity

Major benefits would accrue as a result of the program if malaria was suppressed to or maintained at low levels (below 2.0 API). Human welfare and vigor should be enhanced.

Complete eradication of malaria is probably not a feasible short-term goal in Pakistan, both because of the large population, and the mobility of that population. Cases are always entering the country from abroad. Thus, there will probably always be a need for surveillance and treatment to detect and combat low levels of malaria in Pakistan. The cost of such activities is undoubtedly outweighed by the benefits.

Additional costs, although difficult to estimate, must, however, be factored in. For example, the cost of accidents during the transport, storage or use of project pesticides could be considerable. This EA recommends ways of preparing for such eventualities to decrease the severity of potential accidents (8.2.1.6).

7.3 Irreversible or Irretrievable Commitments of Resources

The proposed project would result in the irretrievable consumption of petro-chemicals in the form of pesticides and motor fuel.

In the unlikely event that insecticide application was to permanently alter some aspect of the affected ecosystem, this would represent an irreversible change. Given the contained nature of intradomiciliary pesticide application in the project, this is not expected to occur.

8.0 ENVIRONMENTAL IMPACT MITIGATION PLAN

The following section describes a prioritized plan of action that should assist project personnel in maintaining and improving the safety aspects of pesticide use in the project.

The EA team feels that current project personnel, from administrator to sprayman, are sensitive to safety concerns and are adequately using many safety precautions. This level of safety awareness is expected to continue through the extension. In certain aspects, it should be enhanced. The recommendations that follow are necessary for the safe use of malathion. They are critically necessary with the anticipated use of fenitrothion.

8.1 Priorities

The EA team believes that the primary pesticide hazard in the extension will be to humans exposed to spray, not to the outdoor environment. Safe handling should minimize the chances of contaminating the outdoors. Thus, safety protocols are considered of highest priority. Appropriate protection, monitoring, treatment, handling and training are important parts of the protocols. Accident contingencies should also be considered. The necessary level of each will be described (8.2.1).

Next in importance is research that should be conducted in direct support of establishing safety protocols (8.2.2).

Thirdly, means to monitor project performance and compliance in safe handling of pesticides are given (8.2.3).

Lastly, cooperative/coordinated planning between vector control, agricultural and engineering projects should be encouraged (8.2.4).

8.2 Safety Protocols

8.2.1 Protection

8.2.1.1 Spray Uniforms. The most critical adjustment that must be made regards protective clothing. Each sprayman, each mixer, each supervisor and each administrative inspector who routinely comes in contact with pesticides must be provided each year with a spray uniform package consisting of 2 suits for malathion sprayers and their supervisors, and 4 suits for fenitrothion sprayers and their supervisors. These suits will include a long sleeve shirt, pants, impermeable shoes, rubber gloves, a disposable mask (one for each day of exposure) and a cloth head covering. Additionally, 40 extra uniforms should be

available in each province to replace worn out, torn or otherwise useless uniforms. The shirts and pants should be made from good quality, durable fabric that withstands frequent wear and washing.

Presently, spraymen and supervisors are provided 1 or 2 suits of poor quality easily-torn material, no gloves, no footwear (Fig. 1), and they use turban cloths as face masks. Mixers have the same gear plus gloves. Provision of a change of suits should enable spraymen to wear a clean suit every day. Supervisors should check that spraymen are wearing clean suits every day. Gloves, shoes and daily disposable masks will greatly decrease exposure to pesticides.

The estimated cost of spray uniforms packages is given in Annex G. The costs provided in Annex G are based on the need for two sets of protective clothing for us of malathion; or, four sets for use of fenithrotion. The actual costs may be calculated when the number of employees using the respective compounds is determined.

The EA team recommends that pesticides not be applied under the extension until spray uniform packages as described above are provided.

Soap should be provided as it currently is, at the rate of 1 bar/week/sprayman. Provisions for spray tank equipment and replacement parts are adequate as planned for the extension.

To minimize mistakes in measuring out pesticides, each mixer should be provided a standard, calibrated container.

8.2.1.2 Householders. The best method of protecting householders from exposure to spray is to enforce the follow protocol:

1. Remove all items from the house.

2. Keep people and animals away from the house as it is sprayed.

3. After spraying, close all doors to prevent entry, but open all windows to hasten ventilation and drying.

4. Prohibit reentry for 1 hour.

5. Sweep floor and bury sweepings in a hole away from house.

6. Post house cards in each house to record visits, inspections and sprays.

8.2.1.3 Overexposure

8.2.1.3.1 Monitoring. Each province should be provided with enough blood cholinesterase monitoring kits such that each spray district in each province has a new kit available at least 2 months before spraying begins.

All members of the spray squad (supervisor, mixer, sprayman) should have levels tested before the spray season and at least once during the spray season -- 2 to 3 weeks after spraying starts. Thus each district must schedule the time needed for trained manpower to conduct this monitoring program.

Workers with levels of cholinesterase lower than 70% of normal should not be allowed to spray for 1 week, and then only if and when levels have returned to above 70% of normal. For details see WHO recommendations (Annex J).

The estimated cost of kits is given in Annex G.

8.2.1.3.2 Treatment. Currently, each spray squad supervisor is aware of the symptoms of overexposure; he is equipped with vials of atropine sulfate and syringes, and knows how to inject. The EA team feels that this level of preparedness is appropriate and should be continued.

At the same time, the team recommends that all squad members should be instructed to seek medical attention for the poisoned victim after initial injection of atropine.

The squad's key role should be to detect overexposure and to deliver cases and medication quickly to a health unit. This recommendation should be reviewed by the Accident Contingency Consultant (see 8.2.1.6).

As part of the project extension, health unit personnel should be trained in the recognition and treatment of pesticide overexposure and all health units in areas to be sprayed should be supplied with atropine sulfate. See Annex G for estimated costs of atropine sulfate kits.

8.2.1.4 Transport, Storage and Disposal. Each driver transporting pesticides from Karachi to storage sites should be provided with instructions (written or oral) on the nature of the hazardous material being transported, safety precautions needed in handling and transporting the materials, and procedures that should be followed in the case of an accident en route. Such instructions should be developed by the Accident Contingency Consultant (see 8.2.1.6).

Storage should be in a secured, solidly constructed, clean, otherwise empty facility that is away from frequented areas. Rain-protected windows that can be opened for ventilation should be available. Inventories should be kept current and a first-in, first-out use pattern should be employed. The decentralized storage system, whereby shipments are transported direct from port to site of use, should be continued. It decreases handling.

Most of the storage conditions described above are met by the ongoing project. The following are recommended:

1. Under no circumstances should living quarters, temporary or otherwise, be used for storage sites. This requirement may complicate storage at localities being sprayed, but it must be followed to minimize human exposure.

2. Based upon recommendations by the Accident Contingency Consultant, provisions for preventing fires in stores should be made.

Disposal of unused pesticides presumably will not be required because all pesticides will be used. If this situation changes, project personnel should immediately seek advise on current methods of disposal in Pakistan.

Empty pesticide boxes should be collapsed, collected, moved away from inhabited areas, and burned.

At the end of each spray day, clean up of mixing buckets and spray cans should be conducted away from inhabited areas and water sources. The present practice of burying rinsate in a hole should be continued. Rinsate should never be poured in a water source or channel.

8.2.1.5 Safety Training. In 1988 as in previous years, workshops were held in each Province on the safe use of pesticides. All Assistant Entomologists and CD officers involved in malaria control attended the workshops. Participants were expected to pass safety information on to each Malaria Supervisor. In this way safety procedures were reinforced throughout the malaria control program system.

The same workshops should be held in Islamabad annually during the extension. Costs of such workshops are provided in Annex G.

8.2.1.6 Accident Contingency Consultant. Accidents with pesticides are a common concern. They can cause serious damage, program setbacks, and loss of life. Although not totally

unavoidable, accidents can be minimized through careful observation of safety precautions. When they occur, their impact can be decreased if contingency plans are in place and observed.

Pesticide accidents can occur at any time between receipt at port to disposal of empty containers, but times of greatest danger are handling at port, transportation, storage and use. The proposed project will, through distribution of atropine sulfate, be prepared for overexposure accidents at the site of use. No other written contingency plans are in place for accidents at other times.

It is recommended that a 3-week Accident Contingency Consultant be contracted to observe project operations, advise on safety aspects of port handling and transportation of pesticides, and develop accident contingency plans for all aspects of the extension project.

A scope of work for such a consultant is given in Annex G.

8.2.2 Research

The proposed project extension includes $300,000 for research support and $150,000 for research equipment. The research will be conducted at NIMRT and is to stress operational, applied research. Ten areas of study have been outlined in the PP including pilot studies of alternate insecticides, monitoring of the effectiveness of currently used insecticides, bionomic studies of vectors, and use of mosquito control alternatives such as fish, bacteria, or source reduction.

The EA team recommends that an epidemiological study be made of factors leading to cholinesterase depression in spray squads. When depression is detected, follow-up research should be conducted by way of interviews to determine what conditions such as age, overall state of health, protective clothing, spray practices, etc., most likely led to the depression. Researchers should refer to WHO's standard protocol (1981) for field surveys of exposure to pesticides as they conduct this research.

Results from such research will enable project personnel to avoid incidences of overexposure.

8.2.3 Monitoring Project Performance and Compliance

A program evaluation will be carried out each year of the project by a joint GOP/AID/WHO team supplemented by one project-financed external consultant.

Included in the evaluation team's assessments will be the utilization of insecticides, spray operations and insecticide handling techniques and safety measures.

The EA team recommends that all recommendations made in this EA be reviewed by a qualified member of the evaluation team. The degree to which compliance with the recommendations has been achieved should be assessed.

8.2.4 Cooperative/Coordinated Planning

To the extent possible, USAID/Islamabad should encourage the participation of staff from HPN, EE and ARD in the review of PIDs and PPs for projects involving dam construction or irrigation schemes. Malariogenic potential of agricultural and engineering projects should be assessed. The Mission's Environmental Advisor may be best positioned to coordinate such reviews.

Communication between agriculturalists and vector control specialists must be enhanced, particularly in regards to pesticide usage. The Mission Environmental Advisor should stay advised of the types of pesticides being used and the pattern of use in each sector. The incidence of resistance to insecticides should be followed in each sector. Resistance in vector control programs should constitute grounds for considering banning the use in agriculture of alternative vector control pesticides.

9.0 LIST OF PREPARERS

Hobbs, Jesse (b. 1925, U.S. citizen), Sc.D., Johns Hopkins; recently Long-Term Malaria Advisor 1985-87 USAID/Ecuador; Retired CDC (1965-1985) as Medical Entomologist; formerly Chief, Training Activities VBC Division, CDC; Colombia, Brazil, Peru; A.I.D.: Jamaica, Philippines, Guatemala; CDC: Brazil, El Salvador. A.I.D. Assessments and Evaluations in Haiti and Pakistan (1984 and 1985); Red Cross: Thailand; World Bank: Brazil. Areas of experience include malariology, vector biology and control, project management, logistics, testing and safe use of pesticides and training in all above areas. Numerous publications and training manuals on above subjects. Languages: Spanish and Portuguese S3; R3.

Larew, Hiram G. (b. 1953, U.S. citizen), Ph.D., Oregon State University; currently American Association for the Advancement of Science Fellow in A.I.D's Bureau for Science and Technology, Office of Agriculture, Pest Management. On leave from USDA, Agricultural Research Service, as a Research Entomologist. Has conducted A.I.D evaluations of pesticide use in Dominican Republic, Guatemala and Pakistan. Areas of experience include: agricultural pest management, agricultural research, safe use of pesticides and alternatives to pesticides. Numerous research publications on agricultural pest management.

10.0 REFERENCES

AID. (1982). Project Paper: Pakistan - Malaria Control II. (391-0472).

AID. (1985). Report of the external review of the Pakistan Malaria Control Program (391-0472).

AID. (1987). Terminal evaluation: Pakistan - Malaria Control II (391-0472).

Baker, E.L., M. Warren, M. Zack, R. D. Dobbins, T.W. Miles, and S. Miller. (1978). Malathion intoxication in spray workers in the Pakistan malaria control program. **Lancet**, 8054: 31-34.

