Improving Livelihoods in the Earthquake Affected Areas of Pakistan

Improving Livelihoods & Enterprise Development (I-LED)

Under Cooperative Agreement 391-A-00-0601082-00

Pesticide Evaluation Report & Safer Use Action Plan (PERSUAP)

(Covering the period August 2006 - August 2009)

I-LED Report no. 5/2007

Delivery date: May 30, 2007

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Acronyms used in the PERSUAP Report

ACP	Asia, Caribbean, and Pacific Group (trade group with EU)
ADB	Asian Development Bank
ADI	Average Daily Intakes ('safe' amount of pesticide consumed daily)
AID	US Agency for International Development (also known as USAID)
AJK	Azad Jammu Kashmire
AKRSP	Agah Khan Rural Support Programme
ANE	Asia and Near East Bureau of USAID
APA	Agricultural Pesticides Act (Pakistan)
APO	Agricultural Pesticides Ordinance (Pakistan)
APSA	Asia & Pacific Seed Association
APTAC	Agricultural Pesticides Technical Advisory Committee (Pakistan)
BEO	Bureau Environmental Officer
BMP	Best Management Practice
BT	*Bacillus thuringiensis* (type of microbial-extract pesticide)
CABI	British Consortium for Overseas Pest Management
CFR	Code of Federal Regulations
CNFA	Citizen's Network for Foreign Affairs (a non-profit NGO)
cm	centimeters
CPC	Crop Protection Compendium
CTO	Cognizant Technical Officer (USAID Project Manager)
D	Dusts (a pesticide formulation)
DFP	Dried Fruit Project
DPP	Department of Plant Protection
EA	Environmental Assessment
EC	Emulsifiable Concentrate (a pesticide formulation)
EPA	US Environmental Protection Agency (also known as USEPA)
EPAs	Economic Partnership Agreements
ETL	Economic Threshold Level
EU	European Union
EurepGAP	European Good Agricultural Practices (also known as EUROGAP)
EXTOXNET	Oregon State University Ecotoxicology Network Pesticides Website
FAO	Food and Agriculture Organization (part of UN)
FF	Flowable (a pesticide formulation)
FFS	Farmer Field School
FLO	Fairtrade Labeling Organization
FSIS	Food Safety and Inspection Service (a part of the US Department of Agriculture)
G	Granular (a pesticide formulation)
g	grams
GDP	Gross Domestic Product
GEF	Global Environment Fund (of UN)
GOP	Government of Pakistan
GMP	Good Manufacturing Practices
GUP	General Use Pesticide

HACCP	Hazard Analysis Critical Control Points
HT	Highly Toxic
ID	Identification
IEE	Initial Environmental Examination
IFOAM	International Federation of Organic Agriculture Movements
IGR	Insect Growth Regulator (a class of insecticide)
I-LED	Improving Livelihoods and Enterprise Development
IOAS	International Organic Accreditation Service
IPM	Integrated Pest Management
IRRI	International Rice Research Institute
ISO	International Organization of Standardization
MEO	Mission Environmental Officer
mg	milligrams
MINFAL	Ministry of Food, Agriculture, and Livestock (Pakistan)
MRL	Minimum Residue Level ('safe' amount of pesticide on sold food)
MRP	Minimum Reentry Period (safety period after pesticide spraying)
MSDS	Material Safety Data Sheet
MT	Moderately Toxic
NAK	Dutch General Inspection Service for Agricultural Seed and Seed Potatoes
NAT	Not Acutely Toxic
NARC	National Agriculture Research Center (Pakistan)
NGO	Non-Governmental Organization
NIPMP	National Integrated Pest Management Programme (Pakistan)
NWFP	North West Frontier Province
OECD	Organization for Economic Cooperation and Development
OP	Organophosphate (a class of pesticides)
PAN	Pesticide Action Network
PARC	Pakistan Agriculture Research Council (Pakistan)
PER	Pesticide Evaluation Report
PERSUAP	Pesticide Evaluation Report and Safer Use Action Plan
PIC	Prior Informed Consent (a treaty, relates to pesticides)
PNT	Practically Non-Toxic
POPs	Persistent Organic Pollutants (a treaty, relates to toxic pesticides)
PPE	Personal Protection Equipment
PPT	PowerPoint (computer program)
PUC	Pesticide Use Checklist
PVO	Private Volunteer Organization
Reg 216	Regulation 216 (USAID Environmental Procedures)
R&E	Research and Extension
RI	Relief International
RNE	Royal Netherlands Embassy
RUP	Restricted Use Product (Pesticide)
S	Solution (a pesticide formulation)
SC	Suspension Concentrate (= Flowable Concentrate, a pesticide formulation)
SG	Water Soluble Granule (pesticide formulation)

SPFS	Special Programme for Food Security
SPS	Sanitary and Phytosanitary
ST	Slightly Toxic
STP	Seed Treatment Product
SUAP	Safe Use Action Plan
TOT	Training of Trainers
UC	University of California
ULV	Ultra Low Volume (spray technology)
UN	United Nations
UNEP	United Nations Environment Program
UNFAO	United Nations Food and Agriculture Organization
US	United States
USAID	United States Agency for International Development
USEPA	US Environmental Protection Agency (also known as EPA)
VHT	Very Highly Toxic
WB	World Bank
WDG	Water Dispersible Granule (a pesticide formulation)
WHO	World Health Organization
WP	Wettable Powder (a pesticide formulation)
WS	Water dispersible powder for slurry seed treatment (a pesticide formulation)
WTO	World Trade Organization
WWW	World Wide Web

Acknowledgements

Analyzing all of these supply chain crop pests, IPM methods, and pesticides would have been impossible without the direct support of the world-class experts who have helped guide data collection and interpretation. I wish to acknowledge and am most grateful to CNFA I-LED staff Mohammad Riaz, Tim Ekin and Paul Sippola for hiring me for this work and for responding quickly to my requests for information from the field. Without their timely support, this report and the accurate details within it would not be possible.

I would also like to thank USAID ANE staff, especially Barney Popkin and John Wilson for keen insights and support and to AID/Islamabad MEO, Aazar Bhandara and CTO, Marilee Kane for reviewing and tracking environmental compliance related to pesticides. Their support in this process is critical and much appreciated.

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FINDINGS

1. Large amounts of pesticides have been increasingly used on staple and higher value crops in Pakistan, especially in the past 10 years. Many issues remain on the path to safe use and environmental protection. There is some experience with the philosophy and practice of integrated pest management (IPM) in Pakistan. This PERSUAP has evaluated proposed, regionally-available, and artesanal pesticides and IPM measures that can be used to manage pests of agriculture on the I-LED Project.

2. This PERSUAP recognizes the following I-LED crops and pests each:

Pests of each I-LED Crop

Grains

RICE

Sheath Blight, *Rhizoctonia solani*
Rice Blast, *Pyricularia grisea*,
Stem borers, several species
Aphids, several species
Rice Leaf roller
Grasshoppers, several species

MAIZE, BARLEY & SORGHUM

Rust
Loose smut, *Ustilago avenae*
Head smut, *Sporisorium holci-sorghi*
Stem rot (Charcoal, Diplodia, Fusarium, Gibberella, Nigrospora, and Anthracnose).
Leaf bights
Stem borers
Cutworms
Silk beetles

WHEAT

Rust
Smut
Kernel bunt
Armyworms
Aphids

Vegetables

POTATO

Early blight, *Alternaria solani*
Late blight, *Phytophthora infestans*
Mosaic Diseases Caused By Potyviruses
Black scurf, *Rhizoctonia spp*.
Cutworm, Agrotis ipsilon
Armyworm
White grubs
Aphids, Green peach aphid: *Myzus persicae*; Potato aphid: *Macrosiphum euphorbiae*
Jassids (leafhoppers)

TOMATO

Blights
Root rot, *Fusarium and Phytophthora spp*
Fruit rot (water mold), *Pythium ultimum* and other species
Cutworm, Variegated cutworm: *Peridroma and Agrotis spp.*
Armyworm, Spodoptera spp.
Aphids
Jassids (leafhoppers)
Tomato fruitworm (fruit borer), *Helicoverpa (Heliothis) zea*
Alternaria, *Alternaria alternata f. sp. lycopersici*
Phytophthora, *Phytophthora parasitica* and *P. capsici*
Fusarium, *Fusarium oxysporum f. sp. lycopersici*

ONION

Purple blotch, *Alternaria porri*
Root rots
Thrips, *Thrips tabaci*
Bollworm
Budworm, *Heliothis virescens*
Armyworm, *Spodoptera* species

FRENCH BEANS

Root rot, *Fusarium* species
Fruit borer
Aphids

PEAS

Powdery mildew
Pod borer

CAULIFLOWER

Fusarium wilt
Aphids
Diamond-back moth

CUCUMBER

Powdery mildew
Downy mildew
Aphids, green peach aphid
Fruit fly (vinegar flies), Drosophila spp.

Oil crop

CANOLA (RAPESEED)

Armyworm
Aphids

Fiber crop

COTTON

Bollworms/Armyworms/Budworms, various species

Fruit and Edible Nuts

APPLE

Coddling moth, *Cydia (Laspeyresia) pomonella*
San Jose scale, *Diaspidiotus (Quadraspidiotus) perniciosus*
Green Apple Aphid, *Aphis pomi*
European Red Mite, *Panonychus ulmi*
Apple Lygus bug
Scab of apple, *Venturia inaequalis*
Powdery mildew, *Podosphaera leucotricha*
Sooty blotch

PEAR

Codling moth, *Cydia (Laspeyresia) pomonella*

Leafroller moth, *Platynota stultana*
Pear Psylla, *Cacopsylla (Psylla) pyricola* (secondary pest after coddling moth spray)
Scab of pear, *Venturia pirina*
Fireblight, *Erwinia amylovora*
Fruit fly, Rhagoletis pomonella
Pear Rust, *Gymnosporangium libocedri*

PEACH/APRICOT/PLUM

Oriental fruit moth, *Grapholitha molesta*
Green Peach Aphid, *Myzus persicae*
Stem borers
Peach Twig borer, *Anarsia lineatella*
Termites
Root rots
Powdery mildew
Shot hole disease, *Clasterosporium carpophilum*
Leaf curl, *Taphrina deformans*
Gummosis (canker)

CITRUS

Citrus canker
Citrus Die Back (transmitted by Asian Citrus Psyllid, *Diaphorina citri***)**
Citrus Leaf-miners, *Phyllocnistis citrella*
San Jose scale, *Diaspidiotus (Quadraspidiotus) perniciosus*
Red Mite, *Panonychus citri*
Black spot, *Guignardia citricarpa*

WALNUT

Bacterial blight, *Xanthomonas campestris pv. juglandis*
Stem borer
Termites

GRAPES

Downy mildew, *Plasmopara viticola*
Powdery mildew,
Jassids (leafhoppers, vectors of disease)

3. **Pesticides *accepted for use* in the project**

Fungicides

Aluminium (aluminum)-fosetyl or Fosetyl-aluminium (aluminum)
Carbendazim
Captan
Copper hydroxide
Copper oxychloride (hydrated lime)
Mancozeb
Metalaxyl
Thiram

Insecticides
Acetamiprid
Bacillus thuringiensis
Carbaryl
Imidacloprid
Lufenuron
Malathion
Thiacloprid
Thiamethoxam

Herbicides
Glyphosate/Roundup
Metolachlor
Pendimethalin

Acaricides
Amitraz
Cypermethrin(e), beta
Deltamethrin (pour-on livestock formulation only)
Diazinon
Fenvalerate
Trichlorfon

4. **Pesticides *not accepted for use* in the project(s), with reason for rejection**

Insecticides
Azinphos-methyl (too toxic)
Carbofuran (too toxic)
Chlorpyrifos (restricted use products)
Cyfluthrin (beta-cyfluthrin) (restricted use products)
Deltamethrin (restricted use products, exception made for pour-on livestock formulations)
Endosulfan (too toxic)
Lambda-Cyhalothrin (restricted use products)
Polytrin C 440 EC (Profenofos 400g + Cypermethrin 40g per liter—both restricted use products)

Acaricides

Chlorfenvinphos (no EPA approval)
Dichlorvos (DDVP) (too toxic)

5. **Pesticides *Conditionally* Accepted (Condition=Users absolutely must receive training and a dual cartridge respirator with agreement to use them)**

Aluminium (Aluminum) Phosphide
Zinc Phosphide

6. **Pesticides that may be used with the Condition that *they become registered by Government of Pakistan* over the life of the project**

Fungicides
Copper sulfate
Lime sulfur (a mixture of calcium polysulfides)

Insecticides
Insecticidal soaps and dormant oils
Pyriproxyfen
Spinosad
Spirodiclofen

Acaricides
Edcidin

7. **Artesanal botanical pesticides that farmers may produce and use on-farm.**

Neem Oil (artesanal)
Pyrethrum (artesanal)
Rotenone (artesanal)

8. No pesticides other than those listed above under numbers 3, 5 & 6 (with conditions), and 7 may be used by I-LED on I-LED's crops in Pakistan, unless the PERSUAP is amended to include additional, EPA-approved (and Pakistan-approved) for same or similar use, without restriction, pesticides.

9. The Conditions for use of aluminum and zinc phosphide are that the uers absolutely must receive training and a dual cartridge respirator with agreement to use them.

10. USAID recognizes and promotes—*as official policy*—Integrated Pest Management, or IPM.

Many IPM tactics that reduce pest risk are relatively simple agriculture best management practices (BMPs), such as:

- scouting, traps and monitoring to catch and manage pest outbreaks early;

- good plant health maintenance through water, soil, and nutrient management (raised-bed, plastic mulches, regulated drip irrigation/fertigation; plant, soil, nutrient, and water analyses);
- cultural practices like use of resistant varieties, pest avoidance through early/late plantings/harvestings, crop rotation, pruning, crop residue destruction, and destruction of pest refuge plants near field;
- biological control methods like parasite/predator enhancement through border plantings of favored refugia plants, use of pheromone releases for mating disruption, parasite releases, and microbial agent sprays (for larger farms);
- and mechanical control through exclusion netting or trapping.

CONCLUSIONS

Increased risks to human health and environment from pesticide use exist in Pakistan due to several factors, key of which are:

- difficulty in enforcement of pesticide regulations;
- lack of affordable, comfortable PPE in pesticide shops;
- no use of PPE by people mixing and applying toxic pesticides;
- lack of good plant health, soil health, and water management practices;
- little or no understanding of IPM theory or principles;
- substandard quality pesticide products from small regional companies finding their way into local markets;
- pesticide product subdivision, or adulteration, with fillers, into smaller quantities and unapproved containers;
- illiteracy leading to inability to read or comprehend pesticide labels and safety warnings;
- poor quality labels on some products;
- inability to properly identify pests, their population levels, and economic thresholds;
- inadequate knowledge about pesticides and their dangers;
- need for more selective pesticides;
- children and women might apply pesticides or enter the field during the no-entry period;
- improper mixing and dosage leading to resistance buildup; among others.

These are the reasons that USAID requires compliance through a PERSUAP, with recommendations for IPM and safety training and use of safety equipment, among others, to begin to reduce risk and change attitudes and behaviors, which are difficult and take time to achieve. To reduce these risks, the following recommendations are provided.

RECOMMENDATIONS

- I-LED can, if resources permit, assist MINFAL with computers, alphabetization, sorting and general organization of the registered pesticides database, since it is currently difficult to search and research.

- I-LED should link to MINFAL, other NGOs, other donors, and CropLife Asia for additional sources of local information and expertise on pesticides and issues to be tackled together; and to present these PERSUAP findings in a local earthquake affected area public forum.

- Future consultancies can include training in farm chemical safe use and IPM, monitoring for USAID regulations compliance, and environmental assessments of small and medium scale agricultural processing activities. I-LED might find a creative way to require recipients of pesticides to agree that they will use safety equipment provided by the project.

- This PERSUAP and the list of pesticides should receive an annual review and amendment to address changes and new discoveries, and things missed with this document. This should occur in May 2008.

- This I-LED PERSUAP recommends the following actions for safer use of and risk reduction from pesticides:

Immediately,

- *Procure protective clothing and safety equipment (PPE) for the most at-risk farmers*

- *Training in safe use of pesticides, IPM, and environmental protection*

- *During training, administer the Pesticide Use Checklist (PUC) for NGOs/PVOs*

- *For training, produce simple safe use training materials and posters (or if PPD or FAO have already produced such training materials, duplicate and/or distribute these to trainees)*

During training, Train farmers to:

- *Ensure fields are clear of children before spraying and kept out after spraying has occurred*

- *Apply pesticides early in the morning before bees forage*

- *Apply pesticides at least 35 meters from drinking water sources and open water*

- *Avoid using pesticides in or near the national parks and where endangered species are known to exist*

And, as feasible:

- *Produce a quick safety reference guide for all of the pesticides to be used on agriculture and anticipated pests for I-LED crops (obtaining MSDSs from CropLife International and individual companies would be a good start in this direction)*

- *Begin to write simple IPM plans for each of the crops to be protected. Teach proper plant, water, and soil management techniques.*

Continuously,

- *Rotate among types or classes of pesticides to reduce the build-up of resistance*

- *Choose and use least toxic pesticides, as practical (toxicities are given in Attachment 1)*

- *Intend to use more target-specific biological and plant-based pesticides, as practical*

- *Work with the MINFAL as they implement environmental compliance and safety training*

- *Monitor resistance by noting reduction in efficacy of each pesticide product during field visits*

- *Monitor the health of laborers using organophosphorous compounds*

- *Annually update changes to pesticides lists and communicate these changes to USAID via an amendment to the PERSUAP*

SECTION 1: Introduction to I-LED PERSUAP

1.1 Purpose and Scope for an IEE/PERSUAP for I-LED

Ironically, it was the death of 5 Pakistani Ministry of Health workers in 1976 during USAID anti-malaria spray campaigns that led USAID to develop regulations that dictate risk reduction to protect human health and safety, and environmental protection. In addition to the 5 deaths, about 2,800 sub-lethal poisonings occurred that season. These could have been avoided with simple risk awareness and reduction training, protective gear, along with knowledge of pesticide sourcing and testing. The environmental regulations that were codified by USAID to mitigate such risks are referred to as Regulation 216.

US Government Regulation 216 Compliance

The US Government's Title 22, Code of Federal Regulations, Part 216, also known as 'Regulation 216', finds that certain environmental compliance procedures and a process must be followed on overseas projects to:

- create modern state-of-the-art development,
- achieve optimal economic results with every dollar invested,
- avoid harming people in both our partner countries and the US,
- avert unintended negative economic growth,
- reinforce practical civil society and democracy through transparency and public participation,
- reduce diplomatic incidents,
- engender public trust and confidence in USAID, and
- comply with the law

Now, following Regulation 216, all USAID activities are subject to analysis and evaluation via—at minimum—an Initial Environmental Examination (IEE), and—at maximum—an Environmental Assessment (EA). And because of risk concerns presented by pesticides, the USAID environmental regulations require that at least the 12 factors outlined in the Pesticide Procedures described in 22 CFR 216.3 (b)(1)(i) (a through l) be addressed in the IEE for any program that includes assistance for the procurement or use of pesticides. The Asia Near East Bureau asks that these factors be examined in a particular type of technical analysis document, termed a "Pesticide Evaluation Report and Safer Use Action Plan" (PERSUAP), which is submitted as an attachment to a short summary IEE (the IEE itself can be very brief, with the analytical work contained in the attached PERSUAP).

The PERSUAP focuses on the particular circumstances of the program in question, the pesticide system within which the program operates, the risk management choices available, and how a risk management plan would be implemented in the field. Further details about what to include in a PERSUAP are given below.

In the USA, when the Environmental Protection Agency (EPA) registers pesticides for use, it specifies the manner in which the product can be "safely" used (that is, with an acceptably small risk), including safety equipment needed when applying the pesticide, how to apply it, the allowed uses, storage, transport, and disposal. But the context in which EPA makes these registration decisions is important to note. An extensive system of capabilities and resources exist in the USA that help give EPA confidence these specifications will be followed and the product will be used appropriately. These include a 97% literacy rate—meaning most of the population can read labels (contrast this with only 47% adult literacy for the population of Pakistan, with most of the literacy occurring in big cities away from agricultural areas); close control by EPA over the content of the pesticide label; training requirements and programs for those pesticide products that require applicator certification—like for many EPA acute toxicity class I or II pesticides and Restricted Use Pesticides (RUPs); worker protection requirements; occupational safety regulations; and relatively effective federal, state and local enforcement mechanisms.

In Asian countries, a local-level analysis and evaluation such as a PERSUAP is needed for pesticide use because farmers and other field workers in these countries are unlikely to have a high rate of literacy or training in order to adequately understand risks of using pesticides, and implement means to reduce these risks. They may not be able to read or understand pesticide labels even if they are present. And, like in 1976, dangerous formulations of pesticides containing very toxic byproducts, or adultered products with unknown or low quality components may enter the country and be used by unsuspecting project staff or recipients.

In allowing the use of certain pesticides in its overseas programs, USAID cannot rely on the same societal capabilities and resources that the USEPA does to assure appropriate use of the product. The preparation of a PERSUAP gives an I-LED program manager the opportunity to consider practical actions by which to *reduce the risks* of using pesticide products in a program in Pakistan, taking into consideration the context in which the products will be used, the particular elements of the program, and the different capacities of the partners and stakeholders involved.

Who prepares a PERSUAP?

Recipients of USAID funds are responsible for due diligence so that their activities do not harm the environment or human health. Thus, they assist with collecting local information and hire a pesticide system expert familiar with USAID regulations and developing country pesticide issues to analyze the information and recommend best practices for reducing risks and complying with US law. A PERSUAP analyzes the pest management choices available in the context of the larger pesticide system in the country, and identifies risks and ways to reduce these risks.

At the AID field mission, the Cognizant Technical Officer (CTO) and Mission Environmental Officer (MEO) are generally responsible for assuring that environmental review requirements for their programs are met, including tracking and approving IEE/PERSUAPs, and monitoring

progress of the projects in meeting recommendations and timelines. Once the IEE/PERSUAP is reviewed and accepted by the CTO and MEO, it is recommended for approval by the Mission Director (MD), who then submits the document to the Bureau Environmental Officer (BEO) in Washington for approval and tracking.

Components of an activity-level PERSUAP

A PERSUAP basically consists of two parts, a "PER" and a "SUAP." The Pesticide Evaluation Report (PER) section addresses the background and pesticide system in Pakistan to inform stakeholders and partners of the levels and types of risk likely to be found, and sets the stage for the specific pesticide analysis. It then analyzes integrated pest and pesticide management options in Pakistan by vetting these through Regulation 216's special section on Pesticide Procedures with 12 informational elements. Note that the use of Integrated Pest Management is USAID Policy, thus it is emphasized throughout the analyses, and must be a focus of all assistance programs that donate pesticides or advice on pesticides.

The Safer Use Action Plan (SUAP) puts the conclusions reached in the PER into recommendations for plans of action, including assignment of responsibility to appropriate parties connected with the pesticide program. This PERSUAP supporting a pesticide IEE for agriculture rehabilitation activities for local consumption and markets in Pakistan is being submitted specifically to address uses of pesticides, as listed below.