CICP. (1988). Guatemala Medfly Environmental Impact Analysis. 272 pp.

Georghiou, G.P. (1986). A review of insecticide resistance in malaria vectors in Pakistan and recommendations for future action. Report filed with USAID. 39 pp.

Gordon, K. (1981). The fate of fenitrothion in the environment and its effects on organisms. Australian plague locust commission, Tech Report No. 3, 149 pp.

TVA. (1940). Malaria Control on Impounded Water.

WHO. (1982). Field survey of exposure to pesticides: Standard protocol. Division of Vector Biology and Control. VBC/82.1 14 pp.

WHO. (1986). Resistance of vectors and reservoirs of disease to pesticides. Tenth report of the WHO Expert Committee on Vector Biology and Control. WHO Tech Report Ser. 737.

ANNEX A

PERSONS CONTACTED

GOVERNMENT OF PAKISTAN

1. Choudhary Mujahid
   Director
   Directorate of Malaria Control
   Islamabad

   In Lahore District

2. Dr. Z. A. Khan,
   Director Health Services, Punjab

3. Dr. D. Tirmizi
   Deputy Director Health Services, Punjab

4. Dr. I. H. Shah
   Director, NIMRT

5. Mr. Mateen ul Haq
   CDCO

6. Mr. Javed Iqbal Malik
   Assistant Entomologist

7. Mr. M. Iqbal
   Admin Assistant
   DHS

8. Dr. Arshad Awan
   Assistant Director Malaria, DHS, Punjab

9. Mr. Abdul Qayyum Khan
   Director Agriculture, Punjab

10. Choudhary M. Shafi
    Deputy Director Agriculture
    Lahore Zone

11. Dr. Mohammad A. Raees, DHO

12. Sardar A. Shaikh
    Assistant Entomologist

13. Shaikh M. Ehsan, CDCO

14. Manzoor H. Shah
    Senior Microscopist

15. Mr. M. Sharif Bhatti
    Microscopist

16. Talib Hussain
    CDC Inspector

17. Abdul Ghafoor

18. Mohammad Ashraf

19. Dr. Akhtar M.O.I

20. Israr ul Haq
    M.O.II

In Sheikhupura District

21. Dr. Munnawar Jussain Bhutta
    DHO

22. Shaikh Naseer
    Assistant Entomologist

23. Mr. Azam Azhar
    CDCO

24. Mr. Mohammad Azeem
    Senior Microscopist

25. Mr. Manzoor Ali
    Microscopist

26. Dr. Noor ul Haq Hassan
    Medical Officer I

27 Dr. M. Ashiq Hussain
    Medical Officer II

28. Mr. Mushtaq
    Microscopist

In Gujranwala District

29. Dr. S. M. Nasir
    Deputy Director
    Gujranwala Division

30. Dr. Ahmad Saeed
    D.H.O, Gujranwala

31. Dr. Tajjamul Hissain
ADHO, Gujranwala

32. Mr. Rafi
CDCO

33. Shaikh Saleem
Assistant Entomologist

34. Choudhary Mohammad Ashraf
CDCO

In Peshawar District

35. Dr. Sardar Ali
Director Health Services, NWFP

36. Dr. Iqbal A. Khan
Assistant Director Malaria, NWFP

37. Mr. Aziz Khan
Malaria Superintendent
NWFP & UNHCR

38. Dr. Abdul Rahim
Assistant Entomologist
DHO, Peshawar

39. Mr. Fazal-e-Raziq
Assistant Entomologist
Provincial NCP Office
Peshawar

40. Mr. Sardar Ali
Deputy Director Agriculture

41. Mr. Abdul Murad
Assistant Director Agriculture

42. Mr. Mohammad Naeem
Plant Protection Officer

USAID/WASHINGTON

1. Mr. Glenn Rutanen-Whaley
ANE/PD/ENV

2. Dr. Clive Shiff
ST/H

3. Dr. Dennis Long
   ST/H

USAID/ISLAMABAD

1. Dr. Rifaq Ismail
   HPN

2. Dr. Ray Martin
   HPN

3. Mr. Babar Hussain
   HPN

4. Dr. Robert Nachtrieb
   PDM

5. John R. Morgan
   EE

OTHERS

1. Dr. Peter Okoye
   United Nations High Commission for Refugees
   Islamabad

2. Richard Nesbit
   United Nations High Commission for Refugees
   Islamabad

3. Dr. Nobill Taweel
   WHO Country Representative
   Islamabad

4. Dr. Andrew Arata
   VBC
   Washington, DC

ANNEX B

SCOPING STATEMENT

SCOPING STATEMENT FOR THE ENVIRONMENTAL ASSESSMENT OF PESTICIDE USE IN THE MALARIA CONTROL II PROJECT EXTENSION

1. INTRODUCTION

This scoping statement was prepared as a result of briefings held in Washington DC and Pakistan, and a field visit in Pakistan in August 1988. It was written by the EA team in accordance with 22 CFR 216.3(a)(4) (a)-(d). Its purpose is to identify the issues that will be analyzed in the EA of pesticide use in the Malaria Control II Project Extension and to describe how the EA will be conducted.

2. PROJECT DESCRIPTION AND PROPOSED PESTICIDE USE IN THE MALARIA CONTROL II PROJECT EXTENSION

The extension of Malaria Control II will, like its predecessor, consist of four components: (1) Program Management: Short- and long-term technical assistance to strengthen the MCP in the areas of program management, entomology, epidemiology, safe handling of insecticides, evaluation, surveillance, urban malaria control, and environmental management; (2) Training: Short term technical assistance to strengthen the training capability of NIMRT to meet in-country training needs of the MCP (i.e., long and short term overseas training, fellowships and in-service training programs for malaria and general health services personnel) in specific aspects of malaria control; (3) Operational Research: Short term technical assistance to strengthen the capabilities of NIMRT and provincial malaria control programs to conduct operational research and field studies, to obtain supplies and equipment for research and to provide budgetary support for operational research and field studies, and, (4) Commodity Support: Residual insecticide, spray equipment, malaria control vehicles, ULV spray and fogging machines, adulticide, microscopes and other necessary commodities.

A limited amount of insecticide spraying of rural dwellings will continue to be a part of malaria control in Pakistan. The GOP recognizes that spraying can no longer be the central effort of its malaria control program, because it does not strike at the root of the malaria problem. The GOP is now directing its insecticidal spray operations mainly to malaria positive areas and

encouraging PCD and treatment of malaria cases at health facilities, and thus the project extension will consolidate this initiative.

In recent years spraying operations have been mounted in 35-40 of Pakistan's 59 districts. Given the development of widespread vector resistance to DDT and HCH (the internationally recognized malaria control insecticides of first and second choice, respectively) in Pakistan, the use of malathion and/or fenitrothion or other OP compounds is indicated. Malathion is one of the least toxic of the residual OP insecticides; fenitrothion, on the other hand, is one of the more toxic.

Future surveillance will restrict spraying to limited areas within each district. Under the MCP selective spraying approach only villages with an API of 2.0 or more cases per thousand population and/or any incidence of falciparum malaria are targeted for spraying. DOMC and USAID have estimated that 1200 MT of insecticide will be needed in the 1988 season for selective spraying of those areas with an API of 2.0.

3. SCOPE AND SIGNIFICANCE OF ISSUES

The proposed use of pesticides in the project extension include: (1) intradomiciliary sprays of malathion or fenitrothion in rural settings and, (2) the application of synthetic pyrethroids through ULV apparatus and larvicides in urban settings. All pesticide applications are to be limited to sites in which the incidence of malaria exceeds a predetermined threshold level of 2.0 API. In other words, pesticide applications will be focused and limited in range. No broad-scale area-wide applications are envisioned.

Although detrimental impact of malathion or fenitrothion on the environment is possible, the EA team believes that it should be minimal both because of its focused nature and because house spraying limits outdoor impacts. (See further comments on ULV application and larvicides, Section 3.1)

The EA team believes the greatest potential negative impact is to humans associated with the pesticide program (i.e., the applicators, the storage managers, and public in treated areas). Thus, the following issues were identified for further assessment.

1. Determine what pesticides are or might be used in the extension project. Discuss appropriateness of each.

2. Determine what the current safety procedures are for house spray operations. If they are adequate, provide recommendations for maintaining current levels of safety. If they are inadequate, provide recommendations for improving safety practices.

3. Determine what the current safety procedures are for pesticide storage, distribution and disposal operations. Provide recommendations for maintaining or improving these operations.

4. Determine proposed level of cholinesterase monitoring for pesticide poisoning in the extension. Provide recommendations for maintaining or improving this monitoring.

5. Determine the extent to which drug treatment will be used in conjunction with insecticides or will be used alone in combating malaria in the extension, and suggest if and when a continued or single-tactic approach would be appropriate.

6. Determine the extent to which means other than synthetic pesticides will be used for insect control in the extension and suggest, as appropriate, ways in which these methods can be incorporated into the extension.

7. To the extent possible, determine impact of agricultural pesticide use in Pakistan on malaria control efforts and suggest methods to mitigate negative impacts.

8. Determine level of malaria control effort in Afghan refugee camps and, if appropriate, suggest ways in which this effort could interact with the extension project.

9. Determine current level of research at NIMRT and, as appropriate, identify critical pesticide-related research topics.

10. Suggest ways that the response and reaction to EA team's recommendations can be monitored during extension, to ensure sustained safety awareness after completion of extension.

4. ISSUES ELIMINATED FROM DETAILED STUDY

It is the EA team's opinion that, like many other malaria control efforts, the Pakistan MCP II extension would not be of detriment to the nonhuman environment. Effects of pesticides used in the extension on non-target organisms will be outlined in the EA but development of mitigative actions in this regard is not warranted.

The importance of storage safety and appropriate disposal will be stressed to minimize these potential sources of environmental contamination. Use of buffer zones around sprayed areas, or set asides, however, will not be covered, as they are not pertinent.

5. TIMING AND PLANNING

The EA will be written as a result of a 2 person team review of the ongoing malaria control effort in Pakistan. The team will visit Pakistan in August, 1988 for 3 weeks. They will discuss pertinent issues with key project personnel in the GOP and A.I.D., and will visit field sites in the Punjab and NWFP to observe spray application and storage.

Before leaving Pakistan the team will submit a draft EA to A.I.D./Pakistan and will brief Mission personnel on EA recommendations. Upon returning to the US the team will complete the EA for submission to AID/ANE/PD/ENV.

No variations on procedural EA guidelines are foreseen.

6. CONDUCT OF ANALYSIS AND TEAM COMPOSITION

The analysis will be conducted as per the statement of work (Attachment 2 of PIO/T No. 391-0472-3-50353), and in accordance with 22 CFR 216.

EA recommendations involving costs to the project will be analyzed by the EA team. Estimates will be included in the EA.

The EA team will be composed of a malariologist with wide experience in the conduct of malaria control programs, and an agricultural pest management specialist with expertise in pesticide safety, in the impact of agricultural projects on malaria control efforts, and in A.I.D. pesticide environmental regulations.

ANNEX C

PESTICIDE LABELS
MALATHION

LOT NO.
DATE OF PRODUCTION:

MALATHION*

PREMIUM GRADE

50% W/W Water-Dispersible Powder

Insecticide

WHO/SIF/10.R5

A.I.D. SPEC. NO. SER/COM/82/02-FM

KEEP OUT OF REACH OF CHILDREN

CYANAMID

Active Ingredient:

O,O-dimethyl S-[1,2-di-(ethoxycarbonyl)ethyl)] phosphorodithioate (Malathion) ..... 50% W/W

Inert Ingredient 50%
(Malathion 500g/Kg)

*TRADEMARK OF AMERICAN CYANAMID COMPANY

Net Contents: 30 kg	24607-34

EPA Est. No. 6720-FL-01

CAUTION!

MALATHION insecticide is an organophosphorus compound that inhibits cholinesterase. It is poisonous if swallowed, inhaled or absorbed through the skin.

Keep out of reach of children.
Keep away from domestic animals. Toxic to fish.
Keep away from food stuffs, animal feed and their containers.
Do not contaminate any body of water by direct application, cleaning of equipment or disposal of waste or containers.
Avoid breathing spray mist or dust.
Avoid contact with skin or clothing.
Wash with soap and water after using.
Remove and wash clothing before re-use.

STATEMENT OF PRACTICAL TREATMENT
In case of contact, wash skin with plenty of soap and water. For eyes, flush with water for 15 minutes; get medical attention if irritation persists. If poisoning occurs call a physician.

NOTE TO PHYSICIAN: MALATHION insecticide is a cholinesterase inhibitor. Atropine is antidotal. Pralidoxime chloride (2-PAM; PROTOPAM chloride) may be effective as an adjunct to atropine. Artificial respiration may be needed.

Container Disposal: Burn or bury containers as soon as possible after they have been emptied, in a commercial incinerator or supervised dump, after notifying the supervisor of the nature of the containers so that necessary precautions may be taken. Do not burn the empty containers as fuel for home heating or cooking.

Do not breathe the smoke of burning containers.

Store in a cool place and use as soon as possible after manufacture to avoid decomposition, which may occur under conditions of prolonged tropical storage.

The label instructions for the use of this product reflect the opinion of experts based on field use and tests. The directions are believed to be reliable and should be followed carefully. However, it is impossible to eliminate all risks inherently associated with the use of this product. Ineffectiveness or other unintended consequences may result because of such factors as weather conditions, presence of other materials, or the manner of use or application all of which are beyond the control of American Cyanamid Company. All such risks shall be assumed by the user. American Cyanamid Company warrants only that the material contained herein conforms to the chemical description on the label and is reasonably fit for the use therein described when used in accordance with the directions for use subject to the risks referred to above.

Any damages arising from a breach of this warranty shall be limited to direct damages and shall not include consequential commercial damages such as loss of profits or values or any other special or indirect damages.

American Cyanamid Company makes no other express or implied warranty, including any other express or implied warranty of fitness or of merchantability.

CONSULT YOUR CYANAMID DISTRIBUTOR FOR DIRECTIONS ON USE OF THIS PRODUCT

Manufactured by:
AMERICAN CYANAMID COMPANY
Agricultural Division
Wayne, New Jersey, U.S.A.

L5393 R7

Sumithion® 40WDP

FOR USE ONLY BY OR UNDER THE SUPERVISION OF STATE OR FEDERAL OFFICIALS RESPONSIBLE FOR MALARIA CONTROL

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS

WARNING

Causes eye irritation. Harmful if swallowed. Do not get in eyes. Avoid contact with skin. Wear protective gloves, clean protective clothing and goggles or face shield when handling the material. Remove and wash contaminated clothing before reuse. Wash hands and arms thoroughly after handling and before eating, drinking or smoking.

Do not permit children or pets near treated surfaces until dry.

Keep out of domestic or animal water supplies.

Do not store or transport with food or animal feed.

Do not contaminate water by cleaning equipment or disposal of containers.

STORAGE AND DISPOSAL

1. **PROHIBITIONS:** Do not contaminate water, food, or feed by storage or disposal. Open dumping is prohibited.
2. **PESTICIDE DISPOSAL:** Pesticide, spray mixture, or rinsate that cannot be used or chemically reprocessed should be disposed of in a landfill approved for pesticides or buried in a safe place away from water supplies.
3. **CONTAINER DISPOSAL:** Dispose of in an incinerator or landfill approved for pesticide containers, or bury in a safe place.
4. **GENERAL:** Consult Federal, State or local disposal authorities for approved alternative procedures such as limited open burning.

ACTIVE INGREDIENTS:
0,0 Dimethyl 0-(4-nitro-m-tolyl) phosphorothioate .....40% (w/w)
INERT INGREDIENTS: .....60% (w/w)

WARNING

KEEP OUT OF REACH OF CHILDREN

SEE SIDE PANEL FOR PRECAUTIONARY STATEMENTS

STATEMENT OF PRACTICAL TREATMENT

If in eyes, wash thoroughly with water for 15 minutes. Get medical attention.

If contact with skin, wash thoroughly with soap and water. Get medical attention if irritation persists.

Note to Physician: Sumithion is an organophosphorous compound that inhibits cholinesterase. Atropine is antidotal. 2-PAM is also antidotal and may be administered in conjunction with atropine.

DIRECTIONS FOR USE

It is a violation of federal law to use this product in a manner inconsistent with its labeling.

For control of adult Anopheline mosquitoes in private residences only. Not for use in food handling establishments or in food handling areas of private residences.

Apply as a residual spray to wall surfaces at a rate not to exceed 2 grams (active ingredient) (0.07 oz) per square meter of surface. Cover floor area, furniture and other objects prior to spraying. After spraying is complete, remove coverings and dispose of in an incinerator or landfill approved for pesticides or bury in a safe place. Do not allow occupants of residence to return until treated surfaces have dried.

Recommended dosage: Mix one kilo (2.2 lbs) of Sumithion 40 WDP with 8 liters (2.1 gal) of water and apply to 200 sq m (2153 sq ft) of wall surface to obtain 2 g/sq m (.07 oz/10.8 sq ft). Agitate well before using. Do not apply more often than once every three months.

NOTICE — READ CAREFULLY

CONDITIONS OF SALE:
Sumitomo (and seller) offer(s) this product for sale subject to, and buyer and all users are deemed to have accepted, the following conditions of sale and warranty which may only be varied by written agreement of a duly authorized representative of Sumitomo.

WARRANTY LIMITATION:
Sumitomo warrants that this product conforms to the chemical description in the directions for use on the label subject to the inherent risks referred to below. Sumitomo makes no other express warranties: THERE IS NO IMPLIED WARRANTY OF MERCHANTABILITY and there are no warranties which extend beyond the description on the label hereof.

INHERENT RISKS:
The directions for use of this product are believed to be reliable and should be followed carefully. However, it is impossible to eliminate all risks associated with use. Buyer assumes all risks associated with use or application of this product contrary to label instructions or resulting from extraordinary weather conditions.

LIMITATION OF LIABILITY:
In no case shall Sumitomo be liable for special, indirect or consequential damages resulting from the use or handling of this product and no claim of any kind shall be greater in amount than the purchase price of the product in respect of which such damages are claimed.

EPA Registration No. 39398-9
EPA EST. NO. 476-FL-1

Made for:
SUMITOMO CHEMICAL AMERICA, Inc.
345 PARK AVENUE
NEW YORK, N.Y. 10154

Net Contents ____ Kilos ____ Lbs.
Lot No. _____

® Registered Trademark of Sumitomo Chemical Co., Ltd

TOTAL P.03

ACCEPTED

JUN 14 1978

For Registration of Sumitomo Insecticide under FIFRA EPA Reg. No. 39398-4

SUMITHION® TECHNICAL

EPA PR 5.31.78

TIVE INGREDIENT:

O,O-Dimethyl O-(4-nitro-m-tolyl) phosphorothioate 95%

ERT INGREDIENTS: 5%

FOR FORMULATION OF INSECTICIDES ONLY

- Do not use, pour, spill or store near heat or open flame.
- This product is toxic to fish and wildlife.
- Keep out of lakes, streams or ponds. Do not contaminate water by cleaning of equipment or disposal of wastes.
- Do not reuse empty drums. Return to drum reconditioner or destroy by perforating or crushing. Bury in landfill away from water supplies.
- Refer to technical bulletin for information on chemical and physical properties.

VARNING Keep Out of Reach of Children

lay be fatal if swallowed, inhaled or absorbed through the skin.

o not breathe vapor or mist. Do not get in eyes, on skin or on lothing. Wash hands, arms and face with soap and water after andling and before eating or smoking. In case of skin contact 'ash with soap and water, for eyes flush with water and get med- :al attention. Wash clothing with soap and hot water before ;use.

void contamination of food and feed. Do not store near feed or ood products.

OTE TO PHYSICIAN: Atropine is antidotal. 2-PAM is also ntidotal and may be administered in conjunction with atropine.

EPA Reg. No. 39398-4 Net wt. 550 pounds

EPA Est. No. 41155-TN-1 (250 kilos)

SUMITOMO CHEMICAL AMERICA INC.

ANNEX D

SLIDE POSITIVITY RATE AND ANNUAL PARASITE INCIDENCES (API)
1975-1986

Year	Population at risk	No. Slides	No. Positive Slides	SPRs*	APIs**
1975	48,305,324	3,205,689	238,315	7.43	4.93
1976	49,789,303	2,857,854	122,219	4.28	2.45
1977	51,279,670	2,667,315	47,571	1.78	0.93
1978	52,737,019	2,588,257	16,160	0.62	0.31
1979	53,929,411	2,682,351	12,304	0.46	0.23
1980	55,103,689	3,006,264	17,707	0.59	0.32
1981	56,934,577	2,523,426	13,629	0.54	0.67
1982	58,067,409	3,303,067	56,360	1.71	0.97
1983	58,468,028	2,587,920	51,596	1.99	0.88
1984	60,746,320	3,255,853	73,996	2.27	1.22
1985	62,133,283	3,119,695	77,607	2.49	1.23
1986	63,997,281	2,899,020	90,393	3.12	1.44

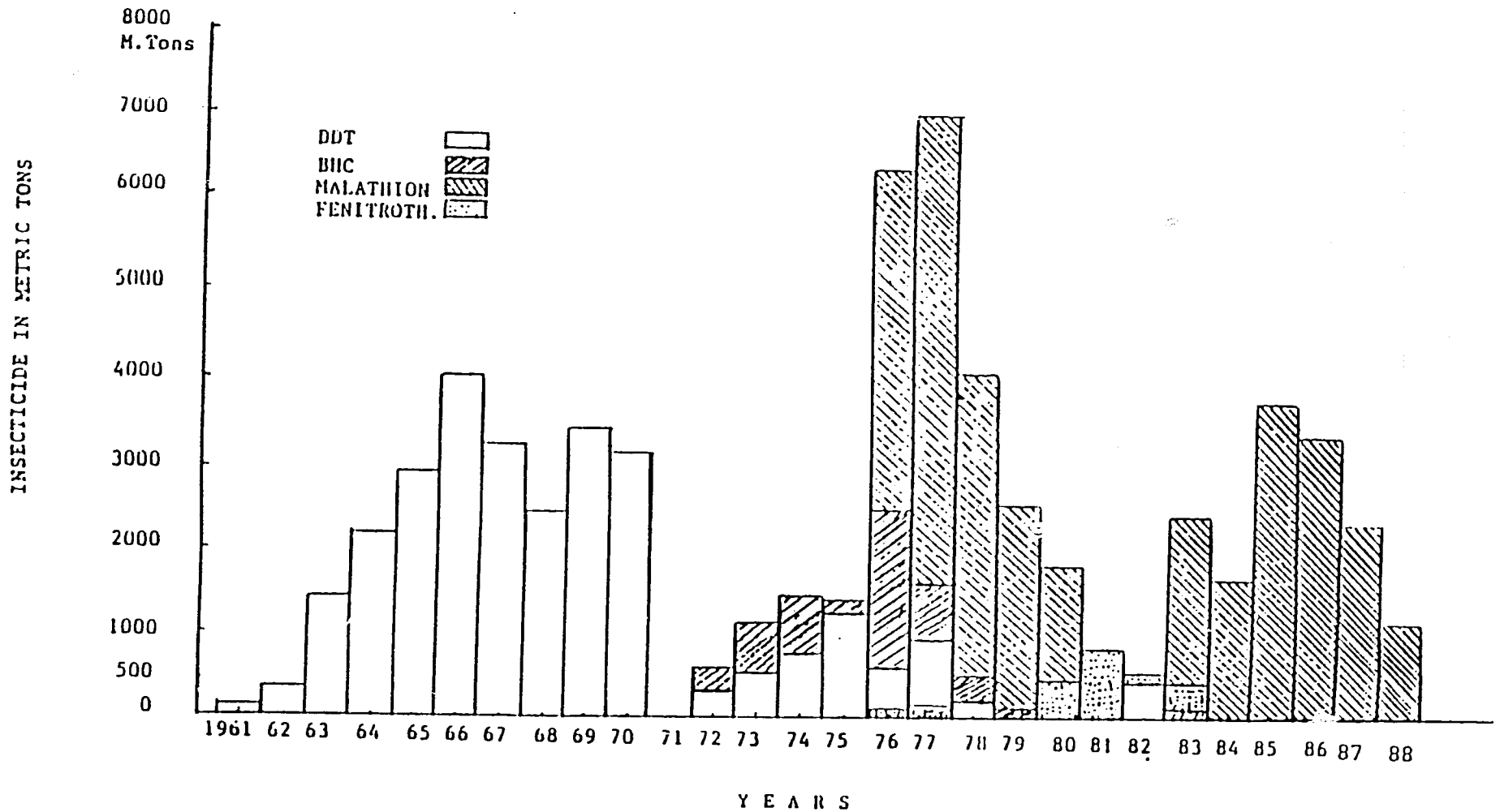
* - SPR (Slide Positivity Rate) = $\frac{\text{Total Positive Cases} \times 100}{\text{Total Slides}}$