1.2 I-LED Project Description

According to CNFA's website, "The Improving Livelihoods and Enterprise Development Project (I-LED) is a three-year initiative to assist those communities affected by the October 8, 2005 earthquake. Ultimately, I-LED aims to increase the incomes of those most seriously affected by the earthquake, living in the Siran and Kaghan Valleys located in the North West Frontier Province (NWFP) and Bagh District located in Azad Jammu Kashmire (AJK), by linking them to markets with economic growth potential."

Further, "The I-LED strategy, which will be implemented in collaboration with Relief International (RI), is aimed at facilitating the successful transition from relief and reconstruction to broad based economic growth and increased employment in agriculture based affected regions through a collaborative community-based mix of:

- technical assistance;
- voucher and cash for work initiatives; and
- targeted matching enterprise grants.

"The net result of I-LED will be the establishment of a solid base for economic development through restored livelihoods and expanding employment and enterprise opportunities, in

conjunction with USAID's commitment to the people of the affected regions of "building back better."

I-LED’s Activities:

Reconstruction of Existing Livelihoods
Value-Chain Development
Local Economic Development

Specific I-LED interventions may include:

- Restoring livestock
- Improving veterinary services
- Constructing animal shelters
- Rehabilitating irrigation infrastructure
- Renovating farm terraces
- Vocational training
- Crop production and post-harvest training
- Agricultural input distribution
- Pilot processing and marketing enterprise”

1.3 Pakistan Country Background

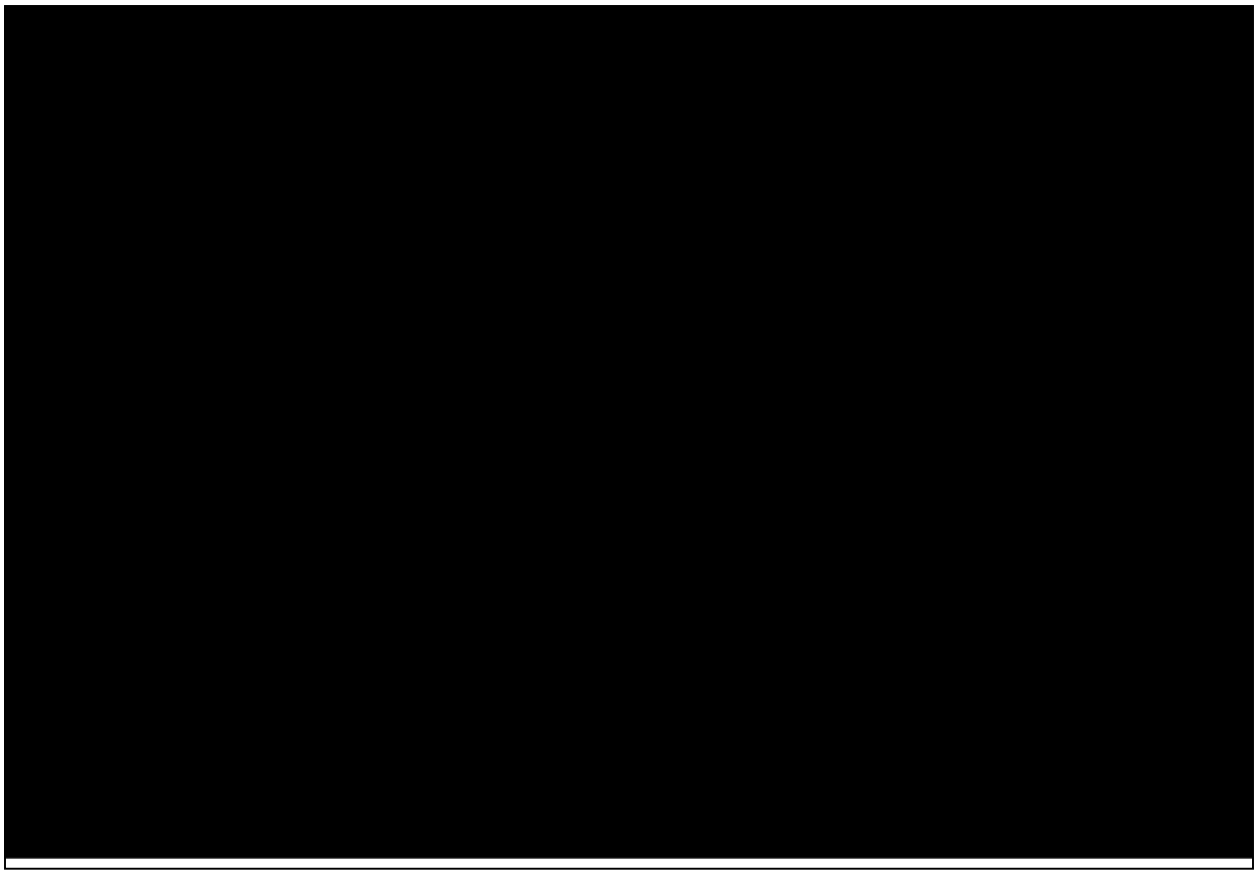


Figure 1: Country Map of Pakistan with CNFA I-LED Target Areas highlighted in green.

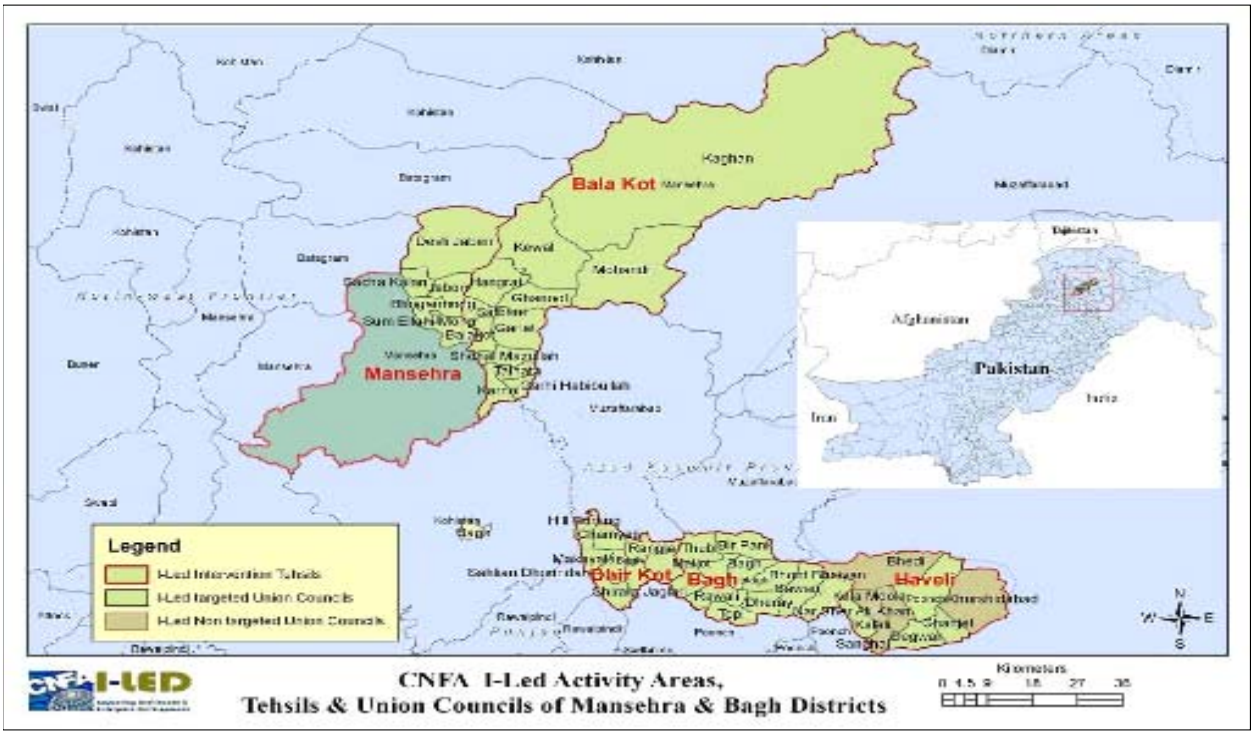


Figure 2: CNFA I-LED Activity Areas; Tehsils & Union Councils of Mansehra & Bagh Districts

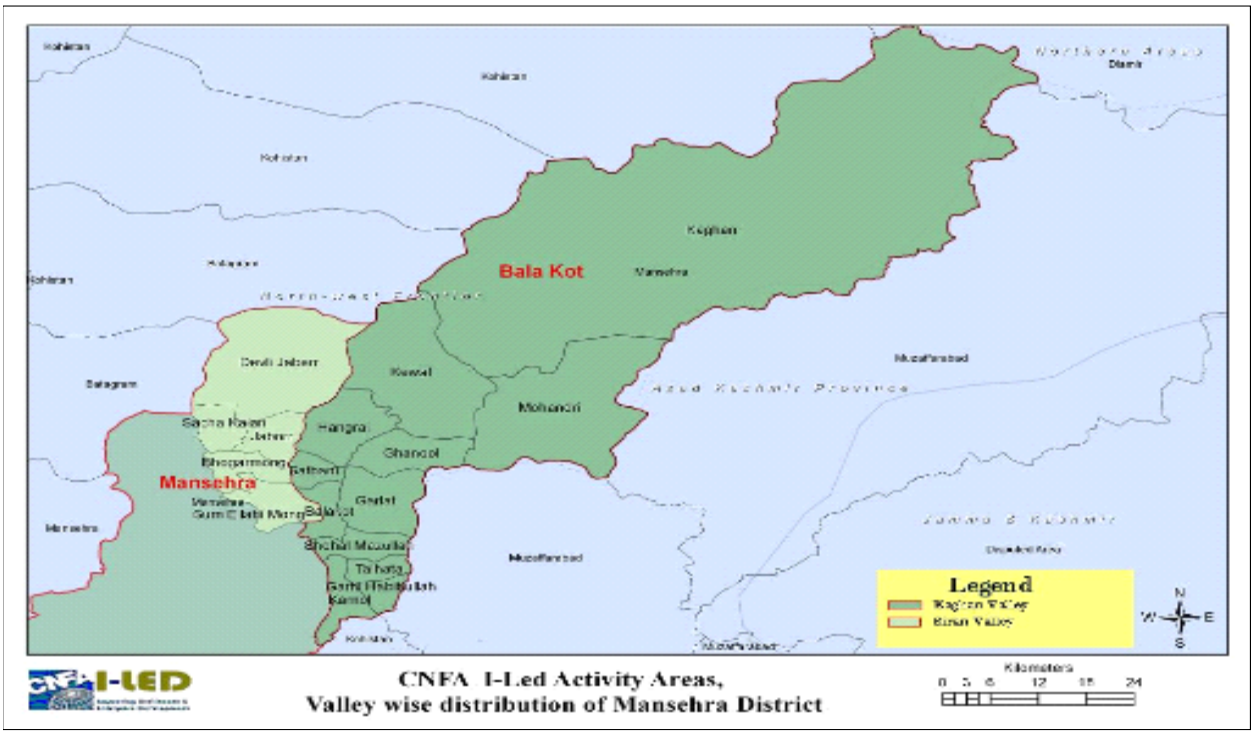


Figure 3: CNFA I-LED Activity Areas; Valley wise distribution of Mansehra District
Pakistan is a Southern Asian country of about 779,000 square kilometers, and almost 165 million people, bordering the Arabian Sea, sandwiched between India on the east and Iran and Pakistanistan on the west and China in the north. It is composed of flat Indus plains in east; mountains in north and along the northwest border with Pakistanistan; the Balochistan plateau in west, and with the Indus River flowing directly through the middle of the country from north to south. The climate is mostly hot, dry desert; temperate in northwest; arctic in mountainous north.

Figures 1, 2 and 3 show the country of Pakistan with close-ups of the areas where I-LED is active.

Pakistan is party to: Biodiversity, Climate Change, Climate Change-Kyoto Protocol, Desertification, Endangered Species, Environmental Modification, Hazardous Wastes, Law of the Sea, Marine Dumping, Ozone Layer Protection, Ship Pollution, Wetlands. It has signed, but not ratified: Marine Life Conservation.

Pakistan Trade (2005 est.) includes: *Exports*--$14.85 billion: textiles (garments, bed linen, cotton cloth, and yarn), rice, leather goods, sports goods, carpets, rugs, chemicals & manufactures. *Major partners*--U.S. 22.6%, United Arab Emirates 8.9%, U.K. 5.8%, China 5.4%, Germany 4.7%. *Imports*--$21.26 billion: petroleum, petroleum products, machinery, plastics, paper and paper board, transportation equipment, edible oils, pulses, iron and steel, tea. *Major partners*--China 14.0%, Saudi Arabia 10.5%, United Arab Emirates 9.0%, Japan 6.2%, U.S. 5.1%, Kuwait 5.1%, Germany 4.9%. Pakistan exports textiles (garments, bed linen, cotton cloth, and yarn), rice, leather goods, sports goods, chemicals, manufactures, carpets and rugs. Major export partners as of 2005 are US 24.8%, UAE 7.8%, Pakistanistan 6.6%, UK 5.7%, Germany 4.5%.

According to the CIA World Fact Book (https://www.cia.gov/library/publications/the-world-factbook/geos/pk.html) for Pakistan, "IMF-approved government policies, bolstered by generous foreign assistance and renewed access to global markets since 2001, have generated solid macroeconomic recovery the last five years. The government has made substantial macroeconomic reforms since 2000, most notably privatizing the banking sector. Poverty levels have decreased by 10% since 2001, and Islamabad has steadily raised development spending in recent years, including a 52% real increase in the budget allocation for development in FY07, a necessary step toward reversing the broad underdevelopment of its social sector. The fiscal deficit - the result of chronically low tax collection and increased spending, including reconstruction costs from the October 2005 earthquake - appears manageable for now. GDP growth, spurred by gains in the industrial and service sectors, remained in the 6-8% range in 2004-06. Inflation remains the biggest threat to the economy, jumping to more than 9% in 2005 before easing to 7.9% in 2006. The central bank is pursuing tighter monetary policy - raising interest rates in 2006 - while trying to preserve growth. Foreign exchange reserves are bolstered by steady worker remittances, but a growing current account deficit - driven by a widening trade gap as import growth outstrips export expansion - could draw down reserves and dampen GDP growth in the medium term."

Agriculture and Natural Resources

According to US State Department (http://www.state.gov/r/pa/ei/bgn/3453.htm), “Pakistan's principal natural resources are arable land, water, hydroelectric potential, and natural gas reserves. About 28% of Pakistan's total land area is under cultivation and is watered by one of the largest irrigation systems in the world. Agriculture accounts for about 21% of GDP and employs about 42% of the labor force. The most important crops are cotton, wheat, rice, sugarcane, fruits, and vegetables, which together account for more than 75% of the value of total crop output. Despite intensive farming practices, Pakistan remains a net food importer. Pakistan exports rice, fish, fruits, and vegetables and imports vegetable oil, wheat, cotton (net importer), pulses, and consumer foods.

The economic importance of agriculture has declined since independence, when its share of GDP was around 53%. Following the poor harvest of 1993, the government introduced agriculture assistance policies, including increased support prices for many agricultural commodities and expanded availability of agricultural credit. From 1993 to 1997, real growth in the agricultural sector averaged 5.7% but declined to less than 3% in 2005. Agricultural reforms, including increased wheat and oilseed production, play a central role in the government's economic reform package. Heavy rains in 2005 provided the benefit of larger than average cotton, wheat, and rice crops, but also caused damage due to flooding and avalanches.

Pakistan has extensive energy resources, including fairly sizable natural gas reserves, some proven oil reserves, coal, and large hydropower potential. However, exploitation of energy resources has been slow due to a shortage of capital and domestic and international political constraints. For instance, domestic gas and petroleum production totals only about half the country's energy needs, and dependence on imported oil contributes to Pakistan's persistent trade deficits and shortage of foreign exchange. The government announced that privatization in the oil and gas sector is a priority.”

Precipitation Patterns

Figure 4 (below) shows the precipitation patterns in Pakistan. According to UENP, (http://www.rrcap.unep.org/lc/cd/html/countryrep/pakistan/map12.JPG), the source for Figures 4 and 5 on rainfall and soil types, rainfall is high in the areas where the I-LED project assists. These areas receive anywhere from 1400 to 2000 mm of rain annually, some of the highest in the country.

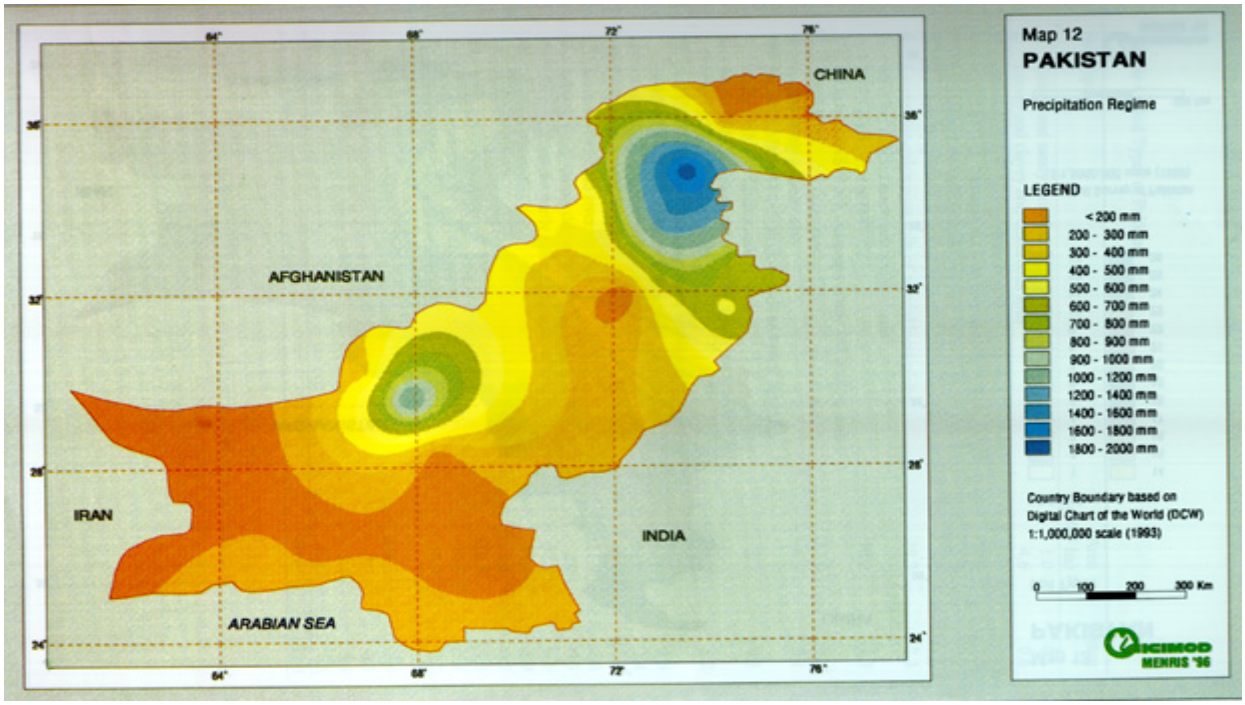


Figure 4 Precipitation Patterns in Pakistan

Soils of Pakistan

According to UNEP, "The soils of Pakistan are derived from two types of parent materials:
1. Alluvium, Loess and wind reworked sands. They are of mixed mineralogy.
2. Residual material obtained from weathering of underlying rocks. Most of the rocks are Calcareous . In some areas, Granites have produced non-calcareous soil material. Very small quantities of salts are released from most of the rocks. The soils are therefore, essentially non-saline.

Soil Classification
The soils of Pakistan have acquired distinct characteristics from the parent material and by their mode of formation. The river-laid sediments have developed into Alluvial Soils. The desert sands have turned into distinct soils. The hills, mountains and the plateaus have produced Residual Soils with patches of Alluvial, Loess and other soils. Accordingly, the soils of Pakistan can be classified into the following six types:
Alluvial Soils of the Flood Plains
Alluvial Soils of the Bar Uplands
Soils of the Piedmont Plains
Desert Soils
Soils of Potwar Plateau
Soils of Western Hills"

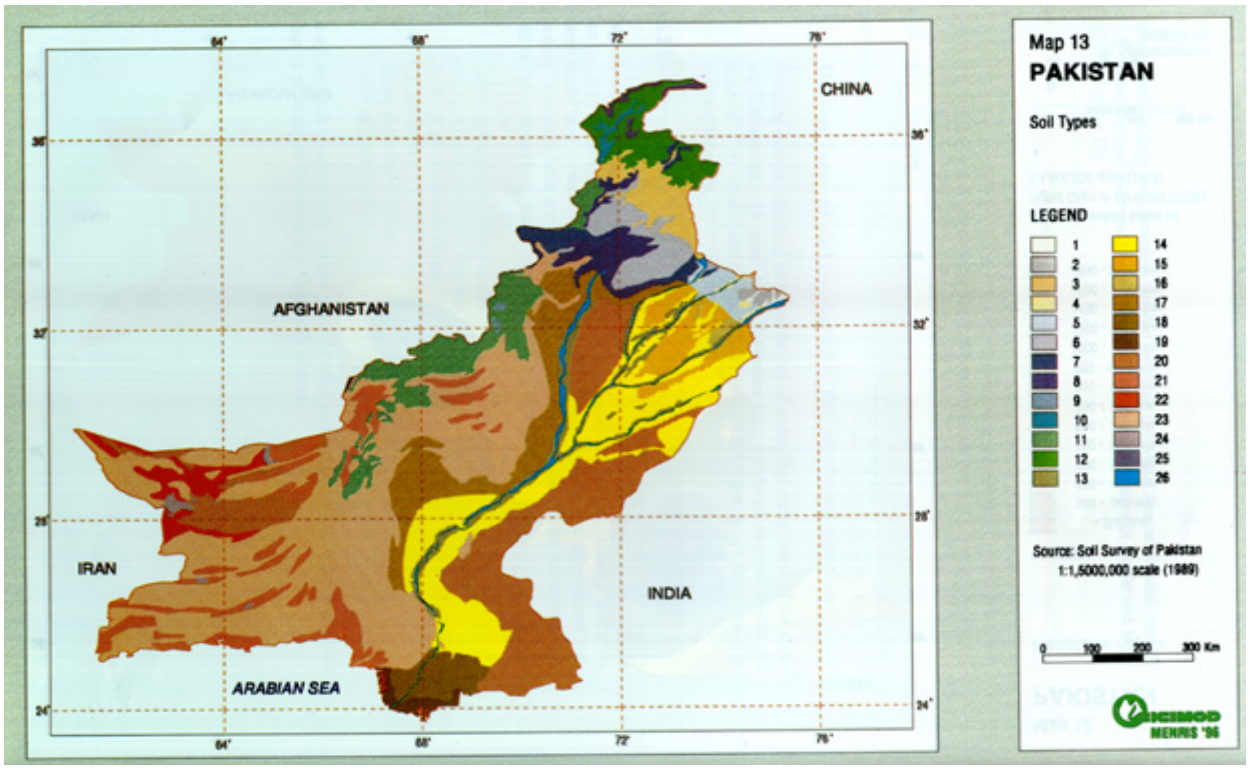


Figure 5: The 26 broad soil types of Pakistan

In the I-LED project area, soils appear to be mostly types 3 (Begh)), and 12 (Mansehra), which are respectively; Loamy shallow soils in the mountains and loamy non-calcareous soils in the valleys (3); Mountains with rock outcrops, and some loamy very shallow soils, and Valleys with mainly loamy soils (12).