** - API (Annual Parasite Incidence = $\frac{\text{Total Positive Cases} \times 1000}{\text{Population at Risk}}$

Source: DOMC

ANNEX E

PROCUREMENT OF INSECTICIDES BY THE MALARIA ERADICATION/CONTROL PROGRAM - PAKISTAN (1961-1988)



ANNEX F

USAID HOUSE SPRAYING OBSERVATION FORMS

Locality _____ |_|_|_|_| Tehsil _____ Dist _____ Province _____

Completed by _____ Date _____ Time _____

Locality projected spray schedule: Date started _____ Completed _____

Previous day's coverage: No. of house scheduled _____ Sprayed _____

		Yes	No	How Long?
1. Supervisor's Name _____	Refresher training with certification	|_|	|_|	_____
2. No. of spraymen in squad: _____	Training for spray	|_|	|_|	_____
	safety	|_|	|_|	_____

3. Safety precautions:

	Yes	No	Qty		Yes	No	Qty
a. Clothing issued	|_|	|_|	_____	e. Atropine, syringes available	|_|	|_|	_____
b. Rubber Gloves to Mixer	|_|	|_|	_____	f. Supervisor know when to use it	|_|	|_|	_____
c. Soap (one cake/man/week)	|_|	|_|	_____	g. House Cards available	|_|	|_|	_____
d. 3 buckets	|_|	|_|	_____				

4. Houses checked: sprayed previous days _____ Current _____ Total _____

5. Discrepancies in reporting: spray form (SPR 1) being filled on the spot: Yes _____ No _____

Houses shown totally sprayed: _____ but unsprayed, _____ or partially sprayed _____

SPR 1 data tally with actual count of No. of rooms: Yes _____ No _____

6. Streaky/patchy spray, approximate % of Rooms _____

7. No. of Houses where preparation is poor _____ Average _____ Good _____

8. Spraying procedure:

	Yes	No	Specify
a. Spraymen and mixer observing safety precautions	|_|	|_|	_____
b. Mixing at least 5 meters from water source	|_|	|_|	_____
c. Leaky sprayers	|_|	|_|	_____
d. Availability of spare parts	|_|	|_|	_____
e. Deposits on walls approximate proper dosing	|_|	|_|	_____
f. Door of sprayed houses properly marked (T,P,X)	|_|	|_|	_____

9. Insecticide storage in locality: Adequacy _____ Amount remaining _____

Amount issued _____

10. Cases of poisoning:

Name of patient _____ Occupation _____

Date of onset _____ Date of recovery _____ How Treated _____

Symptoms:	Yes	No		Yes	No
Blurred vision	|_|	|_|	Vomiting	|_|	|_|
Excessive sweating and salivation	|_|	|_|	Abdominal cramps	|_|	|_|
Muscle weakness	|_|	|_|	Nausea	|_|	|_|
			others _____		

Tintometric Test Performed: Yes |_| No |_| Date: _____ Result: _____

Comments: _____

_____

_____

INSECTICIDE BALANCE PERFORMA

DATE OF VISIT: _____

1. DISTRICT _____, INSECTICIDE STORED AT _____

2. STOREKEEPER'S NAME _____

3. BALANCE SHOWN ON THE REGISTER FOR 19___ IS _____

4. ACTUAL NUMBER OF INSECTICIDE CARTONS AVAILABLE IN THE STORE _____ = _____

5. BALANCE OF INSECTICIDE FROM 19____ WAS _____

6. TOTAL AMOUNT OF INSECTICIDE AVAILABLE _____

7. TOTAL AMOUNT OF INSECTICIDE ISSUED TO _____

8. ARE THE CARTONS STACKED PROPERLY: YES NO

9. IS STORE AREA SAFE FOR THE STORAGE OF INSECTICIDE : YES NO.

10. NUMBER OF DAMAGED CARTONS _____

11. RECORD CONTROL SYSTEM OF DISTRICT HEALTH OFFICE. SATISFACTORY. UN-SATISFAC

COMMENTS

_____

_____

_____

_____

_____

_____

_____

_____

_____

INSPECTION CONDUCTED BY: _____ ON _____

ACCOMPANIED BY 1. _____ 2. _____

3. _____ 4. _____

ANNEX G

ESTIMATED COSTS OF RECOMMENDATIONS

I. Estimated cost of spray uniform packages.
II. Estimated costs of masks.
III. Cost of soap.
IV. Cost of standard calibrated containers.
V. Cost of cholinesterase monitoring kits.
VI. Cost of atropine sulfate kits.
VII. Statement of Work for Accident Contingency Consultant.
VIII. Cost of safety training workshop.

I. ESTIMATED COST OF SPRAY UNIFORM PACKAGES

A. Malathion

Shirts, pants, turban	Rs. 150.00 x 2	Rs. 300.00
Rubber gloves		Rs. 65.00
Impermeable shoes		Rs. 50.00
	Total	Rs. 415.00

Number of packages needed:

Spraymen, Mixers, Supervisors, Inspectors	9,000
Replacements, 40/Province x 4	160
Total	9,160

Total cost of spray uniform packages:

9,160 x Rs. 415.00 = Rs. 3,801,400.00 annually

= $ 211,188.88 annually

($1.00 = Rs. 18.00)

MALATHION

B. Fenitrothion

Shirts, pants, turban	Rs. 150.00 x 4	Rs. 600.00
Rubber gloves		Rs. 65.00
Impermeable shoes		Rs. 50.00
	Total	Rs. 715.00

Total cost of spray uniform packages:

9,160 x Rs. 715.00 = Rs. 6,549,400.00 annually
= $ 363,856.00 annually
FENITROTHION

II. ESTIMATED COSTS OF MASKS

Each sprayman (7,000) should have a mask (Rs. 5.00) each spray day (36).

Total cost = 7,000 x 5 x 36 = Rs. 1,260,000 = $70,000

III. COST OF SOAP

Soap required for 6 persons of the spray squad and 1 malaria supervisor = 7 per week.

Estimated quantity of soap required for 1,500 squads = 1500 x 7 = 10,500 soaps per week.

Spray operations are carried out for approximately 6 weeks = 6 x 10,500 = 63,000 soap cakes for entire spray operations.

Total cost of soap @ Rs.3 per soap cake = 63,000 x 3 = Rs. 189,000 annually = $10,500.00 annually

IV. COST OF STANDARD CALIBRATED CONTAINERS

Container = Rs. 10.00
Need 1,500 (1/Mixer)
Total cost = Rs. 15,000.00
= $834.00

V. COST OF CHOLINESTERASE MONITORING KIT INCLUDING EXPENDABLE ITEMS

Cost of 70 complete kits at $900.00 = $67,000

VI. COST OF ATROPINE SULFATE KITS

10,000 Atropine Sulfate ampules @ Rs.1.00 each = Rs.10,000.00
Disposable 2 ml syringes @ Rs. 2.00 each = Rs. 20,000

Total cost = Rs. 30,000
= $1,667.00

VII. STATEMENT OF WORK FOR ACCIDENT CONTINGENCY CONSULTANT

A. Objective

The objective of this procurement is to contract a consultant to provide expert technical assistance to the GOP in the development of accident contingency plans for the use of pesticides in the Malaria Control II Project Extension. The ongoing project involves the use of insecticides throughout Pakistan in many localities, with approximately 9,000 workers directly involved in pesticide application and transport. The technical services provided by the consultant will assist the GOP in minimizing the occurrence of pesticide related accidents and in decreasing the impact of accidents when they occur.

B. Qualifications and Experience

The consultant will be a qualified public and occupational health and safety specialist with direct experience in the identification, analysis and mitigation of public and occupational hazards and health risks associated with use of insecticides in vector control programs. The consultant will have knowledge of, and experience in safe pesticide management practices including the transport, handling, use, storage, and disposal of pesticides. The consultant will be capable of advising the GOP on contingency plans for accidents that may occur in the extension involving any aspect of pesticide usage. Developing country experience is highly desirable.

C. Statement of Work

The consultant will have primary responsibility for advising the GOP Directorate of Malaria Control and the provincial Directors of Health Services on the potential for pesticide-related accidents, procedures to decrease chances of such accidents occurring, and procedures to follow in the event of an accident. In order to observe important aspects of pesticide operations, the consultant will need to travel to at

least 3 Provinces. Of highest priority will be a visit to the Sind to observe off-loading of pesticides at the Karachi port, and to observe the supervision of drivers transporting the pesticides.

Specifically, soon after project implementation the consultant will:

1. Perform a two-day official predeparture TDY in A.I.D./ Washington to receive briefing on the current malaria control program in Pakistan and to confer with A.I.D./ Washington on current safety procedures used in the program.

2. Upon arrival in-country prepare a detailed work plan and schedule for Mission review, setting forth the principal tasks under the scope of work, and how they will be implemented, including identification of all Mission and GOP support and/or coordination which will be required.

3. Analyze the project's current practices which decrease the chances of pesticide related accidents from occurring.

4. Analyze from observation the safety procedures in place and needed in Karachi as pesticides are received, loaded into trucks and transported to use sites. Identify unrecognized potential causes for accidents and prepare descriptions of realistic measures to decrease likelihood of accidents. Prepare description of measures to be taken in the event of such accidents.

5. Analyze from observation the safety procedures in place and needed at pesticide storage sites. Prepare description of measures to be taken to minimize chances of accidents occurring, and procedures in the case that they occur.

6. Analyze from discussions the safety procedures used during spray applications. Describe any additional precautions that should be made and develop procedures for reacting to an accident.

7. Summarize all data, observations, analysis, and recommendations resulting from the analysis of pesticide safety procedures in a report to be prepared and finalized prior to departure from Pakistan. The report will include a separate section which fully describes all recommended procedures, including methods of implementation, duration, training requirements, estimated costs of implementing recommendations and agencies responsible for implementation. All recommendations shall be realistic given the conditions in Pakistan, and will focus on measures in which USAID can assist, particularly in regards to project management modifications.

D. Level of Effort

The estimated level of effort for the consultant is two days in A.I.D./Washington and 18 days in Pakistan (six day work week).

E. Timing of Effort

The consultant should be in-country at the time when pesticides arrive in Karachi and are off-loaded for transport distribution.

F. Illustrative Costs

ITEM		AMOUNT
Salary - 20 days @ 260/day		$ 5,200
Domestic US travel - one RT Washington		750
International travel - one RT US/Pakistan		3,500
In-country travel	Air	1,000
	Vehicle rental	3,000
Per diem:		
Washington - 2 days @ $117/day		234
Pakistan - 20 days @ $90/day		1,800
Miscellaneous:		
FICA @ 7.15% basic salary		318
DBA @ $2.57/100 salary		134
	Subtotal	$15,936
Contingency @ 10% of total		1,564
	TOTAL	$17,500

VIII. TRAINING COSTS

The EA team has recommended safe insecticide use practice training for four categories of employees of DOM, Health Education Officers, Malaria Superintendents, Entomologists and Malaria Supervisors. Training courses should be held annually for the entire Malaria Control Project II extension period, and will involve 5 day training for malaria supervisors and three day workshop for the other categories of employees.

Approximate training costs are as follows:

Total estimated cost for providing 1 week training to approximately 4000 malaria supervisors:

TA/DA Allowances, all included	Rs. 5,600,000.00
Cost of resource/trainers	22,000.00
Cost of Stationery	150,000.00
Cost of POL	30,000.00
W/TEA	300,000.00
Miscellaneous costs	45,000.00
Total	Rs. 6,147,500.00 annually
Equivalent US $	$ 341,527.00

NOTE: Due to the large number of Malaria Supervisors, it will not be possible to train them at provincial headquarters. The most feasible plan would be to have the training held at Divisional level. Trainers could be the CD officers and assistant entomologists. Disbursements could be made to participants at the Divisional level.

3 Day Workshop to be held in Islamabad for 60 Entomologists

Cost of 60 participants @ Rs. 500.00/day Flat rate for 3 days = 60Px3DxR500	= Rs. 90,000.00
Cost of travel to/from Islamabad for 60 participants	= Rs. 40,000.00
Cost of stationery	= Rs. 2,500.00
Cost of POL	= Rs. 3,000.00
Cost of hiring hall for holding the workshop for three days @ Rs.500 per day	= Rs. 1,500.00
W/Tea and lunch @ Rs.85 per day per head for approximately 80 participants = R85X80PX3D	= Rs. 20,400.00
DOMC charges for resources 7 persons	= Rs. 6,000.00
Total estimated cost	= Rs.163,400.00
Miscellaneous/other direct costs	= Rs. 5,000.00
Total	= Rs.168,400.00

3 Day Workshop held in Islamabad for 70 Malaria Superintendents

Cost of 70 Malaria Superintendents @ Rs. 500.00/day for 3 days = 70Px500x3D	= Rs.105,000.00
Cost of travel	= Rs. 40,000.00
Cost of stationery	= Rs. 2,500.00
Cost of POL	= Rs. 3,000.00
Cost of hiring hall @ Rs. 500/day x 3 days	= Rs. 1,500.00
Cost of w/tea & lunch @ Rs.85 per head per day for approximately 85 persons = R85x3Dx85P	= Rs. 21,675.00
DOMC charges for resource persons	= Rs. 6,000.00
Miscellaneous/other direct costs	= Rs. 5,000.00
Total	= Rs.185,675.00

3 Day Workshop held in Islamabad for 45 Health Education Officers

Cost of 45 participants @ Rs. 500/day x 3 days = 45x500x3	= Rs. 67,500.00
Travel Cost	= Rs. 20,000.00
Cost of stationery	= Rs. 1,500.00
Cost of POL	= Rs. 3,000.00
Cost of hiring hall @ Rs. 500/day for three days	= Rs. 1,500.00
Cost of w/tea and lunch @ Rs. 85/head/day for 55 participants for 3 days = 85x55x3	= Rs. 14,025.00
DOMC charges for resources persons for 3 days	= Rs. 6,000.00
Miscellaneous/direct costs	= Rs. 5,000.00
Total	= Rs.118,525.00

a. Total estimated cost for training 60 Entomologists for 3 days in Islamabad	= Rs.168,400.00
b. Total estimated cost for training 70 Malaria Superintendents for 3 days in Islamabad	= Rs.185,675.00
c. Total estimated cost for training 45 H.E.O's for 3 days in Islamabad	= Rs.118,525.00
General Total	= Rs.471,600.00
Equivalent to US $	= $ 26,200.00

ANNEX H

USAID MALARIA INFORMATION CARD

MALARIA CONTROL WORKERS GUIDELINES
FOR
SAFE HANDLING OF INSECTICIDE
CURRENTLY IN USE
AND
TREATMENT OF MALARIA

Issued by the Directorate of Malaria Control (DOMC), Ministry of Health, Special Education, and Social Welfare Govenment of Pakistan

Printed with the courtesy of USAID Malaria Control Project

آج کل کے استعمال میں کیڑے مار دوائی MALATHION کے بحفاظت استعمال کیلئے چند ہدایات

ملیریا کنٹرول پروگرام میں زیر استعمال کیڑے مار دوائی MALATHION انسان اور جانوروں کے لئے زہریلے اثرات رکھتی ہیں۔ زہریلے اثرات پیدا کرنے کے لئے یہ جسم میں مندرجہ ذیل کسی بھی راستے سے داخل ہوتی ہیں (۱) جسم کی کھال کے ذریعے یعنی ہاتھ کی ہتھیلیوں اور پشت اور پاؤں کے تلوے اور پشت سے گردن یا جسم کے کسی بھی حصے کی کھال سے (۲) آنکھوں سے (۳) جسم پر کسی بھی جگہ کھلے زخم سے (۴) سانس کے ذریعے منہ ناک اور پھیپھڑوں سے (۵) خوراک کے ساتھ شامل ہو کر منہ اور معدے سے۔

ان کے زہریلے اثرات سے بچنے کے لئے دوائی چھڑکتے SPRAY وقت دوائی چھڑکنے والوں کو حفاظتی کپڑے پہننے چاہئیں۔ ان دوائیوں کو ہاتھ سے چھوتے وقت ربڑ کے دستانے پہننے چاہئیں۔ منہ کو کپڑے سے ڈھانپ لینا چاہیئے اور دوائی چھڑکنے کے فوراً بعد جسم پر گری ہوئی دوائی کو اچھی طرح دھو کر دور کر دینا چاہیئے۔ چھڑکنے کے دوران پہنے ہوئے کپڑے دھو لینے چاہئیں اور چھڑکنے والے آدمی کو صابن مل کر نہا لینا چاہیئے۔

دوائی کے جسم میں داخل ہو جانے پر زہریلے اثرات پیدا کر دینے کی علامات یہ ہوں گی سر درد، چکر آنا، کمزوری، کپکپاہٹ، بہت زیادہ پسینہ، پیٹ میں مروڑ، دست کا آنا، منہ میں زیادہ تھوک یا جھاگ نکلنا، سانس مشکل سے لے سکنا، جی متلانا اور الٹی بھی ہو جانا۔

ان زہریلے اثرات کا علاج کرنے کے لئے جس شخص میں زہریلے اثرات ظاہر ہوئے ہوں اسے فوراً دوائی چھڑکے جانے والی جگہ سے دور لے جائیں اس کے تمام دوائی آلود کپڑے اتار دیں اس کے جسم پر جس جس جگہ پر دوائی لگی ہوئی نظر آئے اسے پانی سے دھو کر صاف کر ڈالیں پھر اسے ATROPINE کا ٹیکہ ایک سے پانچ سی سی تک لگائیں۔ اس کے بعد بھی اگر وہ شخص بہت بیمار نظر آئے تو اسے فوراً نزدیکی ہسپتال لے جائیں ——

MALARIA TREATMENT

I. Presumptive Treatment:

Age Group	Number of Chloroquine Tablets (150 mg base)
1–11 months	¼
12–24 months	½
3–4 years	1
5–6 years	2
7–14 years	3
15 + years	4

II. Radical Treatment:

A. Falciparum Malaria

C = Chloroquine Tablet (150 mg base)
*P = Primaquine Tablet (7.5 mg base)

Age Group	Day of Treatment 1		Day 2		Day 3	
1–11 months	C=1/4		C=1/8		C=1/8	
12–24 months	C=1/2		C=1/4		C=1/4	
3–4 years	C=1	P=1/4	C=1/4	P=1/4	C=3/4	P=1/4
5–6 years	C=2	P=1/2	C=1·1/2	P=1/2	C=1·1/2	P=1/2
7–14 years	C=3	P=1	C=2·1/4	P=1	C=2·1/4	P=1
15 + years	C=4	P=2	C=3	P=2	C=3	P=2

B. Vivax Malaria

Age Group	Day of Treatment 1	2	3	4	5
1–11 months	C=1/4	C=1/8	C=1/8		
12–24 months	C=1/2	C=1/4	C=1/4		
3–4 years	C=1 P=1/4	C=3/4 P=1/4	C=3/4 P=1/4	P=1/4	P=1/4
5–6 years	C=2 P=1/2	C=1·1/2 P=1/2	C=1·1/2 P=1/2	P=1/2	P=1/2
7–14 years	C=3 P=1	C=2·1/4 P=1	C=2·1/4 P=1	P=1	P=1
15+ years	C=4 P=2	C=3 P=2	C=3 P=2	P=2	P=2

*Primaquine must not be given to pregnant women nor to children below age 2 years.

ANNEX I

ENVIRONMENTAL CONSIDERATIONS AND CRITERIA REVIEW

Insecticides

Should it become necessary under this project to provide A.I.D. funds for the procurement or use, or both, of pesticides not specifically approved in this EA (i.e., pesticides other than malathion and fenitrothion), an amended EA must be prepared by USAID/Pakistan and approved by the ANE Bureau Environmental Coordinator prior to their procurement or use.

The selection and use of pesticides by A.I.D. supported programs are covered under A.I.D. Regulation 22 CFR Part 216, Environmental Procedures. A model procedure for the future selection of pesticides to be used in the Pakistan Malaria control program is presented below:

1. Is the proposed product or its use exempt under Reg. 22 CFR 216?

   (Note: Pesticides are generally not exempt; however, in some cases (e.g., controlled experimentation exclusively for the purpose of research and field evaluation which are carefully monitored might be (216.2 (c) (iii) (2) (ii)). In all cases of exemption questions, approval should be received from the appropriate A.I.D. Environmental Officer(s).
   Exempt

   Yes ___ No ___

   If the intended use of the pesticide is not clearly exempted under 22 CFR 216 and appropriately approved, the Pesticide Procedures of 22 CFR.216.3(b)(1) should be carefully addressed. (Note: It is advisable to assume that the operational use of a pesticide is not exempt.) Subject to regs.:

   Yes ___ No ___

The factors that must be considered under 22 CFR 216.3(b)(i) are as follows:

- The USEPA registration status of the requested pesticide. _____

- The basis for selection of the requested pesticide. _____

- The extent to which the proposed pesticide use is part of an integrated pest management program. _____

- The proposed method or methods of application, including availability of appropriate application and safety equipment. _____

- Any acute and long-term toxicological hazards, either human or environmental, associated with the proposed use measures available to minimize such hazards. _____

- The effectiveness of the requested pesticide for the proposed use. _____

- Compatibility of the proposed pesticide with target and non-target ecosystems. _____

- The conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils. _____

- The availability and effectiveness of other pesticides or nonchemical control methods. _____

- The requesting country's ability to regulate or control the distribution, storage, use and disposal of the requested pesticide in strict adherence to the label. _____

- The provisions made for training of users and applicators. _____

- The provisions made for monitoring the use and effectiveness of the pesticide. _____

2. Will the use of the pesticide impact on an endangered or threshold species? _____

ANNEX J

WORLD HEALTH ORGANIZATION

ORGANISATION MONDIALE DE LA SANTÉ

VBC/82.1

ENGLISH ONLY

PESTICIDE DEVELOPMENT AND SAFE USE UNIT
DIVISION OF VECTOR BIOLOGY AND CONTROL
WHO HEADQUARTERS, GENEVA

FIELD SURVEYS OF EXPOSURE TO PESTICIDES

STANDARD PROTOCOL[1]

1. GENERAL AIM

To examine the exposure of those workers involved in applying pesticides in order to be able to determine:

(a) whether the actual exposure constitutes a safe level;

(b) what protective measures need to be implemented to ensure safe use.

This can be achieved for a particular pesticide by the following activities:

(a) defining accurately the environmental conditions under which the pesticide is applied, the method and rate of application;

(b) collecting data on:

---

[1] This document replaces unpublished document VBC/75.9, Survey of Exposure to Organophosphorus Pesticides in Agriculture. It was reviewed in November 1981 by a workshop organized by the Scientific Committee on Pesticides of the International Association on Occupational Health whose assistance is gratefully acknowledged.

The participants were:

Dr J. L. Bonsall, F.B.C. Ltd., Hauxton, Cambridge, United Kingdom; Dr J. F. Copplestone, Chief, Pesticide Development and Safe Use, Division of Vector Biology and Control, WHO, Geneva (Chairman); Dr R. Goulding, Chairman of the Scientific Sub-committee, UK Pesticides Safety Precautions Scheme, Ministry of Agriculture, Fisheries & Food, United Kingdom; Dr T. B. Hart, ICI, Plant Protection Division, Fernhurst, West Sussex, United Kingdom; Dr K. W. Jager, Secretary, Scientific Committee on Pesticides, International Association on Occupational Health, Carel van Bylandtlaan 30, The Hague, The Netherlands; Dr L. H. Machemer, Bayer AG, Institute of Toxicology, Wüppertal, Federal Republic of Germany; Dr H. G. S. van Raalte, Chairman, GIFAP Toxicology Committee, c/o Group Toxicology Division, Shell Internationale Research, Maatschappij B.V., The Hague, The Netherlands; Dr W. F. Tordoir Group Toxicology Division, Shell Internationale Research, Maatschappij B.V., The Hague, The Netherlands.