1.4 Priority geographic places or areas of project intervention

As shown in Figures 1, 2, and 3 above, the priority areas for the I-LED project are Siran (3000 – 7000 feet) and Kaghan (3000 – 9000 feet) Valleys located in the North West Frontier Province (NWFP) and Bagh District located in Azad Jammu Kashmire (AJK), areas most heavily impacted by the 2005 earthquake.

1.5 USAID development partners involved in project and influenced by PERSUAP

I-LED works primarily with smallholder farmers and the Ministry of Food, Agriculture, and Livestock (MINFAL), NGOs including Relief International (RI), and others. It also has links to Crop Life International, a pesticide industry consortium. There are possibilities for links with CABI, ADB and FAO Farmer Field Schools and IPM technologies.

1.6 Study Methodology

Environmental Assessment Professional was contacted in April 2007 by USAID/ANE and CNFA about the need for a PERSUAP for agriculture rehabilitation activities. Information requests for crops, pests and pesticides were sent to the I-LED project staff to begin the process. I-LED staff responded and the PERSUAP request was contracted in April (a copy of the Scope of Work/Terms or Reference is found at the end of this PERSUAP as Attachment 3). It was decided to do this study without a field trip to Pakistan; rather it would be done with information collected and sent by I-LED field staff and searches of the World Wide Web.

The USAID Environmental Procedures for pesticide "use" (as provided by USAID Environmental Procedures: Text of Title 22, Code of Federal Regulations Part 216, Reg. 216), dictate that all projects involving assistance for the procurement or use, or both, of pesticides shall be subject to the procedures prescribed in 22 CFR 216.3 (b)(1)(i)(a-l). "Use" is interpreted broadly to include the handling, transport, storage, mixing, loading, application, clean up of spray equipment, and disposal of pesticides, as well as the provision of fuel for transport of pesticides, and providing technical assistance in pesticide management.

"Use" is said to occur if training curricula include information on safer pesticide use even if it does not involve actual application of pesticide. It also applies if pesticide procurement is facilitated by credit or loans. USAID also strongly encourages including instruction in IPM and alternatives to pesticides in any training on pesticide use as defined above. Under this approach, pesticides are considered a tool of 'last resort' and pesticide choice should as much as practical be the 'least toxic' choices. In contrast, support to limited pesticide research and pesticide regulatory activities are not subject to scrutiny under the pesticide procedures.

This definition of "use" applies throughout this PERSUAP document.

The USAID pesticide procedures also indicate that when a project includes assistance for procurement or use, or both, of pesticides registered for the same or similar uses by USEPA without restriction, the Initial Environmental Examination (IEE) for the project shall include a separate section evaluating the economic, social and environmental risks and benefits of the planned pesticide use to determine whether the use may result in significant environmental impact.

The rationale for a PERSUAP- type of environmental review (as opposed to a full-scale Environmental Assessment) is that the affected projects are reviewed and an IEE approved for all other activities in the programs. The IEE approves Categorical Exclusions and Negative Determinations with Conditions as appropriate to each case, with deferrals for pesticide use pending completion of PERSUAPs. The other rationale is that the pesticides are used under tight management, with well laid conservation practices, guided by trained and experienced members of staff who implement actions in the SUAP.

Pesticides are defined as synthetic *or natural product-derived* chemical products intended to kill, control, and repel insects, ticks, plant and animal diseases, weeds, and other pest organisms. Attachment 5 includes natural plant-derived pesticides.

The PERSUAP analysis will cover those pesticides proposed for use by the project that are, at minimum: Registered by USEPA for the same *or similar* uses without restrictions; Registered by the local government, if possible; Available in the country; and Alternate pesticide choices available in the region that could be used if registered and imported. It will also specifically list project-proposed pesticides that are *rejected for use* by the study, with reason(s) for rejection. Websites used to gather information for this report are found in Attachment 12.

SECTION 2: I-LED CROPS, PESTS, IPM, AND PESTICIDES

2.1 Crops & Target Pests of each I-LED Crop

Grains

RICE

Sheath Blight, *Rhizoctonia solani*
Rice Blast, *Pyricularia grisea*,
Stem borers, several species
Aphids, several species
Rice Leaf roller
Grasshoppers, several species

MAIZE, BARLEY & SORGHUM

Rust
Loose smut, *Ustilago avenae*
Head smut, *Sporisorium holci-sorghi*
Stem rot (Charcoal, Diplodia, Fusarium, Gibberella, Nigrospora, and Anthracnose).
Leaf bights
Stem borers
Cutworms
Silk beetles

WHEAT

Rust
Smut
Kernel bunt
Armyworms
Aphids

Vegetables

POTATO

Early blight, *Alternaria solani*
Late blight, *Phytophthora infestans*
Mosaic Diseases Caused By Potyviruses
Black scurf, *Rhizoctonia spp*.
Cutworm, Agrotis ipsilon
Armyworm
White grubs

Aphids, Green peach aphid: *Myzus persicae*; Potato aphid: *Macrosiphum euphorbiae*
Jassids (leafhoppers)

TOMATO

Blights
Root rot, *Fusarium and Phytophthora spp*
Fruit rot (water mold), *Pythium ultimum* and other species
Cutworm, Variegated cutworm: *Peridroma and Agrotis spp.*
Armyworm, Spodoptera spp.
Aphids
Jassids (leafhoppers)
Tomato fruitworm (fruit borer), *Helicoverpa (Heliothis) zea*
Alternaria, *Alternaria alternata f. sp. lycopersici*
Phytophthora, *Phytophthora parasitica* and *P. capsici*
Fusarium, *Fusarium oxysporum f. sp. lycopersici*

ONION

Purple blotch, *Alternaria porri*
Root rots
Thrips, *Thrips tabaci*
Bollworm
Budworm, *Heliothis virescens*
Armyworm, *Spodoptera* species

FRENCH BEANS

Root rot, *Fusarium* species
Fruit borer
Aphids

PEAS

Powdery mildew
Pod borer

CAULIFLOWER

Fusarium wilt
Aphids
Diamond-back moth

CUCUMBER

Powdery mildew
Downy mildew
Aphids, green peach aphid
Fruit fly (vinegar flies), Drosophila spp.
Oil crop

CANOLA (RAPESEED)

Armyworm
Aphids

Fiber crop

COTTON

Bollworms/Armyworms/Budworms, various species

Fruit and Edible Nuts

APPLE

Coddling moth, *Cydia (Laspeyresia) pomonella*
San Jose scale, *Diaspidiotus (Quadraspidiotus) perniciosus*
Green Apple Aphid, *Aphis pomi*
European Red Mite, *Panonychus ulmi*
Apple Lygus bug
Scab of apple, *Venturia inaequalis*
Powdery mildew, *Podosphaera leucotricha*
Sooty blotch

PEAR

Codling moth, *Cydia (Laspeyresia) pomonella*
Leafroller moth, *Platynota stultana*
Pear Psylla, *Cacopsylla (Psylla) pyricola* (secondary pest after coddling moth spray)
Scab of pear, *Venturia pirina*
Fireblight, *Erwinia amylovora*
Fruit fly, Rhagoletis pomonella
Pear Rust, *Gymnosporangium libocedri*

PEACH/APRICOT/PLUM

Oriental fruit moth, *Grapholitha molesta*
Green Peach Aphid, *Myzus persicae*
Stem borers

Peach Twig borer, *Anarsia lineatella*
Termites
Root rots
Powdery mildew
Shot hole disease, *Clasterosporium carpophilum*
Leaf curl, *Taphrina deformans*
Gummosis (canker)

CITRUS

Citrus canker
Citrus Die Back (transmitted by Asian Citrus Psyllid, *Diaphorina citri***)**
Citrus Leaf-miners, *Phyllocnistis citrella*
San Jose scale, *Diaspidiotus (Quadraspidiotus) perniciosus*
Red Mite, *Panonychus citri*
Black spot, *Guignardia citricarpa*

WALNUT

Bacterial blight, *Xanthomonas campestris pv. juglandis*
Stem borer
Termites

GRAPES

Downy mildew, *Plasmopara viticola*
Powdery mildew,
Jassids (leafhoppers, vectors of disease)

2.2 Pests of Stored Products/Grains

Grain Moth, *Sitotroga cerealella*
Rice Moth, *Corcyra cephalonica*
Indian Meal Moth, *Plodia interpunctella*
Almond Moth, *Cadra cautella*
Khapra Beetle, *Trogoderma granarium*
Rice weevil, *Sitophilus oryzae*
Rust-red Flour Beetle, *Tribolium castaneum*
Laser grain Borer, *Rhizopertha dominica*
Pulse Beetle, *Callosobruchus chinensis*

Rodents (Rats, Mice and Moles)

2.3 History of IPM policy and use in Pakistan

According to a Plant Protection Department report released about 2005 by the Pakistani Government, "In 1988, The National Agricultural Policy of Pakistan stressed reliance on IPM. In 1988, the National Agricultural Commission published a report that provided broad outlines of IPM and recommended that IPM techniques should be adopted for major crops by 1992 or 1993, and for all crops by 1995.

Excessive use of pesticides is now supposed to be checked through scouting and pest warning systems executed by the provincial agricultural departments. Farmers are advised through print and electronic media to undertake application of pesticides only when the pest population crosses the economic threshold level (ETL). In this way judicious use of pesticides is supposed to be encouraged. As noted above, the Government has also instituted a National Integrated Pest Management (IPM) Programme to minimize the use of pesticides. Training of Trainers sessions are imparted to farmers in safe handling, use and application of pesticides by the provincial governments and the technical staff of the industry."

According to ADB http://www.asiandevbank.org/Documents/TACRs/PAK/tacr-pak-3383.pdf, "Pakistan is the fourth largest producer of cotton in the world and cotton is a significant contributor to the country's export earnings. National production of cotton in 2003/2004 was about 1.72 million tons lint from 3 million hectares (ha). There are about 1.3 million farmers who grow cotton and many depend on this crop to meet household expenses. For pest control, farmers have tended to rely on pesticides alone. This is due primarily to aggressive marketing campaigns by agrochemical companies, government spraying recommendations and credit packages, farmers' fear of crippling pest outbreaks, and lack of knowledge about alternatives. Pesticide imports grew from about 665 tons in 1980 to over 69,877 tons in 2003. Following a consultative process with stakeholders, the National Integrated Pest Management Programme (NIPMP) was launched in 2000. NIPMP is led by the National Agriculture Research Center (NARC) of the Pakistan Agriculture Research Council (PARC) in the Ministry of Food, Agriculture, and Livestock (MINFAL)."

The National IPM Programme and IPM Project found at http://www.nat-ipm.gov.pk/ does Training of Trainers (TOT) activities guided by a facilitator who has been trained before hand. During one complete growing season the groups use learning by doing, growing their own crop (regular observations on plant development), use of Farmer Field Schools (FFS), group dynamics (serve as preparation for trainees to conduct FFSs themselves and to gain facilitation skills), and fostering corporate identity (provides joint spirit which is crucial factor for the success). To date, they have used these techniques on mango and tomato.

Farmer Field Schools (non-formal adult participatory hands-on education) are being used extensively in Pakistan. They were used in 2001 and 2003 on cotton. The Food and Agriculture Organization (FAO) is implementing Farmer Field Schools (FFS), originally associated with promoting Integrated Pest Management, in Pakistan. These work at the grassroots level to advance the principle of stakeholder participation in program decision-making with a view to eventually giving full responsibility to stakeholders for program development. FFS underscores

FAO's commitment to the development of agricultural extension participatory approaches - in line with its general philosophy and practice of seeking to advance equitable development.

Originating in projects initiated in Asia in the mid-1980s, FFS has spread to other regions. The approach is currently one of the forefront extension- related activities sponsored by FAO, and the principles and methodology of the approach are being replicated by other technical services such as Irrigation and Water Use and Forestry. A comprehensive extension and production support strategy, and a participatory farmer group extension approach have also been developed in support of the FAO Special Programme for Food Security (SPFS) in Pakistan.

According to PAN, http://www.pan-uk.org/Internat/IPMinDC/pmn10.pdf, "FFS initiatives can have a great impact on pest management systems at farm level. In 1997 the Asian Development Bank supported the government of Pakistan and CABI Bioscience to run a pilot FFS project for cotton. Ten groups of 25 farmers were set up from July-December 1997 in the Vehari District, Punjab, conducting field exercises and experiments on the main pests, the crop's ability to compensate for pest damage inflicted early in the season, and the effects of pesticides on natural enemies and livestock.

Farmers managing IPM plots were able to reduce the average number of applications of insecticides to 1.4 per season compared to 5.2 per season in the farmers' practice plots (FP: farmers continue current practice to compare results). Two FFS groups succeeded in reaching the end of the season without a single application of synthetic pesticides. Moreover, at seven of the ten sites, IPM plots achieved yields higher than those in FP plots. FFS groups managing the IPM plots made savings of up to 68% on pesticide input. With reduced production costs and increased yields, FFS groups involved could translate IPM as Increased Profit Margins. The FFS gave farmers confidence and one group demonstrated the impact of unnecessary application to local agrochemical salesmen, Department of Agriculture officials and neighboring farmers."

According to WB, http://www-esd.worldbank.org/ais/index.cfm?Page=mdisp&m=4&p=07, incoherent policies constrain IPM adoption in Pakistan. "Adoption of IPM in Pakistan is still in its infancy, despite significant investment in R&E. The government sees IPM as a key element of agricultural policy, yet deregulating imports of generic pesticides has improved farmer access to inexpensive chemicals. Emerging pest resistance due to misuse of pesticides led to a decade-long decline of productivity in the cotton sector, in which poor rural women, who pick cotton as their only source of income, were most affected by the health impacts of increasing insecticide use. Reviving the cotton economy has been the main motive behind changes in pesticide policy. After thorough analysis of the economics in the pesticide subsector, and consultation with all relevant stakeholders in 2001, a comprehensive national IPM program was designed, including farmer training, tightening regulatory control, and removal of pesticide subsidies.

Time lag for adoption

IPM skills and practices do not spread as easily as information embedded in technologies such as improved seeds or chemicals. Extension services play a key role in providing IPM information,

though the complexity of some IPM approaches requires a heavy emphasis on teaching agro-ecological concepts as a basis for farmer adoption of IPM practices."

I-LED can assist in supporting and recommending that IPM methods be considered and used by its clients, because they represent Best Management Practices (BMP) that are being used by many modern farmers in developed countries, and in many cases reduce costs while reducing risk to human health and environment.

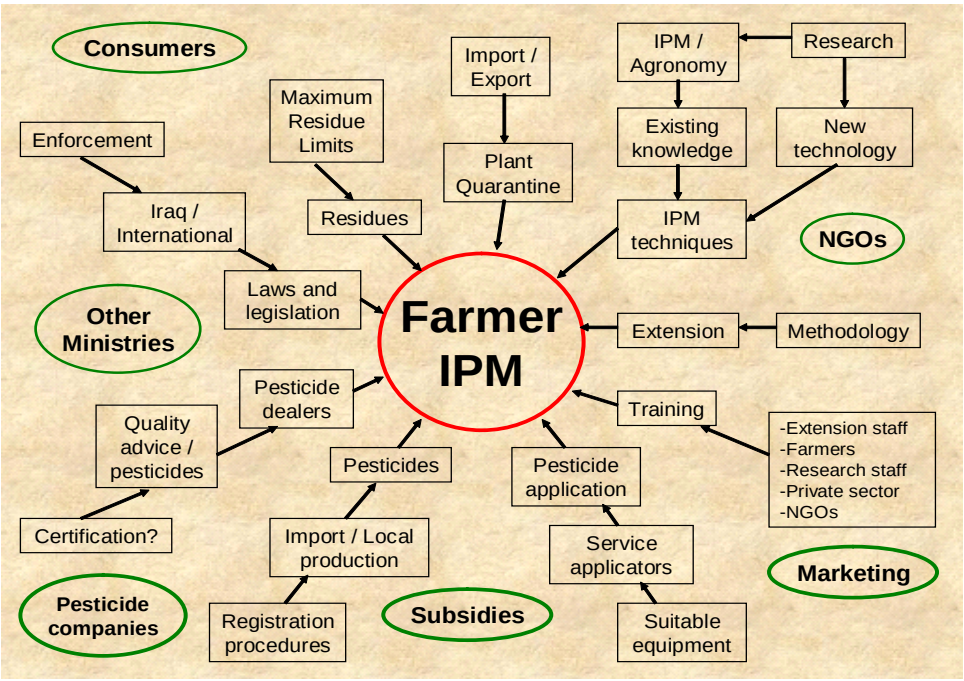
General IPM tactics are summarized below (also see Attachment 12).

General IPM Tactics

IPM makes use of combinations of the following tactics: cultural (use of resistant varieties, crop rotation, variation in time of planting or harvesting, crop refuse destruction, pruning, planting trap crops), mechanical (hand destruction, exclusion by barriers, trapping), physical (heat, cold, humidity, traps, sound), and biological (introduction and/or protection of imported or indigenous natural enemies of pests, propagation and dissemination of microbial control agents).

IPM can also include use of: natural chemical methods (by using attractants, repellents, sterilants and growth inhibitors), genetic methods (propagation and release of sterile or genetically incompatible pests), and regulatory means (plant and animal quarantines, suppression and eradication programs) to the extent possible while permitting the safe integration of pesticides with farmers' traditional cropping and pest management systems. Below is a diagram showing all the possible issues revolving around—and influencing—farmer IPM.

Figure 6: Issues impacting farmer IPM, a Systems Approach to IPM



Source: Tony Treen, Agricultural Pest Management Specialist

2.4 Viable and practical IPM options to use, to test and to potentially integrate

Attachment 2, found at the end of this report, contains practical IPM methods that may be used for many of the pests found on crops in Pakistan. These are techniques and technologies being used on crops in developed and developing countries around the world and are proposed because they work.

Note that many of the farm field best management practices (BMPs) for most crops recommend relatively easy-to-implement activities like use of:

- scouting, traps and monitoring to catch and manage pest outbreaks early;
- good plant health maintenance through water, soil, and nutrient management (raised-bed, plastic mulches, regulated drip irrigation/fertigation; plant, soil, nutrient, and water analyses);
- cultural practices like use of resistant varieties, pest avoidance through early/late plantings/harvestings, crop rotation, pruning, crop residue destruction, and destruction of pest refuge plants near field;
- biological control methods like parasite/predator enhancement through border plantings of favored refugia plants, use of pheromone releases for mating disruption, parasite releases, and microbial agent sprays (for larger farms);
- and mechanical control through exclusion netting or trapping.

2.5 Pesticides *accepted for use* by the I-LED project

Fungicides
Aluminium (aluminum)-fosetyl or Fosetyl-aluminium (aluminum)
Carbendazim
Captan
Copper hydroxide
Copper oxychloride (hydrated lime)
Mancozeb
Metalaxyl
Thiram

Insecticides
Acetamiprid
Bacillus thuringiensis
Carbaryl
Imidacloprid
Lufenuron
Malathion
Thiacloprid
Thiamethoxam

Herbicides
Glyphosate/Roundup
Metolachlor
Pendimethalin

Acaricides
Amitraz
Cypermethrin(e), beta
Deltamethrin (pour-on livestock formulation only)
Diazinon
Fenvalerate
Trichlorfon

2.6 Pesticides *not accepted for use* in the I-LED project, with reason for rejection

Insecticides
Azinphos-methyl (too toxic)
Carbofuran (too toxic)
Chlorpyrifos (restricted use products)
Cyfluthrin (beta-cyfluthrin) (restricted use products)
Deltamethrin (restricted use products, exception made for pour-on livestock formulations)
Endosulfan (too toxic)
Lambda-Cyhalothrin (restricted use products)
Polytrin C 440 EC (Profenofos 400g + Cypermethrin 40g per liter—both restricted use products)

Acaricides
Chlorfenvinphos (no EPA approval)
Dichlorvos (DDVP) (too toxic)

2.7 Pesticides *Conditionally* Accepted for use on I-LED (Condition=Users absolutely must receive training and a dual cartridge respirator with agreement to use it)

Aluminium (Aluminum) Phosphide
Zinc Phosphide

2.8 Pesticides that may be used if *they become registered by Government of Pakistan* & Artesanal botanical pesticides that farmers may produce and use on-farm.

Fungicides
Copper sulfate
Lime sulfur (a mixture of calcium polysulfides)

Insecticides
Insecticidal soaps and dormant oils
Neem Oil

Pyrethrum
Pyriproxyfen
Rotenone
Spinosad
Spirodiclofen

Acaricides
Edcidin

SECTION 3: INTERNATIONAL TRADE ISSUES RELATED TO I-LED CROPS, PESTS, IPM, AND PESTICIDES

One of the most significant developments in risk reduction and environmental compliance in agriculture over the past 10 years has been the development of certifiable voluntary and other standards driven by international produce marketers responding to consumer demand for safely and environmentally soundly produced food. This is the newest, and will likely be the most profound and effective, lever for positive change and compliance in this industry. Therefore it is highlighted here as a potential means for encouraging environmental/human health safety for farmers who wish to reach the cutting edge and join their developed country colleagues in using industry BMPs. The next horizon is food traceability.

3.0 International trade in the general agricultural/horticultural products by Pakistan with specific emphasis on project-targeted commodities

At this stage, the I-LED project is focused on local food security, local and regional markets in the value chain, and is not immediately looking at export markets (this could change). However, agriculture accounts for about 21% of GDP and employs nearly 42% of the labor force. The most important crops are cotton, wheat, rice, sugarcane, fruits, and vegetables, which together account for more than 75% of the value of total crop output. Despite intensive farming practices, Pakistan remains a net food importer. Further, the economic importance of agriculture has declined since independence, when its share of GDP was around 53%.

3.1 Regional or international trade in the I-LED project commodities

Pakistan exports rice, fish, fruits, and vegetables and imports vegetable oil, wheat, cotton (net importer), pulses, and consumer foods. In the future, Pakistan could, if it reaches levels of quality meeting international standards, extend its value chain reach to other countries with more products. Unfortunately, the country's remote and rugged northern terrain and developing transportation network have usually made moving these resources a challenge.

3.2 Codes of conduct, treaties and international conventions that apply to target commodities, crop protection products and systems

According to the Food and Agriculture Organization, over the past twenty years, there has been growing public awareness of environmental and social issues in agricultural production and trade. Several food safety crises and animal disease epidemics have intensified concerns over intensive agricultural practices. Consumers have now become more knowledgeable about labor conditions and about the problems faced by small farmers due to low commodity prices.

There are an increasing number of industry-wide and company codes of conduct, some of which reach far down the commodity chain to producers. In addition, consumers' concerns have given rise to any number of certification and/or labeling initiatives, some led by NGOs and others led by the business sector. Social and environmental certification and labeling are market-oriented

mechanisms; they use market incentives to encourage management improvements above the minimum level required by law, to implement laws that are otherwise difficult to enforce, or to suggest a framework where formal laws may not exist. They very often refer to international treaties and conventions, sometimes translating them into verifiable standards for direct implementation by producers and/or traders. With this approach, voluntary certification programs are complementary to (inter) governmental regulatory frameworks and to labor unions, but do not—and can not—replace these.

Three relevant conventions and codes of conduct on pesticides and pesticide use include:

* International Code of Conduct on the Distribution and Use of Pesticides, of which the Revised Version was adopted by the United Nations FAO Council in November 2002.