Unable to attend:

Professor L. Rosival, Chairman of the Scientific Committee on Pesticides, Research Institute of Preventive Medicine, Bratislava, Czechoslovakia.

R 1083 - 886

(i) times of exposure;

(ii) the quantity of pesticide applied by each man;

(iii) details of protection used;

(iv) the amount of pesticide coming into contact with the exterior of clothing, beneath clothing, and exposed skin;

(v) quantitative tests of absorption and excretion of parent compound or metabolite;

(vi) details of any effects of exposure.

If the exposure is equivalent to or exceeds a threshold level for safety, then the contributory factors involved (e.g. type of protection provided, personal hygiene, pattern of use) and their relative importance should be determined and appropriate recommendations for safe use should be made.

2. INDICATIONS FOR CARRYING OUT A FIELD STUDY

Field studies should be carried out whenever the toxic properties of the substance and/or formulation together with the pattern of usage give cause for concern about workers' safety.

Considerations in determining this include:

(a) the acute dermal toxicity of the formulated product when dermal exposure is considered the most significant route of absorption;

(b) a significant opportunity for inhalational exposure at work of a material which is toxic by the respiratory route;

(c) where compounds have been found to cause adverse effects only at very high doses to ascertain that worker exposure will be at low levels, providing a significant safety margin;

(d) significant changes in formulation of compound or application procedures.

Studies may need to be repeated if there are changes in use patterns, application techniques or formulations which might alter the hazard to workers employed in application.

3. CHOICE OF SURVEY SITE AND GROUP

3.1 The spraying operation should be under single administrative control and should last a period appropriate to the pattern of use and the pharmacokinetics of the pesticide.

3.2 The pesticide should be applied in uniform concentration by uniform means throughout the operation.

3.3 The group studied should consist of four to 10 workers engaged in the application. If practicable, the occupational groups (mixers, loaders, sprayers, flagmen, etc.) should be considered separately. Ideally, the group should not have been exposed to the pesticide used during the survey or to any other pesticide with a similar mode of action during a relevant period preceding the commencement of the operation.

3.4 If it is necessary to select from spraymen, the selection should be on the basis of typical working clothing worn in the area in order that this might be standardized as far as possible. If possible, photographs of the men in their working clothing should be taken. If the workers engaged in the application are not experienced in pesticide application proper instructions and training should be given before the study commences.

3.5 Depending on the parameters measured and the period of the survey a suitable control group applying a blank formulation may be indicated.

4. SURVEY STAFF

4.1 Staff for the adequate supervision of the operational aspects, including proper application of the pesticide, have not been included as it is assumed that these would be provided for in a planned operation.

4.2 The minimum survey staff consists of a physician-toxicologist and one or two assistants of technician status.

4.3 The physician-toxicologist is responsible for:

(a) the general organization of the survey;

(b) the keeping of records;

(c) medical supervision of applicators during the operation, including the collection and handling of specimens where necessary;

(d) the training of local staff in evaluation techniques.

5. METHODS

5.1 Cholinesterase determination

Organophosphorus compounds:

The principal effect of exposure to an organophosphorus compound is depression of cholinesterase. The degree of depression can be estimated in blood by, for example, the methods described by Michel,[1] Ellman,[2] or Voss & Sachsse[3] or other similar methods.

When field conditions would involve an interval between collection and analysis exceeding 10-12 hours, then it is necessary, even when the samples are adequately cooled, to use a field kit such as the Tintometer method.[4] Cholinesterase test papers are also available; as they are of lower sensitivity, they are of more use for routine surveillance than for survey work.

Tests should be carried out on all personnel included within the study:

(a) once on each of three days preceding any exposure to cholinesterase inhibitors; the mean of these three values provides the baseline for the individual against which subsequent values are matched;

(b) on working days when spraying has been completed and the spraymen have removed their protective clothing and washed or bathed;

(c) if a gap of one or more days occurs during the operations, a pre-work test should be carried out on the day that work is resumed;

---

[1] Michel, H. O. (1949) J. Lab. clin. Med., 34, 1564.

[2] Ellman, G. L. et al. (1961) Biochem. Pharmacol., 7, 88.

[3] Voss, G. & Sachsse, K. (1970) Toxicol. Appl. Pharmacol., 16, 764.

[4] Edson, E. F. (1958) World Crops, 10, 49; obtainable from the Tintometer Sales Co. Ltd., Salisbury, United Kingdom.

(d) when any worker in the survey group complains of symptoms which could be related to pesticide exposure, a cholinesterase determination should be carried out immediately; thereafter cholinesterase should be measured at regular intervals until its recovery is established;

(e) if any worker has had an asymptomatic cholinesterase depression which has led to suspension from work, cholinesterase determination should be carried out on succeeding days until it is obvious that its recovery is taking place.

Blood should be taken from an uncontaminated area, preferably by the venous route. Capillary blood is usually used in field tests but in the case of direct acting cholinesterase inhibitors great care has to be taken to prevent the contamination from the skin. Venous blood may have to be used.

Insecticidal carbamates:

Due to the rapid reactivation of cholinesterase when inhibited by insecticidal carbamates, measurement of cholinesterase is not a feasible indicator of impending overexposure. In these surveys, in addition to other tests of exposure, surveillance should be adequate to detect any clinical signs.

5.2 Biological monitoring

5.2.1 Biological monitoring provides a quantitative measure of the absorbed pesticide resulting from exposure via all routes.

5.2.2 The objective of biological monitoring is to relate the level of parent compound or the specific, representative metabolite in biological material to the total uptake. This implies that for this purpose specific and sensitive methods have been developed or should be developed to enable the determination of the above-mentioned substances in biological material.[1]

In view of the limitations innerent to field conditions the biological material in which the pesticide or its metabolite is determined is usually blood or urine or both.

Since it may not always be possible to carry out the required analysis of the specimens close enough to the location of the field study, means of adequate preservation and despatching should be available.

5.2.3 Time and frequency of sampling and the volume of the specimen are dependent on the properties of the compound, the characteristics of the application procedure and the specific conditions of the study.

Detailed guidelines cannot be given; however, some general guidance is presented below:

(a) One or more pre-exposure samples must be analysed in order to establish a reliable baseline.

(b) During the application period an adequate number of samples should be collected in order to provide a good measure of the total uptake and an indication about possible transient retention.

(c) After the application period sampling should continue long enough to provide data on the elimination pattern.

---

[1] A list of metabolites and the pesticides with which they are related is shown in Annex 1. This list is not exhaustive and other tests will be developed in the future.

(d) The decision to collect either spot samples or 24-hour urine samples in the case of monitoring urinary metabolites will depend on the properties of the pesticide, the level and the rate of absorption and the analytical requirements. A check on the adequacy of the 24-hour urine sampling should be carried out by, for example, measuring the creatinine content of that urine.

(e) Safeguards should be taken to avoid contamination of any sample with the parent compound.

5.2.4 The toxicological interpretation of the amounts determined in blood or in urine cannot be made without the knowledge of the pharmacokinetics, preferably in man.

5.3 Assessment of dermal exposure

This may be done by one of the two methods described below.

5.3.1 Disposable overalls and gauntlets

Each worker, who is to be assessed for dermal exposure, is required to wear a new disposable overall and gauntlets for a minimum period of one hour or more during any one day's spraying. If significant head exposure is likely, then a head pad as described below or a disposable hat should also be used. Care should be taken to ensure that the overall or gauntlets do not become saturated and should this occur a fresh overall and gauntlets must be worn. The exact periods of time and amount of pesticide used during the period that each overall(s)/gauntlets are worn must be accurately recorded.

On completion of each assessment period the overalls and gauntlets should be carefully taken off by an assistant to avoid cross-contamination. Each gauntlet should then be placed in a separate plastic or polythene bag and stored in a place out of direct sunlight and as cool as is practicable, prior to analysis.

The overall(s) is (are) immediately sectioned into the following parts:

(a) legs - above and below knee;

(b) arms - above and below elbow;

(c) torso - front and back.

Care should be taken to ensure that the instrument used for sectioning the overall is not contaminated. Decontamination can be carried out by swabbing with cotton wool soaked in an appropriate solvent. Each body part sample is then stored separately under identical conditions as are the gauntlets.

All bags should be labelled separately to include the following information:

(i) the worker's number;

(ii) number of day of survey - preceded by the letter D.

5.3.2 Exposure pads

Pads are preapred of α-cellulose, 10 x 10 cm, backed with glassine paper or aluminium foil. Aluminium foil alone can be used with oily formulations. Benchkote® (Whatman) a white abosrbent paper backed with polyethylene, has also been successfully used as an absorbent pad. Prior extraction of pad material is essential to ensure that there will be no interference with the analysis of residues of a particular pesticide (see section 7).

Pads should be fixed with masking tape covering the edges of the pad only, and on clothing with safety pins through the edge of the pad. On each day of application, four spraymen from the survey group should be chosen serially to wear exposure pads for at least one hour (as for overalls) except for the "skin pad" which should be worn the entire day. The attachment of the pads should be checked frequently and corrected if necessary.

Pads should be applied as shown below, on clothing (where worn) or on skin. This is set out for a right-handed man; if the man is left-handed opposites apply.

Arm: Upper surface of left forearm held with elbow bent at right-angle across body, midway between elbow and wrist.

Leg: (1) front of left leg, above ankle;

(2) front of left leg, mid thigh.

Trunk: (1) over sternum;

(2) on back between shoulder blades.

Head: If head not covered, forehead as high as possible to give good adhesion. If head covered, on hat as close as practicable to top of forehead.

In addition, one pad (the "skin pad") is applied to the skin under clothing to the upper abdomen at approximately the same height as the arm pad and below the sternal pad but not shielded by it.

On removal at the end of the day, a 5 x 5 cm square should be cut from the pad. Care should be taken that the scissors or other cutting instruments are not contaminated. Decontamination can be carried out as described above (5.3.1).

The central portion of the pad should be placed either in a bottle containing solvent or in a plastic envelope (see section 7). If a bottle is used, the cap of the bottle should have an aluminium liner inserted, the bottle closed and shaken gently to ensure that the whole pad is wetted with the solvent. The exterior of the envelope or bottle should be labelled clearly with:

(i) the number of the day, preceded by the letter D;

(ii) the worker's number;

(iii) the site of the pad, and whether it was attached to clothing "C" or skin "S" (e.g. "D3 6 Thigh C").

In addition, on two days during the trial period, a control to determine laboratory recovering rate of the pesticide should be carried out. To 5 x 5 cm squares cut from exposure pads or overalls, add carefully measured[1] 0.05 and 0.1 ml samples of the pesticide concentrate and diluted spray respectively. These samples are then treated in the same way as those taken from the spraymen.

5.4 Respirators

Since the respiratory route of absorption is not significant in most standard pesticide applications, the measurement of respiratory exposure need not be carried out in each study. This is based on the fact that respiratory exposure does not usually exceed 1% of the dermal exposure, except possibly in the case of gaseous fumigants and exposure in confined spaces, or in cases where respiratory toxicity is very high in relation to percutaneous toxicity.

---

[1] These samples need to be measured by pipette, using a suction bulb to draw up the liquid.

To estimate respiratory exposure, two of the men in each group of four wearing pads for the day should be asked to wear half-face cartridge-type respirators for the whole of the working day. Respirator pads should be fitted each morning on the external side of chemical filter cartridges; these pads are removed at the end of the day and placed entirely in a plastic envelope or bottle, clearly marked as in 5.3.2 above. The man should be carefully instructed on the care of the respirator in order to avoid any contamination at times when it is removed. All respirators should be carefully washed at the end of each working day, after the chemical filter cartridges have been removed.

If the men normally wear a surgical or gauge mask, respiratory exposure can be measured by fixing a pad to the underside of the mask in front of the nose. This is not as accurate as the wearing of respirators as set out above.

Individual respiratory samplers are also available and may be suitable for use in some studies.