* The Rotterdam Convention on the Prior Informed Consent (PIC) Procedure for Certain Hazardous Chemicals and Pesticides in International Trade. Under the PIC procedure, the secretariat provides all participating countries with detailed information on the risks the chemicals pose, allowing them to decide whether to accept future imports. If any country does choose to ban or restrict substances on the PIC list, which contains presently 31 chemicals, exporting countries are advised and must immediately inform their exporters, industry and customs departments.

* The Stockholm Convention is a global treaty to protect human health and the environment from persistent organic pollutants (POPs). POPs are chemicals that remain intact in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of living organisms and are toxic to humans and wildlife. In implementing the Convention, Governments will take measures to eliminate or reduce the release of POPs into the environment.

3.3 Status of pesticide regulations in the European Union

According to http://www.pesticideinfo.org/Docs/ref_regulatoryEU.html, “the European Community (EC) has established a harmonized legal framework for the regulation of pesticides in all member countries of the EC. The Commission of the European Communities, in collaboration with member countries of the EC, is responsible for the registration of pesticide active ingredients (also referred to as active substances) for use in all EC member countries. Individual member countries, called Member States, are responsible for the registration in their country of specific pesticide products (active ingredient percentage by weight plus inert ingredients) containing active ingredients authorized for use by the Commission. This dual authority of the EC and its member states is granted by the Council of the European Community under Council Directive 91/414/EEC, adopted on July 15, 1991 and effective July 25, 1993. Standards and regulations for the classifications, labeling, and packaging of pesticides are set by Council Directive 67/548/EEC of June 27, 1967.”

Pakistan is not a member of the EU, nor is it an EC member state. However, information on pesticides toxicity and use restrictions of products from the EU can be found through this mechanism.

3.4 EU registration status of proposed pesticides active ingredients (There are currently 834 existing EU-registered pesticide active ingredients) including ADIs and MRLs

These and new active substances along with minimum residue levels (MRL) and average daily intakes (ADI) can be located at the following 2 websites:
http://europa.eu.int/comm/food/plant/protection/evaluation/index_en.htm;
http://europa.eu.int/comm/food/plant/protection/evaluation/existactive/list1-28_en.pdf)

All of the pesticides proposed and accepted for this I-LED project are registered by the EU. Since no products from this project will likely be exported to the EU, minimum residue levels for export will not be considered.

3.5 Export markets standards, auditing and certification (EurepGAP, ISO 14001, Organic, EU minimum residue levels, HACCP, etc.) schemes applicable to the project, crops, and pesticides

National Standards and Codes:
There are as yet no national Pakistani standards or codes of conduct or practice that address social or environmental standards or certification in tropical agriculture or horticulture. Pakistan does, however, have written pesticide registration and regulations.

Economic Partnership Agreements (EPAs):
EPAs aim to establish new WTO-compatible trading arrangements progressively removing barriers of trade between EU and certain groups or blocks of developing countries (like the Africa, Caribbean, and Pacific Group—ACP Group) countries which would build on the regional integration initiatives of Group states and promote sustainable development and contribute to poverty eradication in the Group countries. Apparently there are no fresh produce trade associations in Pakistan with which to form or become part of an EPA.

Organic Production:
Organic production is a holistic management of the agro-ecosystem, emphasizing biological processes, soil health, and minimizing the use of non-renewable resources. This includes maintenance of soil fertility through the use and recycling of organic materials. Normally, the use of synthetic fertilizers and pesticides is prohibited. The International Federation of Organic Agriculture Movements (IFOAM) has formulated IFOAM Basic Standards, on which organic certifiers can base their standard, with a view of international harmonization. The International Organic Accreditation Service (IOAS) accredits certification bodies that have organic certification programs that comply with the IFOAM standards. During the last revision of the IFOAM Basic Standards, the standards for ecosystem management were strengthened. There are

ongoing discussions on whether the standards should also include criteria for labor conditions and other social issues, to which currently only a very general reference is made.

With the growing market for organic products, many countries have developed national organic regulations to be able to protect producers and consumers against misleading organic claims. The FAO/WHO Codex Alimentarius Commission has formulated guidelines for labeling of organically produced food, with a view to harmonizing national regulations.

Pakistan has yet to develop national organic regulations for either use in-country or for export. In Lahore, there is one supplier of organic cotton garments. According to University of Florida, (http://edis.ifas.ufl.edu/hs213) Pakistan has 2009 hectares of fruits and vegetables under organic management. There are many offers for organic fruits and vegetables on web markets, and Pakistan stands to gain from making the effort to produce more organic produce.

Fair Trade Initiatives:

The fair trade initiatives try to provide better market access and better trading conditions to small farmers. This includes a price premium for producers to be invested in social and environmental improvements. For larger production units an additional aim is to improve the conditions for workers. The Fairtrade Labeling Organizations (FLO) International is an umbrella organization of 17 national fair trade labeling initiatives, but producers and traders are also represented on the board. FLO has developed production criteria, both socially and environmentally oriented, differentiated for smallholder production and plantations. In addition, it has developed standards for trade, with which traders licensed by FLO have to comply. Complementary to the generic standards, there are product specific standards. Currently FLO standards exist for coffee, tea, cocoa, cane sugar, honey, fresh fruit, fruit juices, bananas, and rice. Standards for wine and cut flowers are being developed. From January 2003 the certification unit will be a legally independent certification body.

One fair trade initiative, Tropical Wholefoods (http://www.tropicalwholefoods.co.uk/), supplies dried fruit from partners in Pakistan. It provides its partners with training and helps them to source technology. The farmers of the Northern Areas of Pakistan produce apricots, apples, cherries, mulberries, and peaches, nuts including almonds, walnuts and pine nuts. Due to seasonal gluts in production most of this output is wasted as it rots before it can be consumed or marketed. Mountain Fruits, which grew out of the Agah Khan Rural Support Programme (AKRSP) Dried Fruit Project (DFP), buys these fruits, which are of very high quality, demand and are produced without chemical inputs. The Mountain Fruits apricots are currently available under the Tropical Wholefoods label and Traidcraft label. Mountain Fruits Dried Apricots and Dried Apples are FLO Certified. Tropical Wholefoods also markets fairly traded walnuts from the Hunza region, Pakistan.

HACCP:

The Hazard Analysis Critical Control Points (HACCP) system is a systematic preventative approach to food safety that addresses physical, chemical and biological hazards as a means of prevention, rather than finished product inspection. HACCP is used in the food processing industry to identify potential food safety hazards, so that key actions, known as Critical Control

Points (CCP's) can be taken to reduce or eliminate the risk of the hazards being realized. The impetus behind modern HACCP programs first began as a natural extension of Good Manufacturing Practices (GMPs) that food companies had been using as a part of their normal operations. The system is used at all stages of food production, processing, and preparation processes.

HACCP is based around seven established principles, as follows:

Principle 1: Conduct a hazard analysis. Plants determine the food safety hazards and identify the preventive measures the plant can apply to control these hazards. A food safety hazard is any biological, chemical, or physical property that may cause a food to be unsafe for human consumption.

Principle 2: Identify critical control points. A critical control point (CCP) is a point, step, or procedure in a food process at which control can be applied and, as a result, a food safety hazard can be prevented, eliminated, or reduced to an acceptable level.

Principle 3: Establish critical limits for each critical control point. A critical limit is the maximum or minimum value to which a physical, biological, or chemical hazard must be controlled at a critical control point to prevent, eliminate, or reduce to an acceptable level.

Principle 4: Establish critical control point monitoring requirements. Monitoring activities are necessary to ensure that the process is under control at each critical control point. In the United States, the Department of Agriculture's Food Safety and Inspection Service (FSIS) is requiring that each monitoring procedure and its frequency be listed in the HACCP plan.

Principle 5: Establish corrective actions. These are actions to be taken when monitoring indicates a deviation from an established critical limit. The final rule requires a plant's HACCP plan to identify the corrective actions to be taken if a critical limit is not met. Corrective actions are intended to ensure that no product injurious to health or otherwise adulterated as a result of the deviation enters commerce.

Principle 6: Establish record keeping procedures. The HACCP regulation requires that all plants maintain certain documents, including its hazard analysis and written HACCP plan, and records documenting the monitoring of critical control points, critical limits, verification activities, and the handling of processing deviations.

Principle 7: Establish procedures for verifying the HACCP system is working as intended. Validation ensures that the plans do what they were designed to do; that is, they are successful in ensuring the production of safe product. Plants will be required to validate their own HACCP plans.

Verification ensures the HACCP plan is adequate, that is, working as intended. Verification procedures may include such activities as review of HACCP plans, CCP records, critical limits and microbial sampling and analysis. HACCP plans should include that verification tasks be

performed by plant personnel. Verification tasks may also be performed by inspectors. Both the inspector and the industry should undertake microbial testing as one of several verification activities.

3.6 Export certification authorities/auditors/companies present in Pakistan and the region

Phyto-Sanitary Certification
A phyto-sanitary certificate is a document issued by most countries' Ministry (Department) of Agriculture, or comparable government body, which verifies the quality of a produce shipment, and which many countries require for the import of unprocessed plant products. Currently, Pakistan has offices for certification and food safety:

(a) Standardization and certification undertaken by the Pakistan
Standards Institution:
Pakistan Standards Institution
39 Garden Road
Saddar, Karachi 74400
Tel: +(92 21) 77 29 527
Fax: +(92 21) 77 28 124

(b) Technical regulations relating to food and health safety:
Ministry of Health, Social Welfare and Population
Planning
Government of Pakistan
Secretariat Block 'C', Islamabad
Tel: +(92 51) 820 930
Fax: +(92 51) 829 703

There are a select number of global organizations which verify national phyto-sanitary certification systems. In 1963, FAO and the WHO created the Codex Alimentarius Commission to develop international standards and guidelines for food traded on the global market. The commission aims to protect the health of consumers, ensure fair trade practices in the food trade, and promote coordination of all food standards work undertaken by international governmental and non-governmental organizations.

The Codex Alimentarius system presents a unique opportunity for all countries to join the international community in formulating and harmonizing food standards and ensuring their global implementation. It also allows them a role in the development of codes governing hygienic processing practices and recommendations relating to compliance with those standards.

It is possible to export produce from Pakistan to international markets without a national phyto-sanitary certification system in place. Clearly, some international markets present less strict barriers to trade with regards to phyto-sanitary regulations than others. For example, at this time, Pakistan has no difficulty exporting produce across the border into Afghanistan. Although some countries do not require such certification for importing produce, the implementation of such a

system would greatly expand the number of international markets to which Pakistan can export agriculture products.

Seed Certification
There are also international efforts, mostly led by FAO, to develop a system of seed certification so that only high quality seed is sold to and planted by farmers instead of potentially diseased seed, as can occur with farmers saving seed from season to season. There is also a seed certification effort ongoing in Pakistan led by the Federal Seed Certification and Registration Department (FSC & RD) of MINFAL. Potato seed being imported from the Netherlands is being certified by Dutch General Inspection Service for Agricultural Seed and Seed Potatoes (NAK). The Asia & Pacific Seed Association (APSA) (http://www.apsaseed.org) counts I-LED as one of its members.

Produce Certifying Companies
According to http://europa.eu.int/comm/agriculture/ofis_public/pdf/r8_0000_en.pdf, the following companies operate with or in Pakistan, among other countries:

BCS Ã–ko-GarantieGmbH
Germany

BIOLATINA S.A.C.
Peru

ECOCERT S.A.S.
France

Ecocert SA c/o Ecocert international
Germany

IMO INST FUR MARKTÃ–COLOGIE CH
Switzerland and Liechtenstein

Skal International
Netherlands

SECTION 4: PAKISTAN PESTICIDES PROFILE

The use of pesticides in Pakistan began in 1952 with the introduction of an aerial spraying program on the key crops such as cotton, rice and sugarcane. In addition, pesticides were used for desert locust plague control, organized through an international network coordinated by the FAO. Since then, pesticide use has increased and spread to all crops and agricultural production.

According to World Wildlife Fund (http://www.wwfpak.org/toxics_chemical.php), "The pesticide business started in Pakistan in 1954 with the import of 254 metric tons of formulated product, increasing to 20,648 metric tons in 1986-87 and 44,872 tons in 1998. More than 70-80% of pesticides used in this country are being used on cotton crops. In 1997-98, pesticides were used on 93.9% of the total cropped area of cotton, 86.9% of sugar cane, 70% of rice paddy, and 14.5% of fruit and vegetables. Use of pesticides is increasing at the rate of 25% a year.

As the result of a strong media campaign by about 200 local, national and multinational companies with a distribution network of some 6,000 dealers, farmers believe that it is essential to use pesticides. The import bill of pesticides increased from Rs. 225 million in 1980-89 to Rs. 5,272 million in 1996-97. The sprayed area has increased from 1.8 million hectares to 3.8 million hectares (18% of the cropped area) in 1991. Due to a complex cropping system and small land holdings, ground spray is preferred, with aerial spraying restricted to epidemics. While playing a key role in protecting plants, pesticide use also causes problems like resistance in pests, persistence of toxins in the eco-system, and health problems for field workers, food consumers and dealers. According to a recent report by the Pakistan Agricultural Research Council (PARC), as many as 10,000 farmers are poisoned annually by indiscriminate use of pesticides in cotton growing rural areas only.

In February 2000, the Punjab Assembly was told that about 3,800 tons of obsolete and outdated pesticides were stored in the Punjab Agriculture Department warehouses, but could not be disposed off due to lack of funds. An estimated 1,935 stockpiles of obsolete pesticides in the 41 agriculturally active districts of Pakistan are threatening the lives of thousands of residents. Pesticide manufacture, import and usage are controlled by the 'Agricultural Pesticides Ordinance', 1971 and the Agriculture Pesticide Rules, 1973. Until now 21 pesticides have been de-registered and their import banned. Imports of banned pesticides, their illegal storage in godowns, pilferage from warehouses and adulteration are problems related to lack of implementation of the pesticide ordinance."

4.1 Pesticide Informal/Illicit Import to Pakistan

There are no accurate records on quantities or types of pesticides informally/illegally imported to Pakistan; however, there is evidence in markets that these imports exist. Proximity to India and China assures that low quality products will enter Pakistan and that many of these will not be registered and the label quality will be sub-optimal.

4.2 Pesticide Production in Pakistan

According to a Pakistani government report (Country Report on International Code of Conduct on the Distribution and Use of Pesticides, 2005), "Local manufacturing in the country is very limited and is restricted to Aluminium phosphide, Copper oxychloride and Zinc phosphide only. Local formulation has increased from 14% in 1984 to about 70% in 2004 of the total supply. There are over two dozen formulation plants in the country. For local formulation, the technical grade of a pesticide and other substances including emulsifier, carrier and stabilizer etc. are imported separately, which, together with a solvent, generally xylene (locally available), are blended in precise proportions to produce the finished product. Due to increasing consumption of pesticides, different advanced technologies are required for new formulations."

4.3 Pesticide Packaging, Repackaging & Labeling Quality in Pakistan

Packaging
According to a Pakistani government report (Country Report on International Code of Conduct on the Distribution and Use of Pesticides, 2005), "All packaging is done at registered plants using automatic/semi-automatic filling system. Most liquid pesticides, depending on their chemical nature, are filled in CO-EX and PET bottles or tin cans. Bottles have seals, caps and shrink wraps over them. Powder pesticides are packed in hermetically sealed sachets and granules are packed in plastic bags further contained in cotton bags. The packaging ensures that pesticides are not deteriorated during their shelf-lives as well as there is no leakage."

Repackaging
"No manual re-packing/ re-filling is permitted. The formulators/re-packers are likewise required to have arrangements of safe storage, proper waste disposal and regular medical check up of workers. The importers/formulators are required to undertake to supervise re-packing/re-filling and labeling processes carried out at a plant duly registered and pass on pesticides to the distributors, dealers/vendors only in retail packing. No person can store pesticides unless permission for the same is issued to him."

Labeling
"The Agricultural Pesticides Rules provides an exhaustive guideline for labeling following the FAO Guideline covering necessary aspects of safety. Appropriate warning symbol in accordance with the WHO's recommendation is displayed on label. Withholding period of pesticides is also required to be mentioned."

Packaging and labeling quality is variable in Pakistan, with large multinational companies following recommended best practices and smaller companies from India and China not. Proximity to India and China assures that low quality products will enter Pakistan and that the packaging and label qualities will be sub-optimal. I-LED project farmers will need to be

informed of this trend and advised not to use sub-optimal products not properly packaged or labeled.

4.4 Pesticide distribution/retail sales companies in project area in Pakistan

The following are major pesticide/agrichemical input companies that operate in the study area:

Pesticide & Agrochemical Input Companies

Range (Chinese)
Syngenta, Syngenta/Novartis
Dow Agro Services
NCE
BASF
FMC
Bayer

Fertilizer Company

Engro (preferred supplier)

4.5 Current pesticide consumption in the agriculture sector

Plant protection through the use of pesticides has grown from about 915 tons (230 tons active ingredient) in 1981 to 129,000 tons (28,500 tons active ingredient) in 2004.

With regard to use, the most heavily treated crop is cotton followed by paddy rice, sugarcane, fruits and vegetables. By itself, cotton accounts for about 70% of the total consumption of pesticides active ingredient; this has resulted in the exceptional rise in cotton production in the country.

4.6 Pakistan's pesticide registration and regulation system

Before 1971, pesticides to be imported were standardized by the Federal Government of Pakistan through Department of Plant Protection (DPP), since no rules and regulations were in place. In 1971, the Agricultural Pesticides Ordinance (APO) was promulgated to regulate import, manufacture, formulation, sale, distribution, use and advertisement of pesticides. In 1973, under this APO, Agricultural Pesticides Rules were made and the entire pesticide regulations were put under regular standardization and registration with the help of Provincial Agriculture Departments.

Pesticides were registered under trade names, using a 'Form-1' scheme, and takes a total of three years total for complete and final approval. They go through efficacy evaluation trials of two

crop seasons by at least two research agencies including ones at both the Provincial and Federal levels. The products to be approved under this Form-1 scheme are first standardized by the provincial Governments, with final approval granted by the Federal Government on advice of Agricultural Pesticides Technical Advisory Committee (APTAC).

In 1993, two new kinds of registration, Form-16, the Generic Scheme and Form-17, Permission (Registration Abroad) Scheme, were launched. Generic name registration is granted to products designated by the Federal Government, which have no valid patent rights and have already been tested through field trials using Form-1. Permission (Registration Abroad) Scheme is conditional to the registration of new chemicals that have already been registered and used in any of the OECD countries or China.

The result of liberalized pesticide regulation policy of 1993 has been exceptional. Import sources diversified from about 30 in 1993 to 350 in 2005. During this time, the prices of frequently used products are either remained the same or declined by 30-40% (in few cases even up to 62%), in spite of the devaluation of Pak Rupee.

The registration position of pesticide compounds under various schemes is as follows:

Form-1	192
Form-16 (Generic)	58
Form-17 (Registered Abroad)	155

The Department of Plant Protection (DPP) under the policy advice of the Ministry of Food, Agriculture & Livestock, has the mandate of registration and management of pesticides destined for use in plant/crop protection/general agriculture. Recently (2005) the Federal Government of Pakistan has taken up the revision of Agricultural Pesticides Act (APA) to keep up with recent developments in the world.

A list of all pesticides registered for use in Pakistan is too large to attach to this document. Both the PPD and I-LED project staff have the Forms 1, 16 and 17 registrations information.

4.7 Pakistan's ability to enforce regulations on distribution, storage, use, & disposal of pesticides

National Legislation and Enforcement
According to a Pakistani government report (Country Report on International Code of Conduct on the Distribution and Use of Pesticides, 2005), "National legislation exists in the form of Agricultural Pesticides Ordinance 1971 which is supported by the Agricultural Pesticides Rules 1973. The Rules are amended from time to with the approval of Agricultural Pesticides Technical Advisory Committee (APTAC). APTAC is at liberty to nominate sub committees and can entrust them specific duties."

"Liberalization of pesticide trade had been welcomed because it had given benefit to the farmers. Unfortunately, this has not been entirely problem free. Some unscrupulous elements found opportunity to indulge in unethical activities such as:

- Formulating pesticides using active ingredient in substandard quantity
- Adulteration at supply chain, packing, distribution and marketing level
-

These malpractices are affecting the plant protection quality and causing damage to the environment."

Testing, Quality Control and Effects in the Field
"The legislation on the specifications of pesticides already exists in the Agricultural Pesticides Rules 1973. Method of analysis involves CIPAC, AOAC, PAC etc.

The check on the quality of pesticides, curbing the practice of sale of adulterated / sub-standard pesticides, is maintained through network of inspectors and pesticides laboratories. Officers of provincial Agriculture Department are appointed as inspectors. Their position is as follows:

Punjab	–	232
Sindh	–	074
N. W. F. P	–	157
Baluchistan	–	092
Federal	–	015

(Department of Plant Protection)
There are at present pesticides 10 laboratories with Public/Semi-Government sector, 29 with the private sector. Additionally under new legislation 50 repackaging units are also required to established pesticides laboratories."

4.8 Pakistan Health and Environment Policy and Mitigation

According to a Pakistani government report (Country Report on International Code of Conduct on the Distribution and Use of Pesticides, 2005), "Government with the coordination of industry takes care of human health and the Environment. Rules 37 to 41 specially mention all the requirements, which are necessary for Health and Environment. There are regular surveys on occupational poisoning cases among farmers and industrial workers. Two poison centers are established in the country. One is in Faisalabad and the other is in Karachi."

4.9 Pakistan's adoption of Prior Informed Consent (PIC) procedures

In 1999, Pakistan signed the PIC convention treaty. And, it has banned the import of several PIC chemicals. The extent to which additional PIC chemicals enter the country is not known. Pesticides banned for import to Pakistan are listed in Attachment 13.

4.10 Current pesticide storage, handling and safety procedures in the sector being studied

According to a Pakistani government report (Country Report on International Code of Conduct on the Distribution and Use of Pesticides, 2005), "The Government has taken measures to ensure safety in use of pesticides. Pesticides are not allowed to be handled by persons not having prior approval of their activities from the government. The government has enforced legislation requiring registration of pesticides dealers/venders, distributors, formulators and re-packers. The license for dealership/vending is issued only to a person who has been duly trained in safe storage, transportation and use of pesticides.

The distributors, inter alia, are required to employ adequate number of Agricultural Graduates to ensure safety in handling and judicious use of pesticides. The formulators/ re-packers are likewise required to have arrangements of safe storage, proper waste disposal and regular medical check up of workers. No manual re-packing/ re-filling is permitted. The importers/formulators are required to undertake to supervise re-packing/re-filling and labeling processes carried out at a plant duly registered and pass on pesticides to the distributors, dealers/vendors only in retail packing. No person can store pesticides unless permission for the same is issued to him."

4.11 Pakistan Pesticide Application Methods

Foliar application through knap-sack/power sprayers is most popular, followed by the tractor-mounted sprayers. Some pesticides are sprayed by ULV sprayers as well. Granular pesticides are broadcast manually. Use of protective clothing/gears is little due to hot and humid conditions prevailing in the fields. Special protective clothing/gears that is light and comfortable needs to be procured for I-LED supported clients.