6. RECORDS

6.1 Record of operation details

On the day spraying commences, Form 1 (Annex 2) should be completed. On each day subsequently, the data on the form should be reviewed and any changes recorded by completing a new form with details of the changes only.

6.2 Daily record and diary

Each day, from the day before spraying commences onwards, the daily record Form 2 (Annex 3) should be completed. The diary section of Form 2 should be used for recording any events which are relevant to the survey. Sickness in any man, whether or not he is included in the survey group, should be recorded, together with an account of action taken and result.

6.3 Daily personal record

Form 3 (Annex 4) should be started for each man in the survey group and should be entered daily.

7. LABORATORY PROCESSING OF EXPOSURE AND RESPIRATOR PADS AND OVERALLS

7.1 Before the survey

7.1.1 It is necessary to determine the recovery rate for the pesticide by the method used for its determination. In addition, it is necessary to estimate degradation of the pesticide between the time the exposure pad or overall is removed and the time of processing, and whether this can be reduced by the method of transportation. This is done by preparing patches of overall material or pads with known quantities of the pesticide and processing them immediately and after one, two and three weeks. If after three weeks recovery exceeds 75%, the overalls or pads can be transported in plastic envelopes, kept in the dark and as cool as practicable. Otherwise a suitable technique must be tested similarly. If solvents need to be used for transport and storage it is more practicable to use exposure pads.

7.1.2 A blank estimation using a sample of overall material or the pad only should be carried out to determine whether it is feasible to use an overall or whether prior extraction of pads is needed.

8. CALCULATIONS AND PRESENTATION OF RESULTS

8.1 Calculation of percentage toxic dose received by each man

8.1.1 Dermal exposure (from pads)

Exposed area:

This is calculated from the exposure pads, relating the quantity of pesticide in a pad of known area to the exposed area of the limb or part of the body as modified from Berkow (1931) Amer. J. Surg., 2, 315. These are added to give a total amount expressed in mg/day or per hour.

Head neck area = 1100 cm^2:	
reduce by a quarter if hat worn = 825 cm^2	head pad
Upper chest, V of neck = 150 cm^2	sternal pad
Top of shoulders near neck = 300 cm^2	head pad
Back just below neck = 100 cm^2	back pad
Forearms = 1200 cm^2	arm pad
Hands = 800 cm^2	arm pad or hand wash
Legs from knees down = 2300 cm^2	lower leg pad
Upper legs from knees up = 3500 cm^2	thigh pad

These areas may need adjustment according to area unclothed.

Unexposed area:

Add areas of exposed parts and subtract from 18 000 cm^2: the dermal contamination of the unexposed area is calculated from the "skin pad" underneath the clothing.

8.1.2 Dermal exposure (from overalls)

The potential dermal exposure is found by calculating the quantity of pesticide per section of overall and by adding the quantity of pesticide (in mg) of all sections of the overall covering parts of the body not normally covered by working clothes, plus the quantity of pesticide in the head pad (if worn) relating the mg/cm^2 to a figure of 1100 cm^2. If a head pad was not used the total exposure is body exposure + 10%. The total exposure is then related to the time the suit was worn, as follows:

$$\frac{\text{total quantity in mg} \times 60}{\text{total time (in minutes)}} = \text{total exposure (mg/hour)}$$

8.1.3 Respiratory exposure

If done, this is calculated and expressed in mg/day or mg/hour.

8.1.4 Percentage toxic dose per day or hour

This is calculated from these indices adapted from the method of Durham & Wolfe (1962) Bull. Wld Hlth Org., 26, 75-91, using the formula:

$$\frac{\text{Dermal exposure (mg/day or hour)} + (\text{respiratory exposure (mg/day or hour)} \times 10) \text{ if measured}}{\text{Dermal } LD_{50} \text{ mg/kg (rat)} \times 70} \times 100$$

8.2 Comparison of sites

All the results for a particular exposure pad site are grouped together and the mean and standard deviation (SD) are calculated. If any results fall outside the mean ± (SD x 3), these are excluded and a new calculation made of the mean and SD of those that remain. The purpose of this is to give an idea of the "normal" distribution after those results that represent some unusual contamination have been excluded. The chance of such exclusions being made in error is 1%.

ANNEX J cont.

TABLE OF PESTICIDES AND THEIR METABOLITES OF USE FOR BIOLOGICAL MONITORING

Pesticide	Biological material	Compound measured	Method	Reference
Aldrin	Blood	dieldrin		1. Richardson, A.; Robinson, J.; Bush, B.; Davies, J. M. Arch. Environm. Health (1967) 14, 703-708. 2. Dale, W. E., Curley, A.; Cueto, C. Life Sciences (1966) 5, 47-54.
Azinphos-ethyl	Blood	azinphos-ethyl	GC	Stein, V. B. J. Ass. Off. Anal. Chem. (1976), 59, 1094
Carbaryl	Urine	1-naphthol	GC	Shafik, M. T. et al. Bull. Environm. Contam. Toxicol. (1971) 6, 34
Chlorfenvinphos	Urine	2,4 dichlorobenzoic acid		Not published*
Cypermethrin	Urine	2,2-dichlorovinyl-3, 3-dimethylcyclopropane-1-carboxylic acid		Not published*
2,4-D	Blood) urine)	2,4-D	GC	Rivers, J. B. et al. J. Chromatog. (1970) 50, 334
1,3-Dichloropropene	Urine	N-acetyl-S(3-chloroprop-2-enyl) cysteine		Not published*
Dichlorvos	Blood	dichlorvos	GC	Analysen in biolog. Material** D. Henschler, Verlag Weinheim
Dichlorvos	Urine	dimethyl phosphoric acid		Blair, D.; Roderick, H. R. J. Agric. Food Chem. (1976), 17, 1186
Dicrotophos	Urine	dimethyl phosphoric acid		Blair, D.; Roderick, H. R. J. Agric. Food Chem. (1976), 17, 1186.
Dieldrin	Blood	dieldrin		1. Richardson, A.; Robinson, J.; Bush, B.; Davies, J. M. Arch. Environm. Health (1967), 14, 703-708. 2. Dale, W. E.; Curley, A.; Cueto, C. Life Sciences (1966), 5, 47-54.
Dimethoate	Blood Blood	dimethoate dimethoxon	GC TLC	Martens, M. A. et al. Med. Fac. Landbouwwet, Rijksuniv. Gent (1974), 39, 1279
Endrin	Urine	anti-12-hydroxyendrin		Baldwin, M. K.; Hutson, D. H. Analyst (1980), 105, 60-65
Fenitrothion	Urine	p-nitrophenol	GC, PhM	Analysen in biolog. Material** D. Henschler, Verlag Weinheim
Flamprop-isopropyl	Urine	N-benzoyl-N-(3-chloro-4-fluorophenyl)-2-aminopropioni acid		Not published*
Flamprop-methyl	Urine	N-benzoyl-N-(3-chloro-4-fluoro-phenyl)-2-aminopropionic acid		Not published*

Pesticide	Biological material	Compound measured	Method	Reference
Malathion	Urine	malathion-α- monocarboxylic acid	GC	Bradway, D. E. et al. J. Agric. Food. Chem. (1977), 25, 1342
Mevinphos	Urine	dimethyl phosphoric acid		Blair, D.; Roderick, H. R J. Agric. Food Chem. (1976), 17, 1186
Monocrotophos	Urine	dimethyl phosphoric acid		Blair, D.; Roderick, H. R.; J. Agric. Food Chem. (1976), 17, 1186
Oxydemeton-methyl	Blood Urine	oxydemeton-methyl oxydemeton-methyl	GC GC	Unpublished***
Paraquat	Plasma	paraquat	GC/MS**	Draffan, G. H. et al. J. Chromatogr. (1977), 139, 311
Paraquat	Plasma	paraquat	GC	Van Dijk, A. et al. J. Anal. Toxicol. (1977), 1, 151
Paraquat	Plasma	paraquat	PhM	Knepil, J. Clin. Chim. Acta (1977), 79, 387
Parathion-ethyl	Blood Blood Urine	parathion-ethyl paraoxon p-nitrophenol	GC GC GC, PhM	Analysen in biolog. Material** D. Henschler, Verlag Weinheim
Parathion-methyl	Blood Blood Urine	parathion-methyl paraoxon-methyl p-nitrophenol	GC GC GC, PhM	Unpublished Unpublished Analysen in biolog. Material** D. Henschler, Verlag Weinheim
Pentachlorophenol	Urine) Plasma)	pentachloro-phenol	GC	"Analysen in biologischem Material"** D. Henschler, Verlag Weinheim
Permethrin	Urine	2,2-dichlorovinyl-3, 3-dimethylcyclopropane-1-carboxylic acid		Not published*
Propoxur	Blood Urine	propoxur 2-isopropoxiphenol	GC GC	Unpublished 1. Analysen in biolog. Material** D. Henschler, Verlag Weinheim 2. Machemer, L. et al. Education and Safe Handling in Pesticide Application, E. A. H. van Heemstra and W. F. Tordoir, Elsevier, Scient. Publ. Comp. Amsterdam (1982)
Trichlorfon	Blood	trichlorfon	GC	Kozu, T. et al. J. Hyg. Chem. (1976), 22, 91

* Obtainable on request from Shell Internationale Research Maatschappij B. V., Group Toxicology Division (TOX/1), P.O. Box 162, 2501 AN The Hague, The Netherlands.

** Analytische Methoden zur Prüfung gesundheitsschädlicher Arbeitsstoffe, Band 2, "Analysen in biologischem Material". D. Henschler, Verlag Weinheim, 1981.

*** Obtainable on request from Bayer AG, Institute of Toxicology, Wuppertal, Federal Republic of Germany.

GC = gas chromatography
TLC = thin layer chromatography
PhM = photometry
CM = colorimetric
MS = mass spectrometry

VBC/82.1
page 12

ANNEX 2

FORM 1. OPERATIONAL DETAILS

Day _____

To be completed on Day 1, and reviewed daily. Any changes should be entered on a blank form, entering only those details which have changed.

Site:

Administration of spraying:

Crop:

Height of crop:

Pesticide:

Batch No.:

Concentration - before mixing:

- as applied:

Type of spray equipment:

Capacity of sprayer and tank:

Nozzle type:

Total personnel engaged - supervisors:

- mixers:

- spraymen:

Washing facilities provided:

Protective equipment provided:

Particle size distribution (if known):

FORM 2. DAILY RECORD

	Day of spraying															
			1	2	3	4	5	6	7	8	9	10	11	12	13	14
Time spraying commenced	X	X														
Time spraying finished	X	X														
Quantity of pesticide used in daily operation (before dilution)																
Estimate of area covered																
Minimum temperature °C																
Maximum temperature °C																
Relative humidity																
Rain during spraying period (hours)	X	X														
Rain outside spraying period (hours)																
Wind force																
Wind direction in relation to general direction of spray[1]	X	X														

[1] S = side, B = wind behind, F = wind in front, V = variable.

DIARY: Note below any relevant events, sickness of spraymen, accidents to equipment or man, etc.

ANNEX 4

FORM 3. DAILY PERSONAL RECORD

Name _____ Personal No. _____

Details of exposure to any pesticide during preceding month _____

		Day																	
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	21
Type of work[1]		X	X	X															
Time started work		X	X	X															
Time finished work		X	X	X															
Total working hours		X	X	X															
Amount of pesticide applied or number of pump charges		X	X	X															
Clothing worn[2]	Material																		
Overall		X	X	X															
Scarf		X	X	X															
Hat or helmet		X	X	X															
Boots		X	X	X															
Shoes		X	X	X															
Thongs		X	X	X															
Face mask		X	X	X															
Gloves		X	X	X															
Apron		X	X	X															
Number of times washing during day: hands		X	X	X															
face		X	X	X															
Time (minutes) between end of work and bathing		X	X	X															
changing clothes		X	X	X															
Smoking (while spraying)		X	X	X															
Eating or drinking		X	X	X															
Cholinesterase level: before work																			X
after work		X	X	X															
Haematocrit				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Urine sample taken																			
Urine volume																			
Blood sample taken																			
Days exposure pads worn		X	X	X															X
Days respirator worn		X	X	X															X

[1] S = spraying; M = mixing.

[2] N = not worn; W = worn, newly washed; X = worn, not washed since last worn for spraying.

FIGURE 1

SPRAY TEAM IN NORTHWEST FRONTIER PROVINCE
WEARING UNIFORMS AND TURBANS PROVIDED BY DOMC

FIGURE 2

SPRAYMAN IN LOCALITY NEAR PESHAWAR
SPRAYING WALLS OF A BEDROOM

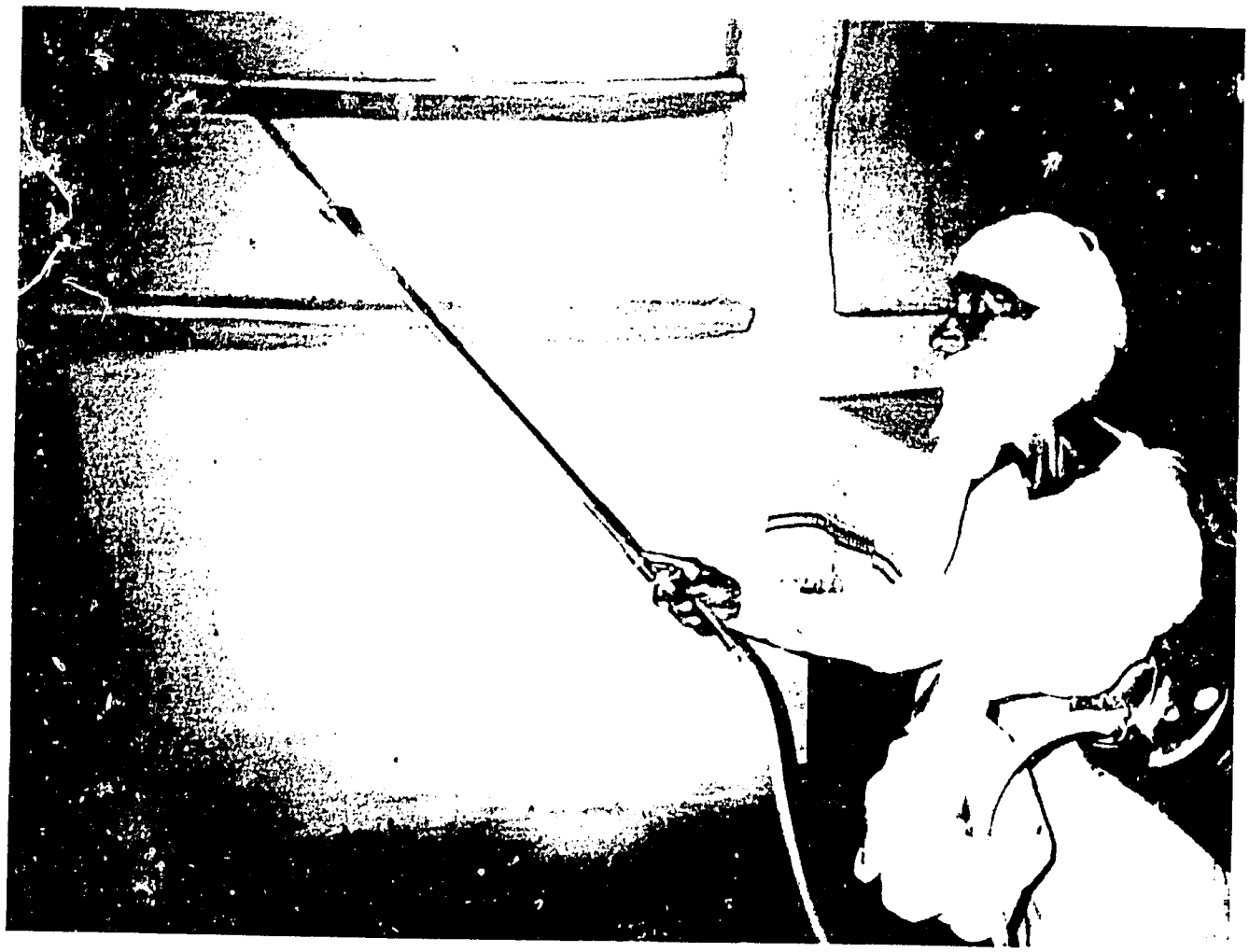


FIGURE 3

MIXER PREPARING SUSPENSION OF MALATHION WDP
TO FILL SPRAY TANKS OF SPRAYMAN

FIGURE 4

HOUSEHOLDERS' BELONGINGS AND FURNITURE
REMOVED FROM HOUSE IN PREPARATION FOR SPRAYING

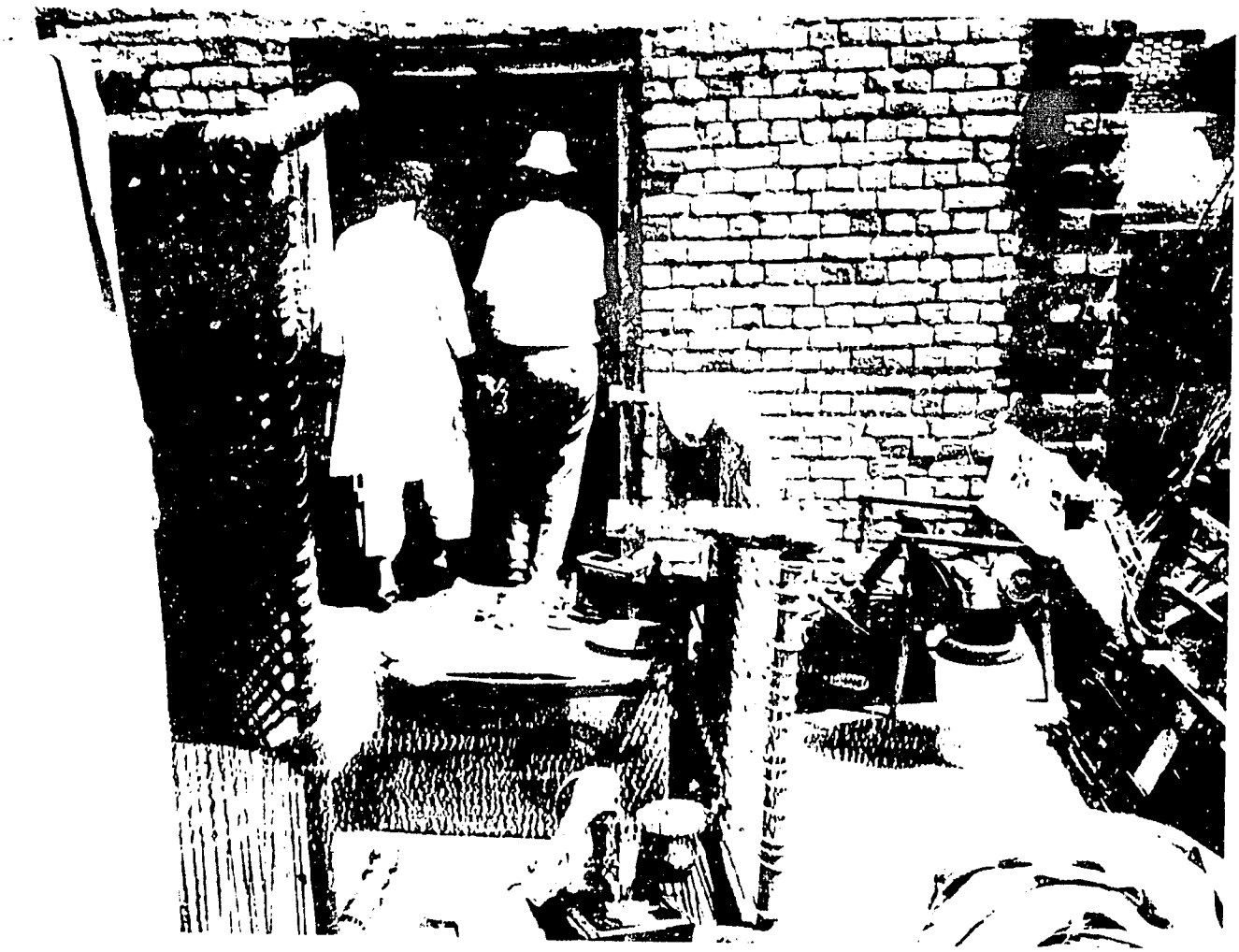
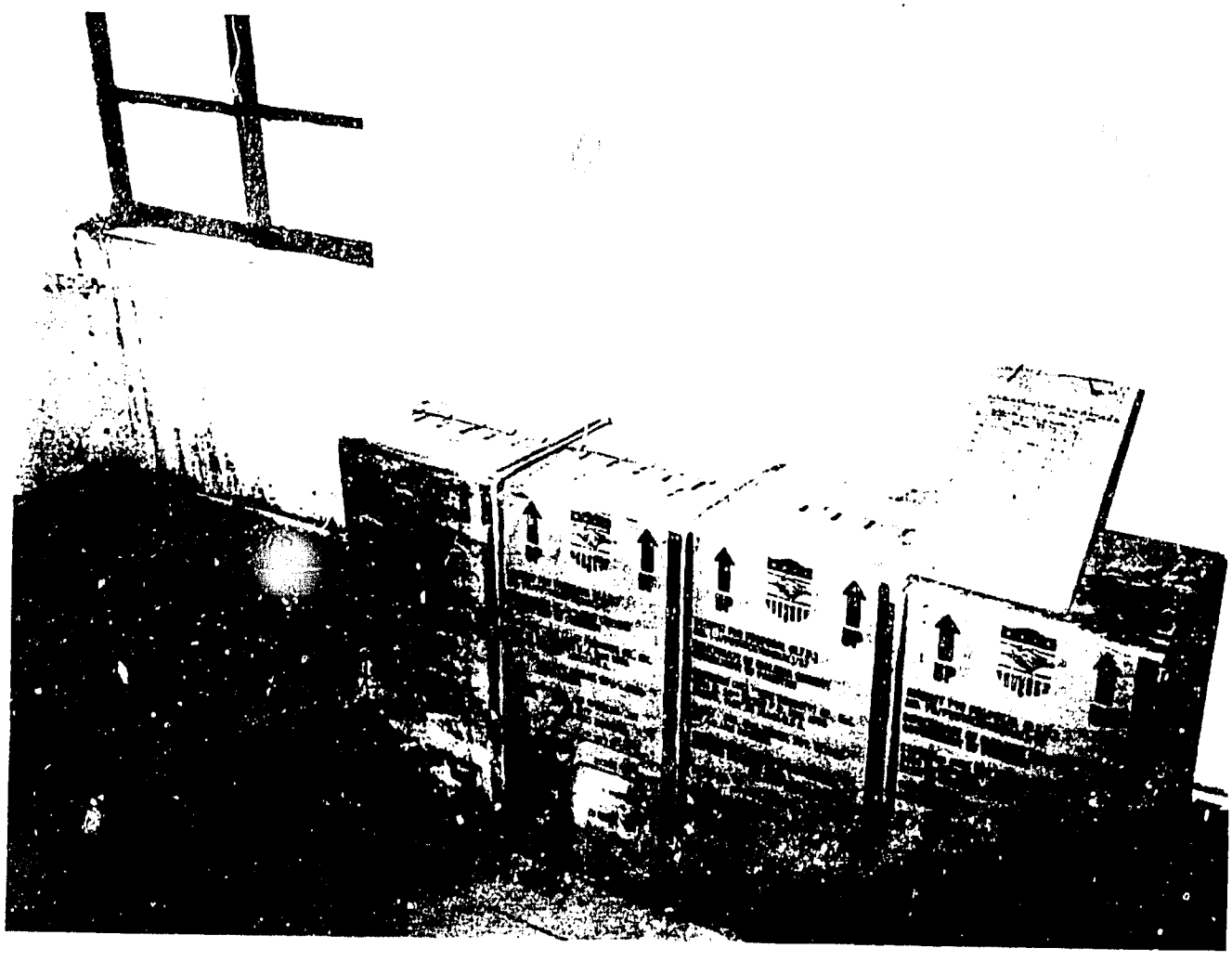


FIGURE 5

INSECTICIDE STORE-ROOM IN A VILLAGE
OF THE PUNJAB PROVINCE