4.12 Phasing Out Severely Toxic Pesticides in Pakistan

According to a Pakistani government report (Country Report on International Code of Conduct on the Distribution and Use of Pesticides, 2005), "Pakistan is the one of the few countries in the region to have banned use of all severely toxic and hazardous pesticides included in the PIC and POP list in the early 1990s. In addition to PIC/POP pesticides, several other pesticides have also been banned. Recently the government is considering banning all formulations of monocrotophos and methamidophos. Practically no pesticide falling in the WHO Category I is used. Due to availability of comparatively safe new chemistry molecules and IGRs at competitive prices, the use of pesticides falling into WHO Category II is also declining." A list of banned pesticides is attached as Attachment 13.

4.13 Additional Pesticide Challenges in Pakistan

A Pakistani government report (Country Report on International Code of Conduct on the Distribution and Use of Pesticides, 2005) finds the following challenges to pesticide use and safety:

Lack of Awareness:
"The farmers have inadequate knowledge about pesticides as to their suitability, application techniques and safety measures. This is one of the reasons of poor pest control, environmental pollution and health problems in some areas. Programs for guidance of the farmers in this respect are far and few. The pesticide industry does not put sufficient resources on dissemination of knowledge on pests, pesticides, environment and management techniques. In this area there is great scope of extension work in the public sector."

Identification of pest problem
"The stage of a particular insect pest is extremely important while determining the need for chemical treatment. Few insects can only be controlled at a particular stage where they have weak links in their life cycle. Care should be taken that the chemical sprays are directed where the pests are available. Clean cultivation helps to achieve better pest control. Those farmers who pay attention to these points, get more yield."

Selection of pesticides
"Normally selective chemicals appear to offer an almost ideal means of pest control. However, only a few such chemicals have been discovered and developed for commercial use. The pesticides that are harmless to predators and parasites are ideal for IPM program. Although their numbers are limited but they are being widely recommended. Pesticides like Emamectin Benzoate, Abamectin, indoxacarb and spinosad are known to be selective in their mode of action. Until more selective pesticides are commercially available at reasonable expenses more judicious use of pesticides should be made."

Under dosing
"Under dosing of pesticide brings more harm than benefit in the shape of triggering development of resistance in the pests. To get good control of pest the recommended doses should be used. Sometimes the farmers reduce the dose thinking that the pest pressure is not much. Under dosing is helping in the resurgence of the pests. The problem of pest control is exaggerated. Insects develop resistance to insecticides more rapidly if under dosing is used. Small farmers tend to use less dose of pesticide."

Indiscriminate Use of Pesticides
"Plant protection has become very specific and objective oriented. It is important to identify the problem first and then buy the chemical otherwise the money will go waste. Indiscriminate use will eliminate natural enemies and cause secondary pests to develop. Field biologists have studied the effects of improper pesticide use. The indiscriminate use of pesticides results in unsatisfactory pest control, environmental pollution and health problems."

Lack of Use of Safety Equipment/PPE

According to one I-LED staff “Inshallah we’ll get some IPM/pesticide training that might reduce use but realistically farmers are unlikely to follow most pesticide dosages or PPE recommendations as equipment is uncomfortable to wear/expensive but more to the point they fail to see the need despite the fact that they know these are poisonous.

Best we might hope for is for them to wear an old shalwal-kamise and change out of this after spraying/handling chemicals but unlikely shoes or boots. And perhaps washing with soap as well as water but that might be hoping for too much.”

4.14 Obsolete Pesticides in Pakistan

The national Pakistani Agricultural Pesticides Rules state that: “the destruction and removal of the empty packages and pesticides remains shall be affected in such a manner that sources of water supply are not contaminated. The unclean packages shall be destroyed in a way as to preclude the possibility of their being reused for any purpose other than as base material. Further procedures for disposal of surplus pesticides and pesticides containers have been notified in 1984 encompassing small use, commercial and municipal use, in situ-disposal; organized disposal and landfill disposal sites.”

Still, according to (http://www.unescap.org/DRPAD/VC/CONFERENCE/ex_pk_17_dop.htm) the United Nations, “Pakistan holds a large stock of obsolete pesticides. The stocks accumulated up until 1980, when national requirements were purchased centrally by the Government. The quantity has been estimated to lie between 3,000 and 5,000 tons. The stocks are held in an estimated 200 major stores (ton quantities) and up to 1,700 Field Assistant stores (typically containing tens to hundreds of kilograms). The stocks are predominantly in the cotton growing areas of the Provinces of Sind and Punjab, but there are also stocks in Northwest Frontier Province and Balochistan.

“The stocks comprise a large range of formulated pesticide types predominantly organophosphate and organochlorine insecticides. The main hazard associated with the pesticides is their acute toxicity, with some of the product active ingredients falling within the highest category of toxicity according to the WHO system of classification, namely "extremely hazardous". The stocks, having been held for around two decades or more, are now in a dilapidated condition, with considerable leakage, and pilferage. This presents a serious risk to those who have to enter the stores. Because store integrity and security is not good in some locations, it also presents a serious risk to the local communities and to the environment. There is apparently some evidence of contaminated wells. There have been complaints and expressions of concern from some communities.

“Fortunately, after pesticide purchase moved to the private sector in 1980, there has been little subsequent accumulation of pesticide stock sand hence further stock accumulation is not seen as a problem for the future. The problem can, therefore, be restricted to how to collect and dispose of the existing obsolete stocks in a safe and environmentally responsible manner.

“There have been several significant past initiatives to deal with the problem. The first was in 1987 when USAID sponsored the visit to Pakistan of a team of hazardous waste disposal experts to assess the situation. The team estimated the stocks and associated hazardous materials at some 8,000 tones. Some of the stores visited were considered to present a serious danger to those entering them. The team made recommendations for the disposal of the stocks.

“Following the above visit, USAID and USEPA, in collaboration with the Government of Pakistan and other, carried out a disposal experiment (1.5 tons of pesticide) using a modern cement kiln at D.G. Khan. Although the experiment was claimed a technical success, there was controversy related to apparent bird deaths and a safety concern from the nearby community, and a local opposition to cement kiln use developed.

“Subsequently a proposal to dump these expired pesticides in the desert areas of Punjab province remained under consideration of the provincial government. In fact some land fill sites were also prepared. However, before implementation could progress, several NGOs voiced their concern against this approach from environmental point of view. As a result this proposal was shelved.

“Later on, several other half-hearted attempts to deal with the problem remained under consideration. None came to fruition, partially due to the inability of the Government organizations to find a viable solution to this problem as well as public opposition of any unscientifically proven method of disposal of these expired pesticides.

“The unsuccessful results of past efforts in this regard brought The Royal Netherlands Embassy (RNE), Islamabad aware of this problem in 1996 relating to the obsolete stock problem and the potential serious risk it presented. It was also recognized that some of the stocks may have originated from the Netherlands and hence they must be called to assist in the disposal of the pesticide stocks. Against this background the RNE commissioned a full-scale study with the following findings:

“The current level of stock is not known, neither are the numbers of stores and their locations. The best estimate is 3,000 tons of pesticide stocks and perhaps 500 tons of associated waste. There are well established procedures and technical options for dealing with the problem, and they have been used successfully in a number of recent (albeit smaller) international projects. The only generally acceptable disposal process for the collected stocks and waste is high temperature incineration in special incinerators having flu gas treatment units that meet internationally acceptable emission standards. Most of the merchant incinerators are located in Europe.

“A number of international hazardous waste disposal companies have submitted offers for undertaking the work, involving offshore incineration.
Although the stock repacking and site clean-up elements are well defined procedurally, there are several final disposal options (all involving high temperature incineration). The options are:

- Off-shore incineration in Europe
- Off-shore incineration in India

- Incineration in local cement kilns
- Installing a local rotary kiln incinerator in Pakistan.

“On the basis of above, a Scoping Inventory is being prepared to identify those stores and stocks posing the greatest risk to the communities. Following a Pilot Project would be considered out to collect and dispose, by offshore incineration in Europe, of 500 tons of the highest risk stocks/stores. Happening in concurrently, is the task to carry out a detailed inventory of the remaining stores and train a local team to carry out the hazardous and complex task of subsequent site clean-ups and product repacking. This project is estimated to cost US$ 2.2 million, including Scoping Inventory and would be implemented in about 2 years.

“Once the detailed inventory produced during the Pilot Project becomes available, a feasibility study of the local rotary kiln and regional options would be completed, cost-estimated and evaluated, then to be followed by the collection and disposal of the remaining some 3,000 tones of stocks and associated materials. The outcome of this could either be to continue with offshore incineration or to switch to one of the other options (or a mix).

“The latest proposal prima facia supported by the donor has yet to achieve full national consensus on the soundness of the approach and its technical efficiency on which consultation must commence immediately for their widest acceptance and support.”

Crop Life International points out (CropLife International Obsolete Stocks Programme Country Reports, Update May 2006) that “in 2001, a pilot project initiated and sponsored by the Royal Netherlands Embassy (RNE) in Islamabad, was completed. On behalf of the RNE, the Pesticide Disposal Project of GTZ managed and carried out the basic survey for the disposal operation, the safeguarding and disposal of 323 tons of obsolete pesticides and associated waste from 13 high risk stores in the Province of Punjab and a complete survey of all 168 pesticide stores in Punjab Province. The 13 warehouses were owned by the Punjab Department of Agriculture and the stocks had been held since the late 1970s. Member companies of CropLife International paid the cost of incineration of 94 tons of the products (those they had either manufactured or supplied). The collection, re-packing, cleaning of storage areas, shipping and incineration activities were undertaken by AVR, the Dutch hazardous waste disposal company, subcontracted and supervised by GTZ. The GTZ survey indicated that there might be around another 1000 tons of obsolete stocks in the Province of Punjab. The Pakistan authorities hope that new donors will help fund further projects to collect and destroy these stocks.

“In 2001, GTZ, the Environmental Protection Agency (EPA) of the North West Frontier Province of Pakistan and Bayer CropScience successfully completed an obsolete stocks disposal project in Peshawar, the provincial capital. Sixty tons of Gusathion, an insecticide for cotton – purchased by the government some 20 years ago – had been mistakenly transported to a government warehouse in a non-cotton growing area. As a result it lay unused and eventually deteriorated. The Pesticide Disposal Project of GTZ managed and carried out the collection and disposal operation. The product was repacked and transported to the United Kingdom, where it was incinerated by Shanks. GTZ and Bayer CropScience shared the technical and financial contributions.

“In 2004, discussions were initiated between the Pakistan Environmental Protection Agency and GTZ for the collection and disposal of 15 tons of dust containing low levels of endrin, held at a depot at Malir, near Karachi. Shell, one of the original manufacturers of endrin, was to fund the project. However, before the project could start, the depot was cleared of pesticides and the site redeveloped.

“Note: Until 1980, all pesticides in Pakistan were purchased centrally and then distributed to farmers. A private market was subsequently introduced, which had the beneficial effect of reducing considerably the accumulation of obsolete stocks.”

SECTION 5: PESTICIDE EVALUATION REPORT (PER) ANALYSES

This section addresses pesticide choices, issues and recommendations according to the 12 Regulation 216 Pesticide Procedures.

Pesticide procedures element a: USEPA registration status of the proposed pesticides.

Pesticides are registered in the USA as formulated products and also by the technical active ingredients. "Registration status" possibilities of the active ingredients and the formulated products include never registered, active registration, and cancelled registration.

USAID and the US Government overseas are effectively limited to using pesticide active ingredients registered in the U.S. by the U.S. Environmental Protection Agency for the same *or similar* uses without restriction *(no Restricted Use Products)*. Emphasis is placed on *similar use* because some of the pests (and crops) found overseas are not present in the USA, and therefore pesticides may not be registered for the exact same use, but often are registered for similar pests and pest situations. In addition, host country pesticide registration procedures must also be identified and followed.

All pesticides proposed by I-LED and some others available in the region are analyzed for registration by USEPA and Pakistan.

In lieu of additional Pakistan registration information, the following conclusions are made about pesticides registered by both EPA and Pakistan, and are not too toxic or RUPs.

Pesticides *accepted for use* in the project

Fungicides
Aluminium (aluminum)-fosetyl or Fosetyl-aluminium (aluminum)
Carbendazim
Captan
Copper hydroxide
Copper oxychloride (hydrated lime)
Mancozeb
Metalaxyl
Thiram

Insecticides
Acetamiprid
Bacillus thuringiensis
Carbaryl
Imidacloprid
Lufenuron
Malathion

Thiacloprid
Thiamethoxam

Herbicides
Glyphosate/Roundup
Metolachlor
Pendimethalin

Acaricides
Amitraz
Cypermethrin(e), beta
Deltamethrin (pour-on livestock formulation only)
Diazinon
Fenvalerate
Trichlorfon

Pesticides *not accepted for use* in the project(s), with reason for rejection

Insecticides
Azinphos-methyl (too toxic)
Carbofuran (too toxic)
Chlorpyrifos (restricted use products)
Cyfluthrin (beta-cyfluthrin) (restricted use products)
Deltamethrin (restricted use products, exception made for pour-on livestock formulations)
Endosulfan (too toxic)
Lambda-Cyhalothrin (restricted use products)
Polytrin C 440 EC (Profenofos 400g + Cypermethrin 40g per liter—both restricted use products)

Acaricides
Chlorfenvinphos (no EPA approval)
Dichlorvos (DDVP) (too toxic)

Pesticides *Conditionally* Accepted (Condition=Users absolutely must receive training and a dual cartridge respirator with agreement to use it)

Aluminium (Aluminum) Phosphide
Zinc Phosphide

Pesticides that may be used if *they become registered by Government of Pakistan* & Artesanal botanical pesticides that farmers may produce and use on-farm.

Fungicides
Copper sulfate
Lime sulfur (a mixture of calcium polysulfides)

Insecticides
Insecticidal soaps and dormant oils
Neem Oil
Pyrethrum
Pyriproxyfen
Rotenone
Spinosad
Spirodiclofen

Acaricides
Edcidin

Recommendations

* *For I-LED to use the accepted pesticide products in the short term, users will require immediate (before the next spraying season-June 2007) training in pesticide safe use and IPM, if this has not yet occurred.*

* *As needed, I-LED updates the list of pesticides proposed for use and communicate these changes to USAID so that an amendment to this document may be made.*

* *I-LED produce a quick reference guide for all of the pesticides to be used on the project for each anticipated pest, with use rates, safety measures, environmental concerns, and minimum reentry periods (MRPs)*

A quick reference guide will be useful for pesticide applicators to refer to in the field as they make pesticide choice and use decisions.

----------End of Element a----------

<u>Pesticide procedures element b</u>: Basis for Selection of Pesticides.

This generally refers to the environmental and economic rationale for choosing a particular pesticide. In general, the least toxic pesticide that is effective is selected. Economic analyses are difficult to ascertain for the given project's pesticides.

The bases for selection of each pesticide are most often availability, effectiveness (efficacy), price, and a reputable manufacturer. Human safety, and environmental safety are additional factors that this report encourages will influence the choice of pesticides for I-LED.

Recommendations

* *Choose and use least toxic pesticides, as practical (toxicities are given in Attachment 1)*

* *Intend to use more biological and organic pesticides, as practical*

Attachment 1 shows two products that are derived from natural sources: ivermectin (abamectin), which is a mixture of insecticidal and miticidal compounds called avermectins produced by fermentation from the soil bacterium *Streptomyces avermitilis*; and spinosad, a mix of new insecticidal compounds called spinosyns produced by fermentation of the soil actinomycete microorganism *Saccharopolyspora spinosa*.

Pyrethrum, a mix of natural chemicals called pyrethroids, can be extracted from chrysanthemum flowers, and provides good general pest control. Extracts from Neem trees are effective insecticides that are commercially available. Spore extracts from the bacterium *Bacillus thuringiensis* are effective against worm or caterpillar larvae of moth and butterfly pests. Insecticidal soaps and oils are effective against relatively sedentary pests like scales, mealybugs, aphids and mites. A list of botanical products studied and registered by EPA is attached at the end of this report as Attachment 5.

----------End of Element b----------

<u>Pesticide procedures element c</u>: Extent to which the proposed pesticide use is, or could be, part of an IPM program.

USAID policy promotes the development and use of integrated approaches to pest management (IPM) whenever possible. This section discusses the extent to which the proposed pesticide use is incorporated into an overall IPM strategy, and if not, how it can be.

As noted above in Section 2, there is an active national IPM initiative with Farmer Field Schools in Pakistan. If feasible, I-LED can link with this group to receive training for clients on IPM practices that may work in Pakistan.

Attachment 2 (attached) provides examples of IPM techniques that can be tried and integrated with each pesticide in Pakistan for different types of pests. IPM makes use of combinations of the following tactics: cultural (use of resistant varieties, crop rotation, variation in time of planting or harvesting, crop refuse destruction, pruning, planting trap crops), mechanical (hand destruction, exclusion by barriers, trapping), physical (heat, cold, humidity, traps, sound), and biological (introduction and/or protection of imported or indigenous natural enemies of pests, propagation and dissemination of microbial control agents).

IPM can also include use of: natural chemical methods (by using attractants, repellents, sterilants and growth inhibitors), genetic methods (propagation and release of sterile or genetically incompatible pests), and regulatory means (plant and animal quarantines, suppression and eradication programs) to the extent possible while permitting the safe integration of pesticides with farmers' traditional cropping and pest management systems.

In general, the following IPM techniques may be tried Pakistan (most of these require little training or specialized knowledge, and some are inbeded technologies—like use of resistant plants):

Resistant plant varieties should be used as much as possible and available. Information on these can be obtained from the national plant research and extension services.

For moth larvae that bore into agriculture, try sprays of *Bacillus thuringiensis* (BT) and/or spinosad, bacteria-derived products. Use sanitation—destroy infested fruit. Parasitoids also hold promise against moth larvae.

For weeds: use mechanical weeding or weeding by hand. Use crop rotation and early & thorough land preparation. Focus on prevention, ID and map their location and populations in the field. Determine the critical weed-free period for each crop and use control during this time.

Note also that many of the farm field best management practices (BMPs) for most crops recommend relatively easy-to-implement activities like use of:

- scouting, traps and monitoring to catch and manage pest outbreaks early;
- good plant health maintenance through water, soil, and nutrient management (raised-bed, plastic mulches, regulated drip irrigation/fertigation, plant and soil nutrient and water analyses);
- cultural practices like use of resistant varieties, pest avoidance through early/late plantings/harvestings, crop rotation, pruning, crop residue destruction, and destruction of pest refuge plants near field;
- biological control methods like parasite/predator enhancement through border plantings of favored refugia plants, use of pheromone releases for mating disruption, parasite releases, and microbial agent sprays (for larger farms);
- and mechanical control through exclusion netting, trapping, and plow down.

The strongest selling points for IPM beyond the health and environmental benefits are:

- IPM is more effective then synthetic pesticides *in the long run*
- IPM is less damaging to essential soil health and nutrient cycling
- IPM generally requires less capital investment
- IPM can be used preventatively to eliminate or minimize the need for "responsive" controls (that is, applying pesticides after a pest outbreak occurs and much damage already has been done).

Recommendations

* *Enhance understanding of and emphasis on Integrated Pest Management (IPM) philosophy and techniques for I-LED clients, with pesticide use as a last resort*

* *IPM plans can be written for the agriculture crop to be protected, by pests, as practical*

An attachment outlining a general approach to IPM program planning and design is found at the end of this report as Attachment 12.

----------End of Element c----------

<u>Pesticide procedures element d</u>: Proposed method or methods of application, including the availability of application and safety equipment.

This section examines how the pesticides are to be applied and the measures to be taken to ensure safer use.

Pesticides will be applied mostly by way of hand-pump backpack sprayers. If fruit trees are sufficiently high, it may be necessary to use motorized backpack sprayers to reach the tops and fruit as regular backpack sprayers may not reach high enough, although these are quite expensive and may be provided communally or on lease, or purchased spray service. I-LED can ensure that protective clothing (gloves, boots, respirator masks (both paper filter for dusts and dual cartridge for organic mists), goggles) is issued to farmers, especially those whose fields are used as a demonstration plots (see Attachment 12 for safety equipment). People who mix pesticides as well as those who apply them should also wear protective clothing—especially gloves and goggles—during mixing operations.

The following are some general measures that can be used to ensure safe pesticide use.

Mitigating potential pesticide dangers; measures to ensure safe use

If there are no feasible alternatives to pesticides, take the following measures to mitigate and reduce their risks to human health and the environment. Note that risk is a function of both toxicity and exposure. Reducing risk means (1) selecting less toxic pesticides and (2) selecting pesticides that will lead to the least human exposure before, during and after use.

Reduce exposure time or the degree of exposure

Before using

Transport:

- separate pesticides from other materials being transported

Packaging:

- follow international and national norms and guidelines
- use packaging (small containers) adapted to local needs
- eliminate re-use of packaging materials

Storing:

- develop strict guidelines for village-level storage
- ensure permanent, well-marked labeling
- follow and respect national norms
- use appropriate language and approved pictograms

Formulating:

- use appropriate type and concentration

During use

Training:

- should be continuous
- should identify level and audiences (distributors, farmers, transporters, etc.)

Use application equipment:

- should be adapted to user needs and possibilities
- should assure maintenance and availability of parts and service

Use protective equipment and clothing:

- should be adapted to local climatic conditions
- should be adapted to user needs and resource possibilities
- should eliminate exposure rather than just reduce it, if at all possible

Focus on "buffer zones" around the following:

- housing
- environment: water, sensitive/protected areas

After using

- know, enforce, respect exclusion or reentry periods after application
- assure proper cleaning and rinsing off of:
  - applicators' preparation and application equipment
  - applicators' clothing
  - storage containers
- develop a workable monitoring and evaluation system for:
  - adherence to national and international policies regarding pest management and pesticides
  - health effects on applicators, the local population, and domestic animals
  - efficacy on target pests

- impacts on environment: water, soils, etc.
- elimination of pesticide leftovers and containers

Recommendations

* *Immediate (before the next season) training in safe handling and use*

Project staff who will use or oversee the use of pesticides require training in safe handling and use of insecticides.

* *The production of safe use training materials and posters, and distribution during training*

One way to remind applicators of safety issues is through the production and use of high quality training materials and safe use posters in the local language—first check to see if the Department of Plant Protection or FAO or FFS has already done so, and duplicate these for I-LED clients .

* *Administer the Pesticide Use Checklist (PUC) for NGOs/PVOs*

Translate into the local language and administer during training the PUC to all project participants to gather baseline data on their understanding of safe pesticide issues. A copy of the PUC is attached at the end of this report as Attachment 5.

* *Continued procurement and use of protective clothing and safety equipment, and distribution ideally during training on risks, risk reduction and use of the PPE*

Protective clothing and safety equipment needs to continue to be provided for all pesticide handlers, mixers, users, applicators, and others present while application occurs. Examples of safety equipment to be used for each type of pesticide are found in Attachment 12).

- *Ensure fields are clear of children before spraying and kept out after spraying has occurred*

----------End of Element d----------

<u>Pesticide procedures element e</u>: Any acute and long-term toxicological hazards, either human or environmental, associated with the proposed use, and measures available to minimize such hazards.

This section of the PERSUAP examines the acute and chronic toxicological data associated with the proposed pesticides. In addition to hazards, this section also discusses measures designed to mitigate any identified toxicological hazards, such as training of applicators, use of protective clothing, and proper storage.

The acute and chronic human and environmental toxicological hazards are listed for each pesticide in Attachment 1. There are several ways to mitigate exposure to humans. Some of the best examples are outlined below.

Mitigation of Human Toxicological Exposures

Most pesticide poisonings result from careless handling practices or from a lack of knowledge regarding the safer handling of pesticides. The time spent learning about safer procedures and how to use them is an investment in the health and safety of oneself, one's family, and others. Pesticides can enter the body in four major ways: through the skin, the mouth, the nose, and the eyes. A checklist is given below to help avoid these various routes of overexposure to pesticides.

To avoid dermal (skin) exposure

- Check the label for special instructions or warnings regarding dermal exposure
- Use recommended protective clothing and other equipment as listed on the label
- Do not re-enter the area until deposit has dried or re-entry interval is past

To avoid oral (mouth) exposure

- Check the label for special instructions or warnings regarding oral exposure
- Never eat, drink, or smoke, chew tobacco while working with any pesticide
- Wash thoroughly with soap and water before eating, drinking, smoking, or chewing tobacco
- Do not touch lips to contaminated objects (such as nozzles)
- Do not wipe mouth with contaminated hands or clothing
- Do not expose food, beverages, drinking vessels, or cigarettes to pesticides
- Wear a face shield when handling concentrated pesticides

To avoid respiratory (lungs) exposure

- Read the label to find out if respiratory protection is required
- If respiratory protection is required, use only an approved respiratory device
- Stay upwind during application

To avoid eye exposure

- Read the label to find out if eye protection is required
- If eye protection is required use goggles to protect eyes or a face shield to protect eyes and face
- Keep pesticide container below eye level when pouring

In addition to these common sense measures, there is a way to ensure protection against exposure to pesticides by the type of clothing required for different classifications of pesticides (the classification of each pesticide by EPA toxicity class I, II, III, or IV (Attachment 13). Toxicity classes are provided for each I-LED pesticide in Attachment 1. Good protection is achieved by reading the pesticide label and MSDS and by following the protective clothing and equipment guide.

Basic first aid for pesticide overexposure

Get medical advice quickly if you or any of your fellow workers have unusual or unexplained symptoms during work or later the same day. Do not let yourself or anyone else get dangerously sick before calling a physician or going to a hospital. It is better to be too cautious than too late.

First aid is the initial effort to help a victim while medical help is on the way. If you are alone with the victim, make sure the victim is breathing and is not being further exposed to the poison before you call for emergency help. Apply artificial respiration if the victim is not breathing.

Read the first aid instructions on the pesticide label, if possible, and follow them. Do not become exposed to poisoning yourself while you are trying to help. Take the pesticide container (or the label) to the physician. Do not carry the pesticide container in the passenger space of a car or truck.

Basic first aid procedures are presented in Attachment 12 to this PERSUAP.

Recommendations

* *Get training in proper use of protective equipment and safe use of pesticides*

All I-LED project farmers who handle, supervise, or spray pesticides will require safe use training if not already received.

* *Avoid damage to environment through training to avoid non-target (honeybees, aquatic, protected areas/biodiversity) ecosystems*

IPM and safe use training should components or training modules on how to mitigate exposure of non-target organisms to pesticides.

----------End of Element e----------

<u>Pesticide procedures element f</u>: Effectiveness of the requested pesticide for the proposed use.

This section of the PERSUAP requires information similar to that provided in item b, but more specific to the actual conditions of application. This section also considers the potential for the development of pest resistance to the proposed insecticide.

All of the pesticides chosen for the project were selected based upon effectiveness as one of the primary criteria, from local farmer and international experience. As little pesticide use is expected on this pilot project, resistance will likely not be an issue.

Recommendations

* *I-LED recommend to clients that they rotate pesticides to reduce the build-up of resistance*

* *I-LED field staff and farmers monitor resistance by noting reduction in efficacy of each pesticide product*

Project staff can monitor the kill rate of the pesticides for any reduction in efficacy, communicate with neighboring farmers and extension agents, to determine when pesticide rotation is called for. If it is, rotate to a different class of pesticide (see Attachment 1 for classes).

----------End of Element f----------

<u>Pesticide procedures element g</u>: Compatibility of the proposed pesticide use with target and non-target ecosystems.

This section examines the potential effect of the pesticide on organisms other than the target pest (for example, the effect on bee colonies in the spray area). Non-target species of concern also include birds, fish, aquatic organisms, and beneficial insects (honeybees, predators, parasites). The potential for negative impact on non-target species should be assessed and appropriate steps should be identified to mitigate adverse impacts.

The effect of each insecticide on non-target ecosystems will depend on how long it stays in the environment, or rather its rate of break-down, or half-life. Half-life is defined as the time (in days, weeks or years) required for half of the pesticide present after an application to break down into degradation products. The rate of pesticide breakdown depends on a variety of factors including temperature, soil pH, soil microbe content and whether or not the pesticide is exposed to light, water, and oxygen.

Many pesticide breakdown products are themselves toxic, and each may also have a significant half-life. Since pesticides break down in soil, light, and water, there are half-lives for exposure to each of these factors. In the soil, types and numbers of microbes present, water, oxygen, temperature, pH, and soil type (sand, clay, loam) all affect the rate of breakdown. Most

pesticides also break down, or photo-degrade, with exposure to light. Lastly, pesticides can be broken down, or hydrolyzed, with exposure to water.

Attachment 1 addresses the potential impact of each pesticide on aquatic organisms, fish, birds, bees, beneficial insects, and ground water contamination. Please refer to this table to see the impacts and suggestions for mitigating these impacts.

Since pests and pesticide use will likely be low on the project pilot sites, there should be little impact to non-target organisms. However, since water and groundwater are a limited resource in some parts of Pakistan, all attempts must be made to reduce contamination.

Recommendations

* *Investigate the use of botanical and biological controls*

The geography (islands of green crop in river valleys surrounded by a sea of rocky mountains) and cropping methods in Pakistan are very amenable to the use of biological controls. The project could investigate their use.

* *I-LED advise farmers to apply pesticides early in the morning before bees forage*

* *I-LED advise farmers to apply pesticides at least 35 meters from drinking water sources and open water*

----------End of Element g----------

<u>Pesticide procedures element h</u>: Conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils.

In general, this requirement attempts to protect soil and water resources from contamination endangered species, forests, and parks from the dangers of pesticide misuse—as well as.

Pesticide adsorption and leaching potentials

Each pesticide has physical characteristics, such as solubility in water, ability to bind to soil particles and be held (adsorbed) by soil so they do not enter the soil water layers and the ground water table, and their natural breakdown rate in nature. This data can be found for the pesticides proposed for use on the I-LED project by checking each pesticide on the PAN website: http://www.pesticideinfo.org. The water solubility, soil adsorption and natural breakdown rates, if available, are included at the bottom of the webpage for each parent chemical.

In general, pesticides with water solubility greater than 3 mg/liter have the *potential* to contaminate groundwater; and pesticides with an adsorption coefficient of less than 1,900 have the *potential* to contaminate groundwater. And, pesticides with an aerobic soil half-life greater

than 690 days or an anaerobic soil half-life greater than 9 days have the potential to contaminate groundwater. Moreover, pesticides with a hydrolysis half-life greater than 14 days have potential to contaminate groundwater.

The detailed environmental, hydrological, and soil conditions at the project pilot sites are likely included in the official Project Papers for I-LED. Look at these documents to find details. Further, potential for surface and ground water contamination for each pesticide are addressed in Attachment 1 for each proposed pesticide. Look to this table to determine contamination potential and use with care.

Groundwater Contamination Issues and Discussion

Most of the proposed pesticides are not potential ground water contaminants; however a few are (see Attachment 1). Further, the arid conditions under which the pesticides will be used indicate that they will be rapidly evaporated upon application. In the highlands, the distance to ground water tables is likely great, and many of the soils contain a highly impermeable calcium layer. There is much closer proximity to surface water via rivers and canals in the Pakistani river valleys in the North of the country. Do not apply pesticides near or in water.

Biodiversity

Pakistan has 714 national parks, reserves and wilderness areas, in addition to 205 protected areas, according to information found on biodiversity and protected areas for countries at Earthtrends: http://earthtrends.wri.org/pdf_library/country_profiles/bio_cou_586.pdf.

Altogether 188 (19 threatened) mammalian species are recorded in Pakistan, of which the Caspian tiger (*Panthera tigris virgata*), cheetah (*Acionony x jubatus venaticus*), musk deer (*Moschus*), snow leopard (*Panthera uncia*), sand fox (*Vulpes ruppelli*), Blandford's fox (*Vulpes cana*), and three species of ungulates, the goitered gazelle (*Gazella subgutturosa*), markhor (*Capra falconeri*), and Bactrian deer (*Cervus elaphus bactrianus*) are on endangered species' lists.

Also, Pakistan is fortunate to have recorded 237 bird species (17 threatened); 4,950 plant species (2 threatened); 189 reptile species (9 threatened); 137 fish species (3 threatened) and 17 amphibian species. Note that Attachment 1 shows pesticides that kill fish, amphibians and birds. Ensure, especially if clients are located near to any of these protected areas, that they are made sufficiently aware of the need to protect valuable biodiversity resources.

Recommendations

* *I-LED recommend and supply pesticides with low ground water contamination potential, as practical.*

As one of the criteria for selection of pesticides, determine the potential for risk of surface and ground water contamination at each site, and choose pesticides based upon little contamination potential.

* *Investigate and promote the use of biological pesticides to replace synthetic pesticides, as feasible.*

Lists of botanical and biological pesticides are included as Attachment 5 at the end of this report. Investigate their usefulness and availability in Pakistan.

* *I-LED ensure that farmers avoid using pesticides in or near the national parks and where endangered species are known to exist.*

* *I-LED train farmers to apply pesticides at least 35 meters from drinking water sources and open water.*

----------End of Element h----------

Pesticide procedures element i: Availability of other pesticides or non-chemical control methods. This section identifies other options for control of pests and their relative advantages and disadvantages.

Non chemical IPM techniques/technologies are listed under element c above and in Attachment 2. Only two products from biological sources are identified being useful on project sites, Spinosad and Abamectin, are derived from microbial organisms. Though expensive for small-holders, there are international companies that can provide support in biological controls, should the project or clients so choose. And, these companies specialize in many, if not most of the pests encountered in Pakistan.

Biological Control Agents

Biological 'pesticides' are available commercially from two large international companies, Koppert of Holland and Biobest of Belgium. The Dutch company Koppert provides many biological controls against spider mites, beetles, leaf miners, mealy bugs, thrips, aphids, whiteflies, and moth and butterfly larvae. Koppert also provides the Koppert Side Effects List, a list of the side effects of pesticides on biological organisms. Their website is: http://www.koppert.com.

Biobest of Belgium provides many of the same or similar biological controls as Koppert, and includes a control against leaf hoppers. Their website is: http://www.biobest.be.

Recommendations

* *Research and try 'biological pesticides' as practical*

All the resources are provided in this PERSUAP to do this. The websites given provide direct links to companies producing biological 'pesticides' and Attachment 5 to this PERSUAP provides botanically extracted products.

* *If practical, research and try traps for fruit fly control combined with good sanitation and begin fertilization of fruit orchards*

----------End of Element i----------

<u>Pesticide procedures element j</u>: Host country's ability to regulate or control the distribution, storage, use, and disposal of the requested pesticide.

This section examines the host country's existing infrastructure and human resources for managing the use of the proposed pesticides. If the host country's ability to regulate pesticides is inadequate, the proposed action could result in greater harm to the environment.

Clearly, information in Section 4 above shows that Pakistan still has a long ways to go to improve pest and pesticide management for smallholder farmers. The fact that there are many issues adds to the risk that unintended consequences of pesticide use will occur. I-LED can reduce these risks by training participants, providing safety equipment, and monitoring participants for compliance. The unintentional (by accident) pesticide poisoning rate is too high in Pakistan to take a risk that I-LED (and ultimately USAID) clients may be poisoned. According to a recent (about 2000) report by the Pakistan Agricultural Research Council (PARC), as many as 10,000 farmers are poisoned annually by indiscriminate use of pesticides in cotton growing rural areas only.

Recommendations

* *Work with the MINFAL as they implement environmental compliance and safety training*

I-LED staff can continue to work closely with the MINFAL to stay abreast of developments in the regulation and registration of pesticides, and improve pesticide use safety.

----------End of Element j----------

<u>Pesticide procedures element k</u>: Provision for training of users and applicators.

USAID recognizes that safety training is an essential component in programs involving the use of pesticides. The need for thorough training is particularly acute in developing countries, where the level of education of applicators may typically be lower than in developed countries.

Training in IPM and Safe Use are of paramount importance for Pakistanis using pesticides, due to high rates of unintended poisonings. There has been some training in IPM and pesticide safe use in Pakistan, however the I-LED project can assist with this need. Such training (of trainers) should commence before the next field season, that is, before June 2007 (before or with pesticide donations).

Recommendations

* *Implement Pesticide Safe Use training for staff and farmers*

Training can occur via a train-the-trainer format, whereby program field supervisors are trained for 2-3 days, followed by training for actual applicator and laborer staff for the following 2-3 days.

----------End of Element k----------

Pesticide procedures element l: Provision made for monitoring the use and effectiveness of each pesticide. Evaluating the risks and benefits of pesticide use should be an ongoing, dynamic process.

I-LED project staff will monitor pesticide efficacy and effects to the environment on an on-going basis and switch to alternative pesticides as the need arises. Program site managers will monitor for efficacy against pests and impact on beneficial organisms.

Recommendations

* *Simple monitoring plans will be drawn up by site managers*

Site managers will be responsible for drawing up simple monitoring plans, to collect data on reduction in efficacy and any other known environmental impacts leading to a change to a new or different pesticide. This will be reported to USAID, as a small section, along other reporting requirements.

----------End of Element l and End of PER----------

6.0 SAFER USE ACTION PLAN (SUAP) RECOMMENDATIONS

For each of the 12 elements of the PER, and for each pesticide listed in Attachment 1, there are recommended mitigation procedures or actions that will need to be completed in order to increase the safety of pesticide use to both the environment and all its organisms (non-targets), water resources, and human health. What follows is a plan, including the recommendations, with timeline, for doing all of these.

Immediately,

* *Procure protective clothing and safety equipment*

Protective clothing and safety equipment needs to be provided for all pesticide handlers, users, applicators, and others present while application occurs. The I-LED projects will need to have safety equipment on hand for use during application beginning during the 2007 field season. See Attachment 12 for safety equipment suggestions.

* *Training in safe use of pesticides, IPM, and environmental protection*

I-LED project participants, including staff, associated staff, farmers, laborers, and extension agents involved in project implementation require train-the-trainer training in environmental protection and safe pesticide clothing, handling, calibration, use and disposal.

Training can occur via a train-the-trainer format, whereby supervisors are trained for 2-3 days, followed by training for actual applicator and laborer staff for the following 2-3 days.

* *During training, administer the Pesticide Use Checklist (PUC) for NGOs/PVOs*

Translate into local languages and administer during training the PUC (Attachment 5) to all project participants to gather baseline data on their understanding of safe pesticide issues, to guide I-LED actions.

* *For training, produce or, if they already exist, duplicate PPD or FAO simple safe use training materials and posters*

One way to remind applicators of safety issues is through the production and use of high-quality training materials and safe use posters.

During training, Train farmers to:

* c*hase children away from the field while spraying is occurring and kept out after spraying has occurred.*

* *apply pesticides early in the morning before bees forage*

* *apply pesticides at least 35 meters from drinking water sources and open water*

* *avoid using pesticides in or near the national parks and where endangered species are known to exist.*

And, as feasible:

* *Produce a quick safety reference guide for all of the pesticides to be used on agriculture and anticipated pests for I-LED crops*

A quick reference guide with toxicity, safety equipment required, safe use, and environmental cautions, will be useful for pesticide supervisors and applicators to refer to as they make pesticide choice decisions. Contact the PPD and compile lists of pest species (by species and genus name) present in Pakistan.

* *Begin to write simple IPM plans for each of the crops to be protected*

For each pest, Attachment 2 has IPM recommendations for practical ways to reduce the use of the pesticides. For each pest, fold these recommendations, as appropriate, into simple IPM plans with timelines. Consult Attachment 2. I-LED has an opportunity to serve as a model for further cropping initiatives, and IPM should be a part of a rational approach to reducing pesticide use while protecting crops and expanding markets. A detailed IPM plan outline is included as an attachment at the end of this report as Attachment 12.

Continuously,

* *Rotate pesticides to reduce the build-up of resistance*

* *Choose and use least toxic pesticides, as practical (toxicities are given in Attachment 1)*

* *Intend to use more biological and organic pesticides, as practical*

* *Work with the MINFAL as they implement environmental compliance and safety training*

* *Monitor resistance by noting reduction in efficacy of each pesticide product*

Project staff can monitor the kill rate of the pesticides for any reduction in efficacy; communicate with neighboring farmers and extension agents, to determine when pesticide rotation is called for. Site managers will be responsible for drawing up simple monitoring plans, to note and report reduction in efficacy and any other known environmental impacts leading to a change to a new or different pesticide. This will be reported to USAID, as a small section, along other reporting requirements.

* *Monitor the health of laborers using organophosphorous compounds*

Organophosphorous (OP) poisoning can be severe and there are chronic effects. Monitor the health and blood cholinesterase levels of any worker extensively (more than 2 hours) using an OP product, or who accidentally receives a large dose exposure (spill on skin, ingestion).

* *Annually update changes to pesticides lists and communicate these changes to USAID*

USAID Project Managers will need to report changes to less toxic products on the list of pesticides recommended for monitoring purposes. This I-LED IEE and PERSUAP will be amended by USAID to reflect these changes.

----------End of SUAP----------

Attachment 1: Table Synopsis of Pakistan I-LED Crop and Livestock pesticides analyzed for EPA & Pakistan registration, EPA & WHO acute toxicity classifications, product and company names, acute & chronic human health impacts, and environmental impacts.

Environmental toxicity classification key: NAT = Not Acutely Toxic, PNT = Practically Non-Toxic, ST = Slightly Toxic, MT = Moderately Toxic, HT = Highly Toxic, VHT = Very Highly Toxic. RUP = Restricted Use Products.

Pakistan name of Pesticide Active Ingredient, Classification Type, EPA & Pakistan Registration Status, EPA & WHO Acute Toxicity Classification, GUP or RUP, & Product name	**Human Acute and Chronic Health Toxicology and Environmental Hazards**
Fungicides	
Aluminum-fosetyl (Fosetyl-aluminum); an organometallic fungicide & bactericide. Registered by EPA; Registered by Pakistan. Class III, moderately toxic, Caution. WHO acute toxicity: U, unlikely to be hazardous. No RUPS. Easily absorbed and translocated by and in plants. Sold as Aliette 80% WP by Bayer; and Sinofos 80% WP (Weal-AG Corp); Tahufuz 90% SP (Biologic AG). Useful against species of phycomycetes like Phytopthora, Pseudomonas, Alternaria, Pythium like brown rot, root rots.	**Health Acute:** Severe eye irritation. **Chronic:** No issues. **Environment:** Potential ground water contaminant. MT to zooplankton. Practically non toxic to birds, bees, slightly toxic to fish. Harmless to worms and beneficial species. Degrades rapidly in the environment.

Captan Registered by USEPA. Registered by Pakistan. No RUPs. **EPA Classes I, II, III (use care with Class I)** **WHO Class: No rating** Sold in Pakistan as Captan 50% WP (Arysta Lifescience Pakistan), a seed treatment product (STP). Major risk is at seed treatment stage.	**Health Acute:** Irritation of skin, eyes and respiratory tract. Skin sentization and/or contact dermatitis may occur. Exacerbation of asthma. At high doses, laboratory animals exhibit hypothermia, irritability, listlessness, anorexia, hyporeflexia, and oliguria , the latter with glycosuria and hematuria. **Chronic:** Known human carcinogen. **Environment:** HT to fish; MT to amphibians, aquatic insects, mollusks; zooplankton; PNT to birds; NAT to bees. Note that a high number of countries (8) have banned Captan use.
Carbendazim (benzimidazole) Registerd by USEPA. Registered by Pakistan. EPA product toxicity Class III, slightly toxic WHO acute toxicity: U, unlikely to be toxic No RUPs. Sold in Pakistan as Range Bavistan STP	**Health Acute:** Eye redness. **Chronic:** Possible carcinogen; suspected endocrine disruptor. **Environment:** HT to zooplankton; MT to fish; ST to amphibians and crustaceans.
Copper hydroxide (inorganic) Registered-USEPA. Registered by Pakistan. USEPA Toxicity Classes I, II, and III, depending upon concentration/formulaiton. Most technical (pure) products are Class I,	**Health Acute:** Easily absorbed through skin. Corrosive to mucous membranes and cornea. Irritates eyes, skin, and respiratory tract. Causes stomach pain, nausea, and vomiting.

which are diluted for use. Soil treatment for *Fusarium* and damping off diseases. Use copper hydroxide to rotate with aluminum fosetyl and copper oxychloride. Sold in Pakistan as Champion 77% WP (National Insecticides Co); Samar 77% WP (ChemAgro International).	**Chronic:** No issues. **Environment:** Kills aquatic crustaceans and mollusks. Persistent chemical; not broken down in environment.
Copper oxychloride (hydrated lime, inorganic) Registered-USEPA. Registered by Pakistan USEPA Toxicity Classes I, II and III, depending upon formulation/concentration. General Use Pesticide. Available as WP (class I and II) and Dust formulations (class III). Most technical (pure) products are Class I. If only Class I toxicity copper oxychloride is available, use copper hydroxide, copper sulfate or mancozeb in place of copper oxy-chloride. Useful against many diseases of citrus.	**Health Acute:** Soluble salts are corrosive to mucous membranes and the cornea. Organic copper compounds are more absorbable and exhibit greater systemic toxicity than many inorganic compounds. Irritation of skin, eyes, and respiratory tract, particularly to eyes. Metallic taste, nausea, vomiting and stomach pain. In more severe cases, there may be blood in vomit or black or tarry stools, jaundice and enlarged liver. Blood cells rupture resulting in circulatory collapse and shock. **Chronic:** Possible carcinogen, endocrine disruptor, reproductive or developmental toxin. **Environment:** Kills worms, zooplankton, slightly toxic to fish. Ground water contaminant.

Copper sulfate (pentahydrate form also known as 'Bordeaux mixture' and 'bluestone copper') An inorganic compound with fungicidal, microbiocidal, nematicidal, insecticidal, and molluscicidal action. Registered-USEPA. Not registered in Pakistan. Toxicity Classes I and III, depending upon concentration/formulation. WHO Acute Toxicity II. No RUPs. Useful against many diseases including angular leaf spot. Use copper sulfate to rotate with aluminum fosetyl and copper oxychloride.	**Health** Acute: Deadly acute toxicity if ingested. Injury to brain, liver, kidneys, stomach and intestinal lining. Easily absorbed through skin. Corrosive to mucous membranes and cornea. Irritates eyes, skin, and respiratory tract. Chronic exposure leads to liver disease. Inhalation may lead to cough, sore throat. Ingestion may lead to: Abdominal pain. Burning sensation. Diarrhea. Nausea. Shock or collapse. Vomiting. Contact with skin and eyes may lead to: redness, pain, blurred vision. **Chronic:** no issues. **Environment:** VHT to aquatic mollusks, nematodes and flatworms; HT to amphibians, bees and earthworms; MT to fish; ST to crustaceans and zooplankton. PNT to birds. Persistent chemical; not broken down in the environment.
Lime sulfur (a mixture of calcium polysulfides) An inorganic compound. Lime sulfur is sold as a spray for deciduous trees to control fungi, bacteria and sedentary insects living or dormant on the surface of the bark. Registered-USEPA. Not registered in Pakistan. Toxicity Classes I (Highly Toxic DANGER-Poison) and III, depending upon concentration. WHO Acute Toxicity II. No RUPs. Controls powdery mildew.	**Health Acute:** Toxic upon ingestion. **Chronic:** No issues. **Environment:** ST to fish.

Mancozeb (a dithiocarbamate, inorganic zinc compound with fungicidal action). EPA Toxicity Classes III & IV, slightly to non-toxic, WHO rating U, unlikely to be toxic; Registered by USEPA. Registered by Pakistan. No RUPs. Sold in Pakistan as Dithane M-45 WP Has uses on tomatoes, onions, grapes, potatoes, pears, apples.	**Health Acute:** poisoning may lead to cough, sore throat, redness and pain of skin and eyes; diarrhea, nausea, and vomiting. **Chronic** issues are probable human carcinogen, suspected endocrine disruption, and known reproductive or developmental toxin. **Environment:** HT to amphibians; MT to fish, bees, and aquatic plants; ST to birds; NAT to zooplankton. Domestic/wild mammals not to be grazed in treated areas.
Metalaxyl (a xylylalanine, benzanoid compound) Registered-USEPA. Registered by Pakistan. EPA Toxicity Class II Warning, moderately toxic. WHO Toxicity Class III, slightly hazardous. [for use on runner beans, French beans, zucchini] Metalaxyl is a systemic fungicide used in mixtures as a foliar spray for tropical and subtropical crops, as a soil treatment for control of soil borne pathogens, and as a seed treatment to control downy mildews. Sold in Pakistan by Syngenta as: Apron seed treat product (STP), which is Metalaxyl 350 g/kg D; or Ridomil Gold 68 WP STP, a mix of Metalaxyl-m, and Mancozeb.	**Health Acute:** Slight eye and skin irritation. **Chronic:** No issues. **Environment:** Potential ground water contaminant. ST to fish and zooplankton, PNT to birds and bees.

Thiram. (a dithiocarbamate compound) Registered-USEPA. Registered by Pakistan. EPA Toxicity Class III, slightly toxic. WHO Toxicity class III, slightly hazardous **Thiram is a UNEP Rotterdam Convention "Prior Informed Consent" or PIC compound, and is banned in 2 countries.** Seed treatment for maize seed and dry bean seed. Sold in Pakistan as Vitavx 200 FF 37.5% (Agricides (Pvt) Ltd) & (Prime Venture) as seed treatment products.	**Health Acute:** Irritating to eyes, skin, and respiratory tract. Slightly toxic orally and dermally; relatively non-toxic via inhalation. May damage liver, nervous system, blood, and kidneys. **Chronic:** Reproductive effects evident at very high doses only; Teratogenic effects at very high doses. Doses at these levels are unlikely to be seen in humans. Inconclusive mutagenicity effects. Non-carcinogenic. A suspected endocrine disruptor. **Environment:** VHT to amphibians, HT to fish, aquatic invertebrates, nematodes and zooplankton. MT to ST to birds. Slightly to relatively non-toxic to domestic/wild mammals. NAT to bees and aquatic plants. No data on earthworms. No data on beneficial arthropods, but likely to be slightly toxic to arthropod predators.

Insecticides	
Acetamiprid (a chloro-nicotinyl compound) Registered-USEPA. Registered by Pakistan. EPA Class III, slightly toxic. No RUPs. Sold in Pakistan as Assail 30 SG, 70 WP (also Intruder, Tristar), Nippon Soda	**Health Acute:** Low acute toxicity in humans. **Chronic:** No issues. **Environment:** MT to bees; NAT to crustaceans and fish. Degrades rapidly by aerobic soil metabolism.
Azinphos-methyl (an organophosphate) **Do not use; Find an alternate chemical.** Registered-USEPA. Registered by Pakistan. EPA toxicity class I, highly toxic WHO toxicity class Ib, highly hazardous Some RUPs (All azinphos-methyl liquids with a concentration greater than 13.5% are classified as Restricted Use Pesticides (RUP) by the U.S. Environmental Protection Agency (EPA) because of the inhalation hazard and acute toxicity they present, as well as their potential adverse effects on mammalian species, birds, and aquatic organisms.) Used in apple and pear industries against fruit fly maggot and coddling moth. Use of this product is being phased out in the USA due to health concerns. Biocontrol using pheromone release and mating disruption in replacing azinphos-methyl in the US apple/pear industries.	**Health Acute**: A strong cholinesterase inhibitor. Symptoms of organophosphate poisoning include: Excessive salivation, sweating, rhinorrhea and tearing. Muscle twitching, weakness, tremor, incoordination. Headache, dizziness, nausea, vomiting, abdominal cramps, diarrhea. Respiratory depression, tightness in chest, wheezing, productive cough, fluid in lungs. Pin-point pupils, sometimes with blurred or dark vision. In severe cases: seizures, incontinence, respiratory depression, loss of consciousness. **Chronic:** Likely few issues. **Environment:** Potential ground water contaminant. Banned in 3 countries. High aquatic toxicity. VHT to crustaceans, aquatic insects; HT to earthworms, fish, nematodes, and bees; MT to mollusks, zooplankton and

	birds.
Bacillus thuringiensis (BT, a microbially derived compound) Registered-USEPA. Registered by Pakistan. EPA Acute Toxicity Class III-slightly toxic No RUPs Sold in Pakistan as Agree 50 WP (Syngenta); Dipel 3.5% (Agricides (Pvt) Ltd); Condor WP (Green Technologies).	**Health Acute:** Very safe by acute oral or dermal contact. An eye irritant. Practically non-toxic to humans and animals by acute exposure. If ingested, may cause bacterial gastroenteritis: abdominal cramps, vomiting and diarrhea. **Chronic:** No issues. **Environment:** No known effects on non-target organisms from normal use. ST to crustaceans and mollusks. Not toxic to birds, fish, earthworms, bees, domestic/wild mammals, aquatic plants, and beneficial arthropods, except possibly predatory mites and insects used for biocontrol of weeds.
Carbaryl (n-methyl carbamate) Registered-USEPA. Registered by Pakistan. EPA Toxicity Classes I DANGER, Class II WARNING (80% formulation), Class III CAUTION (< 50 % formulation); Only formulations of Toxicity Class II and III being proposed for use in I-LED project. No RUPs. WHO acute toxicity: Class II, moderately hazardous. Note: Carbaryl is banned in 4 countries.	**Health Acute:** Skin, eye, ingestion hazards. May affect the lungs, kidneys, liver, and nervous system with chronic use. Highest risk to public is from residues in food. No reproductive or fetal effects, although lowered sperm counts and sperm morphological abnormalities have been noted. **Chronic:** endocrine disruptor, likely carcinogen **Environment:** High aquatic and terrestrial toxicity. Potential ground water contaminant. VHT to earthworms; HT to crustaceans, aquatic insects, and bees; MT to amphibians, fish, and zooplankton. PNT to birds.

Carbofuran Do not use; Find an alternate chemical. A carbamate class of insecticide/nematicide. Registered by USEPA. Registered by Pakistan. EPA Toxicity Classes I & II, highly toxic. WHO Class 1b, highly hazardous. **RUPs (5 Furadan formulations RUPs based on acute aquatic toxicity).** Banned in 4 countries. A PIC chemical. Sold in Pakistan as Furadan 5% (FMC)	**Health Acute:** A strong cholinesterase inhibitor. Symptoms of carbofuran inhalation exposure include: Dizziness. Sweating. Labored breathing. Unconsciousness. Vomiting. Pupillary constriction, muscle cramps, excessive salivation. Ingestion may lead to: Abdominal cramps, diarrhea, headache, nausea, vomiting, and weakness. **Chronic:** No issues. **Environment:** High aquatic ecotoxicity and bioconcentration potential. Potential ground water pollutant. VHT to earthworms & zooplankton, HT to crustaceans, aquatic insects, birds and honeybees, MT to fish, mollusks and reptiles, ST to amphibians.
Chlorpyrifos Restricted Use Products—Do not use on I-LED project. Registered-USEPA Registered by Pakistan. EPA product toxicity class II, moderately toxic. WHO acute toxicity: Class II, moderately hazardous. **RUPs based upon high aquatic toxicity. In the USA, only highly qualified certified personnel may apply.**	**Health Acute**: Chloinesterase inhibitor. Symptoms of poisoning by organophosphate pesticides may include: Excessive salivation, sweating, rhinorrhea and tearing. Muscle twitching, weakness, tremor, un-coordination. Headache, dizziness, nausea, vomiting, abdominal cramps, diarrhea. - Respiratory depression, tightness in chest, wheezing, productive cough, fluid in lungs. Pin-point pupils, sometimes with blurred or dark vision. Severe cases: seizures, incontinence, respiratory depression, loss of consciousness. Antidote is atropine. **Chronic:** Suspected endocrine disupotor. **Environment:** High aquatic toxicity. VHT to crustaceans; HT to fish, aquatic insects, birds, and bees; MT to

	amphibians, mollusks, nematodes, and zooplankton; PNT to earthworms.
Cyfluthrin (beta-cyfluthrin). A synthetic pyrethroid**. Restricted Use Products—Do not use on I-LED project.** Registered-USEPA. Registered by Pakistan. EPA product toxicity: Class II, moderately toxic. WHO acute toxicity: Class II, moderately hazardous. **RUPs based upon high aquatic toxicity. In the USA, only highly qualified certified personnel may apply.** Sold in Pakistan as Baythroid.	**Health Acute**: Pyrethroid exposure may lead to - Irritation of skin and eyes; Irritability to sound or touch, abnormal facial sensation, sensation of prickling, tingling or creeping on skin, numbness; Headache, dizziness, nausea, vomiting, diarrhea, excessive salivation, fatigue. In severe cases: fluid in the lungs and muscle twitching may develop. **Chronic:** Suspected endocrine disruptor. **Environment:** VHT to fish, aquatic insects and zooplankton; HT to bees; ST to mollusks and birds;
Deltamethrin. (A synthetic pyrethroid). **Restricted Use Products—Do not use on I-LED project.** Registered-USEPA. Registered by Pakistan. EPA product toxicity Class II, moderately toxic. WHO acute toxicity: Class II, moderately hazardous. **RUPs based upon high aquatic toxicity. In the USA, only highly qualified certified personnel may apply.** Sold in Pakistan as 2.5% (W/V) EC. Range. Red Sun Group Corp, Nanjing STP	**Health: Acute:** Inhalation may lead to: Burning sensation. Cough. Dizziness. Headache. Nausea. Skin contact may lead to: Redness. Burning sensation. Numbness. Tingling. Itching. Eyes may become red with pain. Ingestion may lead to: Abdominal pain. Convulsions. Unconsciousness. Vomiting. **Chronic:** no issues. **Environment:** VHT to amphibians, aquatic insects and zooplankton. HT to fish. MT to bees.

Endosulfan (an organochloirne) Do not use; Find an alternate chemical. Registered by USEPA. Registered by Pakistan. EPA Toxicity Classes I, highly toxic. WHO Class II moderately hazardous. No RUPs. **Banned in 8 countries.** Sold in Pakistan as Thiodan. Used on leaf lettuce, cotton, cantaloupe, strawberries, melons, corn,	**Health Acute:** High acute toxicity. Ingestion may lead to Blue lips or fingernails. Confusion. Convulsions. Diarrhoea. Dizziness. Headache. Laboured breathing. Nausea. Unconsciousness. Vomiting. Weakness. **Chronic:** A known endocrine disruptor. **Environment:** VHT to marine/benthic communities, fish; HT to crustaceans and aquatic insects; MT to amphibians, mollusks, zooplankton, earthworms,
Imidacloprid Registered-USEPA. Registered by Pakistan. EPA product toxicity Class III CAUTION. Controls insect pests of citrus, including white flies. Sold in Pakistan as Sold under the trade names Confidor, Impower, Admire, Merit, Gaucho, Intercept, Genesis STP	**Health Acute:** Practically non-toxic orally. Slightly toxic via inhalation and dermally. **Chronic:** No issues. **Environment:** ST to aquatic invertebrates.

Lambda-Cyhalothrin. (A synthetic pyrethroid) **Restricted Use Products—Do not use on I-LED project.** Registered by USEPA. Registered by Pakistan. EPA Toxicity Classes I, II and III, Highly to Moderately to Slightly Toxic, Danger to Caution, depending on concentration and formulation; WHO rating II**.** **Restricted Use Products (RUPs).** Sold in Pakistan as '**Karate** 50g/L'. **All similar Karate products registered in USA are RUPs due to aquatic toxicity. Do not use EPA Restricted Use Products (RUPs) in Pakistan.**	**Health: Acute: I**nhalation may lead to Burning sensation. Convulsions. Cough. Labored breathing. Shortness of breath. Sore throat. Ingestion may lead to Abdominal pain. Cough. Skin contact may lead to redness and pain. **Chronic:** Suspected endocrine disruptor. Carcinogenicity tests are inconclusive, but suggest that lambda-cyhalothrin is probably not carcinogenic. **Environment:** VHT to fish and aquatic insects. HT to bees. PNT to birds.
Lufenuron (abenzoylurea compound) Registered-USEPA Registered by Pakistan. EPA Toxicity Class III. **Sold in Pakistan as Match 050**	**Health: Acute:** Urea compound systemic toxicity is unlikely unless large amounts have been ingested. Many substituted ureas are irritating to eyes, skin and mucous membranes. Coughing and shortness of breath. Nausea, vomiting, diarrhea, headache, confusion and electrolyte depletion. Protein metabolism disturbances, moderate emphysema, and weight loss with chronic exposure. **Chronic:** No issues. **Environment:** No information.
Malathion Registered-USEPA. Registered by Pakistan.	**Health Acute:** Chloinesterase inhibitor. Slightly toxic dermally, relatively non-toxic via inhalation. May affect the central nervous system, immune system, adrenal glands,

EPA Toxicity Class II WARNING Flies, cutworms on all grasses, leafhoppers, and locust outbreaks on all crops.	kidneys, liver, and blood. Unlikely to cause reproductive effects in humans at normal use levels. **Chronic:** Possibly mutagenic. **Environment:** HT to aquatic invertebrates, tadpoles, earthworms, and honeybees. Not toxic except at high dosages to domestic/wild mammals. Harmful to many beneficial arthropods. Slightly to moderately toxic to birds. Slightly toxic to fish, depending on species.
Neem Oil (an artesanal botanical insecticide) source of azadirachtin Registered-USEPA. Not registered in Pakistan. WHO toxicity not listed. EPA product toxicity class III. **Neem oil** is a vegetable oil pressed from the fruits and seeds of Neem (*Azadirachta indica*), an evergreen tree which is endemic to the Indian sub-continent and has been introduced to many other areas in the tropics.	**Health Acute**: Exposure by high concentration may lead to severe skin and gastrointestinal irritation; central nervous system stimulation and depression have been observed. **Chronic:** No issues. **Environment:** MT to amphibians and aquatic insects; ST to fish; NAT to birds, bees.
Profenofos 400g + Cypermethrin 40g per liter. Restricted Use Product—Do not use on I-LED project. Both chemicals registered USEPA & Pakistan. **EPA Toxicity class II for both chemicals.** **Profenofos is RUP due to high aquatic toxicity.** **Sold in Pakistan as Polytrin C 440 EC**	**Health Acute:** Profenofos is a cholinesterase inhibitor. **Chronic:** Cypermethrin is a possible human carcinogen. **Environment:** Profenofos potential ground water contaminant. Both chemicals VHT to crustaceans, zooplankton, aquatic insects. HT to fish.

Used to control lepidopterous pests as well as control of sucking insects such as whiteflies, aphids, jassids and mites.	
Pyrethrum (an artesanal botanical insecticide; a mix of pyrethrins extracted from chrysanthemum flowers) Registered-USEPA. Not registered in Pakistan. EPA toxicity class III, slightly toxic**.** Some pyrethrins are RUPs based upon high aquatic toxicity. **Pyrethrum** is the name of a natural insecticide made from the dried flower heads of several Old World plants of the genus *Chrysanthemum*, e.g., *C. cinerariifolium* and *C. coccineum*. **Used on tomatoes, leaf lettuce, grapes, lemons, strawberries, artichokes, potatoes.**	**Health Acute**: Exposure to pyrethrins may lead to: Irritation of skin, eyes and respiratory tract; and as a sensitizer that may cause allergic reactions. **Chronic:** Possible human carcinogen. **Environment:** VHT to honeybees and aquatic organisms amphibians, zooplankton, aquatic insects, crustaceans, fish.
Pyriproxyfen (an insect growth regulator) Registered-USEPA. Not registered in Pakistan. EPA product toxicity classes II and III, moderately to slightly toxic. WHO acute toxicity: U, Unlikely to be hazardous. No RUPs. Used on oranges, almonds, cotton, strawberry, walnuts, applea, lemons, plums, tangerines, pistachios.	**Health Acute:** No serious acute issues. **Chronic:** no issues. **Environment:** VHT to zooplankton; MT to fish.
Rotenone (an artesanal botanical insecticide) Registered-USEPA.	**Health Acute:** Inhalation may lead to Confusion. Cough. Headache. Labored breathing. Nausea. Sore throat.

Not registered in Pakistan. EPA product toxicity class: III, slightly toxic in dilute formulations WHO acute toxicity: class II, moderately hazardous No RUPs. **Rotenone** is produced by extraction from the roots and stems of several tropical and subtropical plant species belonging to the genus *Lonchocarpus* or *Derris*. Used on leaf lettuce, artichoke, spinach, strawberry, collards, head lettuce, peas.	Unconsciousness. Tremor. May cause redness to skin and eyes. Ingestion may lead to abdominal cramps. Convulsions. Diarrhea. Vomiting. **Chronic:** No issues. **Environment:** HT to fish and amphibians; MT to crustaceans, aquatic insects, mollusks, nematodes and zooplankton.
Spinosad Registered-USEPA. Not registered in Pakistan. Toxicity Class IV, slightly toxic A costly product used against white flies on citrus, avocado, mango, cactus, pineapple, broccoli, cucumber, tomato, grapes, peppers; thrips on onion, bean, peppers; aphids on grapes, tomato, cucumber, eggplant, broccoli, artichoke, potato, cactus, pear, peach, apricot, pistachio, blueberry, and other high-value crops**. Cost will limit use to only larger operations and organic initiatives.**	**Health Acute:** Not toxic orally or dermally, or via inhalation. No body organs affected. **Chronic:** No issues **Environment:** HT to bees. MT to ST to fish. NT to birds, livestock/domestic mammals, aquatic plants, beneficial arthropods. No data on earthworms.
Spirodiclofen (a keto-enol) Registered-USEPA. Not registered in Pakistan. EPA product toxicity: Class III, slightly toxic. WHO acute toxicity: not rated. No RUPs.	**Health Acute:** Low acute toxicity, few issues. **Chronic:** Likely carcinogen. **Environment:** Not toxic to aquatic organisms, low toxicity to mammals and birds. Non-toxic to adult bees, but may affect honey bee brood if pollen or nectar is directly

Used against mites and some scales on grapes, tree nuts, apples, pears, cherry, peach, plum, apricot, and citrus.	contaminated by the spray.
Thiacloprid (a chloro-nicotinyl compound) Registered by USEPA. Registered by Pakistan. EPA Toxicity Class II, Moderately Toxic. WHO rating II. Sold in Pakistan as Calypso 240 SC , a broad-spectrum Bayer product Used on cotton whitefly (nymph & adults), Jassid and thrips.	**Health: Acute**: Eye: Avoid contact with eyes. Skin: Harmful if absorbed through the skin. Avoid contact with skin or clothing. Ingestion: May be fatal if swallowed. Inhalation: Harmful if inhaled. Avoid contact or inhalation of spray mist. **Chronic:** Probable human carcinogen. **Environment:** VHT to aquatic invertebrates. Over-use will cause cross-resistance to other chloro-nicotinyl pesticides. To avoid resistance, rotate with another type of pesticide.
Thiamethoxam (an unclassified compound) Registered by USEPA. Registered by Pakistan. EPA Toxicity Class III, Slightly Toxic. No WHO rating. Sold in Pakistan as Actara ST 70 WS for use on cotton Jassid & thrips & whitefly & maize shootfly as seed treatment; and Actara 25 WG (Syngenta) on cotton Jassid & thrips, potato and okra Jassid, tobacco aphids, mango hoppers and RICE whitebacked plant hopper, Brinjal Jassid, Citrus Pyslla & Leaf miner.	**Health: Acute:** Causes moderate eye irritation. Harmful if absorbed through skin. Avoid contact with eyes, skin, or clothing. Wash thoroughly with soap and water after handling. **Chronic:** Known/probable human carcinogen. **Environment:** HT to aquatic invertebrates and bees. Toxic to wildlife. Thiamethoxam has properties and characteristics associated with chemicals detected in ground water. The use of this chemical in areas where soils are permeable, particularly where the water table is shallow, may result in ground water contamination.

Herbicides	
Glyphosate. Registered by USEPA. Registered by Pakistan. Toxicity Class III, CAUTION. Classified as a General Use Pesticide (GUP). **Sold in Pakistan as Round-Up.** General use on all broad-leaf plants for weed control.	**Health Acute:** Slight human toxicity. **Chronic:** No issues. **Environment:** MT to crustaceans; ST to fish and zooplankton; possible water contamination.
Metolachlor (a **c**hloroacetanilide compound) Registered-USEPA. Registered by Pakistan. EPA Toxicity Class III, slightly toxic. WHO Toxicity class III, slightly hazardous No RUPs. Sold in Pakistan as Primextra SC and Dual Gold SC 960 g/L Short residual, pre-emergent herbicides.	**Health Acute:** inhalation may lead to headache, nausea; ingestion may lead to abdominal cramps. **Chronic:** Possible carcinogen, suspected endocrine disruptor. **Environment:** Known ground water contaminant. MT to fish; ST to zooplankton.
Pendimethalin (a 2,6-Dinitroaniline compound) Registered-USEPA.	**Health: Acute:** Slightly to practically nontoxic by ingestion and skin exposure. Mild eye irritation. Inhalation of dusts

Registered by Pakistan EPA Toxicity Class III, slightly toxic. WHO Toxicity class III, slightly hazardous No RUPs. Sold in Pakistan as Stomp	or fumes may be mildly to moderately irritating to the linings of the mouth, nose, throat, and lungs. **Chronic:** No issues. **Environment:** MT to crustaceans, fish and aquatic insects; ST to birds, NAT to honeybees.

Acaricides	
Amitraz. A formamidine class of insecticide. Registered by USEPA. Registered by Pakistan EPA Toxicity Class III, slightly toxic, Caution. WHO Class III, slightly hazardous. No RUPs. Marketed as Bovitraz, Taktic, Milbitraz spray dip.	**Health Acute:** Ingestion may lead to slow heart beat, low blood pressure, sedation, low body temperature. **Chronic:** Known reproductive or developmental toxin. Possible human carcinogen. **Environment:** MT to fish, ST to amphibians, zooplankton and birds, NAT to crustaceans, PNT to honeybees.
Carbaryl. A carbamate class of insecticide. Registered by USEPA. Registered by Pakistan EPA Toxicity Class III, slightly toxic, Caution. WHO Class II, moderately hazardous. No RUPs. Note that there are pesticides that contain mixtures of carbaryl with other pesticides and have higher (class I and II) ratings. Do not use these mixtures.	**Health Acute:** Cholinesterase inhibitor. Inhalation may lead to convulsions, dizziness, labored breathing, nausea, unconsciousness, vomiting, muscle cramp, excessive salivation. Skin/eye exposure may lead to redness, pain, papillary constriction. Ingestion may lead to abdominal cramps, diarrhea, nausea, vomiting, papillary constriction, muscle cramps, excessive salivation. **Chronic:** Probable human carcinogen, suspected endocrine disruptor. **Environment:** Potential ground water pollutant. High aquatic toxicity. VHT to earthworms, HT to crustaceans, aquatic insects & honeybees, MT to amphibians, aquatic annelids, fish, zooplankton, ST to mollusks, PNT to birds.

Chlorfenvinphos (no EPA approval). Not approved for use on livestock projects. **Not registered by USEPA** Registered by Pakistan Marketed as Supona or Steladone.	
Cypermethrin(e), beta (a synthetic pyrethroid) **Do Not use near open water**. Registered by USEPA. Registered by Pakistan EPA Toxicity Classes II and III, Moderately to Slightly Toxic No WHO rating. Some RUPs sold under name: FMC Ammo. Sold in Pakistan as Ecofleece 10%.	**Health: Acute:** Poisoning symptoms for pyrethroids include: Irritation of skin and eyes. Irritability to sound or touch, abnormal facial sensation, sensation of prickling, tingling or creeping on skin, numbness. Headache, dizziness, nausea, vomiting, diarrhea, excessive salivation, fatigue. In severe cases: fluid in the lungs and muscle twitching may develop. Seizures may occur and are more common with more toxic cyano-pyrethroids. **Chronic:** Possible human carcinogen. **Environment**: VHT to crustaceans, aquatic insects, & zooplankton. HT to fish and bees. MT to mollusks. PNT to birds.
Deltamethrin (pour-on only) A synthetic pyrethroid class of insecticide. Registered by USEPA. Registered by Pakistan EPA Toxicity Classes I, II and III, Highly to Moderately to Slightly Toxic, Warning to Caution. WHO Class II, moderately hazardous. **Some RUPs due to high aquatic toxicity—Use only as pour-on formulation, Not as spray-on. Do not use near open water.**	**Health:** Acute: Inhalation may lead to: Burning sensation. Cough. Dizziness. Headache. Nausea. Skin contact may lead to: Redness. Burning sensation. Numbness. Tingling. Itching. Eyes may become red with pain. Ingestion may lead to: Abdominal pain. Convulsions. Unconsciousness. Vomiting. **Chronic:** no issues.

	Environment: Very high aquatic toxicity. VHT to amphibians, aquatic insects and zooplankton. HT to fish. MT to honeybees.
Diazinon. (an organophosphate) Registered by USEPA and by Ethiopia. Registered by Pakistan EPA Toxicity Class III, Slightly Toxic, Caution. WHO Class II, moderately hazardous. No RUPs. Marketed as Diazol, Diazinon 60%, and Neocidol EC.	**Health: Acute:** Strong cholinesterase inhibitor. Symptoms of Diazinon Inhalation Exposure include: Convulsions. Dizziness. Labored breathing. Nausea. Unconsciousness. Vomiting. Pupillary constriction muscle cramp excessive salivation. Ingestion may lead to: Abdominal cramps. Diarrhea. Labored breathing. Nausea. Unconsciousness. Vomiting. Pupillary constriction. Muscle cramps. Exposure of eyes and skin may lead to: redness, pain and pupillary constriction. **Chronic:** Known reproductive or developmental toxicant. **Environment:** Very high aquatic toxicity. VHT to birds. HT to crustaceans, aquatic insects, nematodes/flatworms, zooplankton & honeybees. MT to amphibians, annelids (worms), fish & mollusks. Potential ground water pollutant.
Dichlorvos (DDVP). Do not use; Find an alternate chemical. An organophosphate class of insecticide. Registered by USEPA. Registered by Pakistan EPA Toxicity Classes I, II and III, depending upon concentration. **WHO Class IB, Highly Hazardous.** **Banned from 6 countries.**	**Health Acute:** High acute toxicity, Strong cholinesterase inhibitor. Inhalation may lead to convulsions, dizziness, sweating, labored breathing, nausea, unconsciousness, papillary constriction, muscle cramps, excessive salivation. May be absorbed easily by skin, leading to redness and pain. Ingestion may lead to abdominal cramps, diarrhea, vomiting.

No RUPs.	**Chronic:** Known/probable carcinogen. **Environment:** Aquatic toxicity. HT to crustaceans, aquatic insects, birds, MT to amphibians, fish, zooplankton, honeybees, ST to aquatic annelids, mollusks, earthworms.
Fenvalerate. A synthetic pyrethroid class of insecticide. Registered by USEPA. Registered by Pakistan EPA Toxicity Class III, Slightly Toxic, Caution. WHO Class II, moderately hazardous. No RUPs. Do not use near open water. Sold in Pakistan as Edcidin 20 EC (Edgro (Pvt) Ltd).	**Health Acute:** Inhalation may lead to burning sensation, cough, dizziness, headache, nausea. Skin contact may lead to redness, burning sensation, numbness, tingling, itching. Eye contact may lead to redness and pain. Ingestion may lead to abdominal pain, convulsions, vomiting. **Chronic:** Suspected endocrine disruptor. **Environment:** High marine/benthic, aquatic toxicity. VHT to aquatic annelids, fish, zooplankton, HT to amphibians, crustaceans, aquatic insects, mollusks, nematodes/flatworms, and honeybees.
Ivermectin (Abamectin, Avermectin) 1% A microbial extract class of insecticide and antihelminth. Registered by USEPA. Registered by Pakistan EPA Toxicity Classes II & III, moderately to slightly toxic, Warning. No WHO toxicity rating. **Some RUPS due to high aquatic toxicity—Not for external use. Internal parasite use only. Not for use near open water sources, like streams, ponds.**	**Health Acute:** High acute toxicity at higher doses. Acute poisoning symptoms include central nervous system depression, incoordination, tremors, lethargy, excitation, pupil dilation, coma, vomiting, convulsions and/or tremors, and coma. Irritation of skin and eyes. At high doses, respiratory failure. **Chronic:** Known reproductive or developmental toxicant. **Environment:** High aquatic toxicity for some formulations.

Sold in Pakistan as Euvectine by LG	VHT to aquatic insects and zooplankton, HT to crustaceans & bees, ST to fish, PNT to birds.
Propoxur. A carbamate class of insecticide. Registered by USEPA. Registered by Pakistan EPA Toxicity Classes I, II and III, Highly to Moderately to Slightly Toxic, Danger, danger, danger, Warning to Caution. WHO Class II, moderately hazardous. No RUPs. Do not use near open water. Use only EPA class III products.	**Health Acute**: Strong cholinesterase inhibitor. Inhalation may lead to dizziness, headache, sweating, labored breathing, nausea, unconsciousness, vomiting, pupillary constriction, muscle cramp, excessive salivation. Eye contact may lead to papillary constriction, blurred vision. Ingestion may lead to abdominal cramps, convulsions, diarrhea, weakness, muscle twitching. **Chronic:** Probable human carcinogen. **Environment:** Aquatic and bird toxicity. VHT to birds, HT to crustaceans, honeybees, MT to fish, zooplankton, ST to amphibians, aquatic insects, mollusks, NAT to aqutic annelids, earthworms.
Trichlorfon (an organophospate) Registered by USEPA. Registered by Pakistan EPA Toxicity Classes II & III, Moderately to Slightly Toxic. WHO rating II. No RUPs. Banned in 2 countries. Sold in Pakistan as Santrifon-100, Negavan, **Anthon, Negufan, and Tagafon**.	**Health Acute:** Chloinesterase inhibitor. Symptoms of poisoning by organophosphate pesticides may include: Excessive salivation, sweating, rhinorrhea and tearing. Muscle twitching, weakness, tremor, un-coordination. Headache, dizziness, nausea, vomiting, abdominal cramps, diarrhea. - Respiratory depression, tightness in chest, wheezing, productive cough, fluid in lungs. Pin-point pupils, sometimes with blurred or dark vision. Severe cases: seizures, incontinence, respiratory depression, loss of consciousness. Antidote is atropine. **Chronic:** Possible human carcinogen.

	Environment: HT to birds; MT to crustaceans, aquatic insects, and mollusks; ST to fish and zooplankton; PNT to bees.

Anti-Parasitics	
Albendazole (antihelminth) 2.5-10% Sold in Pakistan as Valbazine by Pfizer	**Use only reputable company products, use within expiration date, store in cool, dry place, read label, dispose of properly.**
Levamizole (antihelminth) 1.5% Sold in Pakistan as part of Nilzan Plus by ICI	**Use only reputable company products, use within expiration date, store in cool, dry place, read label, dispose of properly.**
Oxyclozanide (antihelminth) 3% Sold in Pakistan as part of Nilzan Plus by ICI	**Use only reputable company products, use within expiration date, store in cool, dry place, read label, dispose of properly.**

Stored Grain/Product Fumigants	
Aluminium (aluminum) phosphide (may be used with *Condition* that users are well trained and protected) Registered by USEPA. Registered by Pakistan **EPA Toxicity Class I, Highly Toxic.** WHO rating II. All RUPs. **A very toxic Class I substance needed to protect stored grain, but that should not be used by unprotected or untrained individuals. Phosphine gas is rapidly dissipated in open air.** Sold in Pakistan as Aluminium phosphide 56% w/w; and Celphos ; Phostoxin-R 56% Pellets (A.G. Services & Supplies); Delicia Gastoxin Tablets 56.8% AIP (Dawood Corporation); DETIA Gas EX-T 56% Tablets (The Planters (Pvt) Ltd); Agtoxin Tablets & Bags (AG Pesticides (Pvt) Ltd); Ragto-AP 56 (w/w) Tablets (R. A. Associate (Pvt) Ltd); AGRIPHOS 56 (w/w) Tablets (Agricides (Pvt) Ltd); Fumikill 56 (w/w) Tablets (S. Essa (Pvt) Ltd); ALUMPHOS 56% ALP Tablets (Adeel Pesticide Manufacturing Co Ltd); WELTOXIN 56% ALP Tablets (Warble (Pvt) Ltd).	**Health Acute**: Inhalation may lead to Cough. Dizziness. Headache. Nausea. Shortness of breath. Sore throat. Vomiting; Exposure to skin and eyes leads to redness; Ingestion may lead to Abdominal pain. Convulsions. Diarrhoea. Headache. Nausea. Shock or collapse. Unconsciousness. Vomiting. **Chronic:** No issues **Environment:** HT to fish, but risk unlikely because phosphine gas will bubble out into air. Inhalation may lead to Cough. Diarrhoea. Headache. Fatigue. Nausea. Vomiting. Skin contact may lead to Burning sensation. Eye contact may lead to Pain. Photophobia. Ingestion may lead to Abdominal pain. Cough. Diarrhoea. Dizziness. Headache. Laboured breathing. Nausea. Unconsciousness. Vomiting. Ataxia. Fatigue.
Zinc phosphide (may be used with *Condition* that users are well trained and protected)	**Health Acute**: Inhalation may lead to Cough. Diarrhoea. Headache. Fatigue. Nausea. Vomiting; Skin contact may

Registered by USEPA. Registered by Pakistan **EPA Toxicity Class I, Highly Toxic.** WHO rating IB, Highly hazardous. All RUPs. **A very toxic Class I substance needed to protect stored grain, but that should not be used by unprotected or untrained individuals.** **Phosphine gas is rapidly dissipated in open air.** Sold in Pakistan as Zinc phosphide 80% w/w (Agrochemicals Ltd; Edgro Ltd); Ratokil 80% Powder (National Insecticide Co); Technical 90-95% (International Enterprises); Zodphos 80% (National Agro Trading (Pvt) Ltd); Ratophos 80% WP (R. A. Associate (Pvt) Ltd).	lead to Burning sensation; Eye contact may lead to Pain. Photophobia; Ingestion may lead to Abdominal pain. Cough. Diarrhea. Dizziness. Headache. Labored breathing. Nausea. Unconsciousness. Vomiting. Ataxia. Fatigue. **Chronic:** Reproductive/Developmental toxin. **Environment:** HT to fish, birds, and other wild animals.

Attachment 2: A list of viable and practical IPM options to try in Pakistan and to potentially integrate into an IPM system approach to pest management

Crops and Pests IPM

Note Well: For all crops and pests, one of the best sources of IPM methods that work and are used in the USA (in California—the state with the widest diversity of agriculture production) is the university site: http://www.ipm.ucdavis.edu/. For fruit, Washington State, Michigan State, Cornell, and Florida are other university systems to search.

Note also that many of the farm field best management practices (BMPs) for most crops recommend relatively easy-to-implement activities like use of:

- scouting, traps and monitoring to catch and manage pest outbreaks early;
- good plant health maintenance through water, soil, and nutrient management (raised-bed, plastic mulches, regulated drip irrigation/fertigation; plant, soil, nutrient, and water analyses);
- cultural practices like use of resistant varieties, pest avoidance through early/late plantings/harvestings, crop rotation, pruning, crop residue destruction, and destruction of pest refuge plants near field;
- biological control methods like parasite/predator enhancement through border plantings of favored refugia plants, use of pheromone releases for mating disruption, parasite releases, and microbial agent sprays (for larger farms);
- and mechanical control through exclusion netting or trapping.

The following is a listing of many of the recommended IPM practices (BMPs) for each I-LED crop, for the most common pests. Most techniques are relatively universal—they will work in many countries for the same or very similar species.

Grains

RICE

Note that rice diseases and insects are studied by the International Rice Research Institute (IRRI) and they should be used as a source of knowledge and information about IPM for these.

Sheath Blight, *Rhizoctonia solani*
http://www.knowledgebank.irri.org/factsheets/HowToGrowRice/Pest_Management/Diseases/fs_sheathBlight.pdf provides IPM tips, as follows:

"Prevent sheath blight by:

• Healthy Soil = Strong Rice. If possible, right after harvest, turn over the soil and apply compost. Applying the right fertilizer (for your field's soil type) at the right time makes your rice strong and healthy.
• Varietal resistance. No rice cultivars have been identified as resistant to sheath blight.
• Select good seeds. Do not use seeds that are half-filled, discolored or misshaped. Separate good seeds from bad seeds by hand, by wind, and/or by water (Note: bad seeds float).
• Seed treatment. If sheath blight is a recurring problem, treating seeds with fungicides may help. See a crop protection specialist for guidance on the selection and application of a fungicide. Do not touch treated seeds with bare hands. Treated seeds are poisonous and must not be eaten by humans or animals.
• Cultural methods. Reduce plant density in fields that suffer sheath blight. Drain fields at maximum tillering for a few days. Deep plow to bury infested plant residues. Crop rotation with beans may reduce fungal disease incidence.
• Sanitation. Remove weeds and sick plants from your field."

"Control sheath blight by:

If sheath blight appears, the only control methods available are removing and destroying the affected plant, or applying fungicide. Neither option is particularly useful for most rice farmers. Pulling and destroying plants is laborious and impractical on a large scale. Destroying plants is likely to reduce yields more than the sheath blight itself within a single season. The only real benefit of pulling and destroying (burning, not burying) plants is to prevent the further spread of the disease into future crops. Fungicides are not readily available in Asia. Most rice farmers in Asia lack the knowledge and equipment to use fungicides safely."

Rice Blast, *Pyricularia grisea*,

According to http://www.ipm.ucdavis.edu/PMG/r682100611.html,

"Cultural Control
Blast is favored by excessive nitrogen fertilization, aerobic soils, and drought stress. High nitrogen rates and nitrate nitrogen increase rice susceptibility to the disease. Extended drain periods may also encourage the disease by aerating the soil, by converting ammonium to nitrate, and by causing drought stress to rice.

Use proper seed sampling and testing to identify and avoid the use of blast-infested seed in areas where blast is not a problem. This may help limit the introduction of the disease into noninfested areas.

Water seeding is recommended to reduce or eliminate disease transmission from seed to seedlings. Drill seeding is not recommended because it may allow seed transmission, nitrate formation, and result in drought stress.

Continuous flooding is recommended to limit blast development. Avoid field drainage, especially for extended periods because it allows the formation of nitrate and may cause drought stress. Some studies in other areas suggest that shallow water is more favorable to blast development than deeper water."

Resistant Varieties
Use blast-resistant varieties of rice, if available and cost-effective.

"Monitoring and Treatment Decisions
Monitor to determine the need for treatments. Throughout the season, examine plants in several locations throughout the field for the presence of leaf lesions; intensify monitoring as plants approach the boot stage. If blast lesions are present and increasing just before the boot stage, a treatment may be justified. When making a treatment decision, consider disease progress, crop growth stage, environmental conditions, and rice variety. For example, there is a greater risk of neck and panicle blast infections occurring when growing one of the more susceptible cultivars and long periods of leaf wetness and warm night temperatures occur. Use a protectant fungicide so that the panicles is protected as it emerges from the boots. Because rice blast is a multiple cycle disease, fungicide applications to control leaf blast early in the season are generally ineffective in reducing the incidence of neck blast and yield losses."

Stem borers, several species
http://www.knowledgebank.irri.org/factsheets/HowToGrowRice/Pest_Management/Insects/fs_stemBorer.pdf states that:

"Stem borers can destroy rice at any stage of the plant from seedling to maturity. If the plant is young, the center leaves of the damaged tillers turn brown and die. This condition is called deadheart. If the damage occurs after the spikelets form, then the panicles turn white - a condition known as whitehead. Although damage often looks very bad, control is often not economic. Also by the time damage is evident, it is too late to apply control measures. Stem borers can have a significant impact on the yield of traditional rices, however, as tillers lost to deadheart are often not replaced.

• Preserve Biological Control Agents! - To conserve natural enemies do not apply broad spectrum insecticides (e.g.. methyl parathion).
• Clip the tip of the leaf blades before transplanting – The eggs of yellow stem borers are laid near the tip of the leaf blade. Clipping the seedling before transplanting reduces the transfer of eggs from the seed bed to the field.
• Plant later than usual to avoid yellow stem borer moths.
• Plant stem borer resistant varieties - For example, IR36, lR32, IR66, and IR77 have varying degrees of resistance to some stem borer species.
• Spread straw in the sun to kill resident stem borer larvae.
• Skim stem borer larvae on floating leaves off of the water with a net.
• Plow and flood the field after harvest.

About chemical control

Chemical control of stem borers is generally not recommended as stem borers are quite difficult to control with insecticides. The caterpillars are only vulnerable to many foliar sprays in the short time between hatching from the egg and entering a stem. Systemic insecticides, which go inside the plant, are the only reliable form of chemical control for stem borers after the borers have entered the stem, but by then it is generally too late to save the rice stem anyway. Like all pesticides, the benefits of using an insecticide must be weighed against the risks to health and the environment. Indiscriminate insecticide use can disrupt existing biological control, resulting in pest resurgence or outbreaks. Before using a pesticide contact a crop protection specialist for suggestions, guidance, and warnings specific to your situation. Always read pesticide labels carefully."

Aphids, several species

Maintain plant health with good management, but take care to not over-fertilize. Monitor for aphids using yellow sticky traps to determine economic injury levels. Spray only when these levels are reached.

According to http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn7404.html,

"Insecticidal soap, neem oil, and narrow-range oil (e.g., supreme or superior parafinic-type oil) provide temporary control if applied to thoroughly cover infested foliage. To get thorough coverage, spray these materials with a high volume of water and target the underside of leaves as well as the top. Soaps, neem oil, and narrow range oil only kill aphids present on the day they are sprayed, so applications may need to be repeated. Predators and parasites often become abundant only after aphids are numerous, so applying nonpersistent insecticides like soap or oil may provide more effective long-term control. Although these materials do kill natural enemies that are present on the plant and hit by the spray, because they leave no toxic residue, they do not kill natural enemies that migrate in after the spray."

Biological Control
"Natural enemies can be very important in the control of aphids, especially in gardens not sprayed with broad-spectrum pesticides (organophosphates, carbamates, and pyrethroids) that kill natural enemy species as well as pests. Usually natural enemy populations do not appear in significant numbers until aphids begin to be numerous."

Cultural Control
"Before planting vegetables, check surrounding areas for sources of aphids and remove them. Aphids often build up on weeds such as sowthistle and mustards, moving onto crop seedlings after they emerge. Check transplants for aphids and remove them before planting.
Where aphid populations are localized on a few curled leaves or new shoots, the best control may be to prune these areas out and dispose of them. In large trees, some aphids thrive in the dense inner canopy; pruning these areas out can make the habitat less suitable."

Rice Leaf roller

Use *Bacillus thuringiensis* spray to control.

Grasshoppers, several species

Use *Metarhizium anisopliae* spray to control.

MAIZE

Rust

Use rust resistant or tolerant varieties or hybrids, maintain soil and plant health (test these with lab tests), destroy infected residue. Rotate maize with other crops.

Loose smut, *Ustilago avenae*

Use resistant or tolerant varieties or hybrids, maintain soil and plant health (test these with lab tests), destroy infected residue. Rotate maize with other crops.

Head smut, *Sporisorium holci-sorghi*

Use resistant or tolerant varieties or hybrids, maintain soil and plant health (test these with lab tests). Rotate maize with other crops. Destroy smutted plant parts by removal and burning.

Stem rot (Charcoal, Diplodia, Fusarium, Gibberella, Nigrospora, and Anthracnose).

According to http://ipm.uiuc.edu/pubs/iapmh/04chapter.pdf,

"Plant hybrids with good stalk rot resistance and stalk strength. Maintain adequate nitrogen, phosphorus, and potassium fertility. Control corn borers and corn rootworms. Scout fields at 30 to 40% moisture for lodging potential. Walk a zigzag pattern through the field, pushing random plants about 5 inches from the vertical. If more than 10 to 15% lodge, schedule the field for early harvest."

Leaf bights

Use resistant or tolerant varieties or hybrids, maintain soil and plant health (test these with lab tests), destroy infected residue. Rotate maize with other crops.

Stem borer

Monitor. Use *Bacillus thuringiensis* spray to control.

Cutworm

Monitor. Use *Bacillus thuringiensis* spray to control.

Silk beetle

Monitor frequently and spray insecticide only when action threshold is reached.

WHEAT

Rust

Use resistant or tolerant varieties or hybrids, maintain soil and plant health (test these with lab tests), destroy infected residue. Rotate wheat with other crops.

Smut

Use resistant or tolerant varieties or hybrids, maintain soil and plant health (test these with lab tests), destroy infected residue. Rotate wheat with other crops.

Kernel bunt

Use resistant or tolerant varieties or hybrids, maintain soil and plant health (test these with lab tests), destroy infected residue. Rotate wheat with other crops.

Armyworms

Use *Bacillus thuringiensis* spray to control.

Aphids
See aphids above under Rice.

BARLEY & SORGHUM

Same as above for maize.

Vegetables

POTATO

Early blight, *Alternaria solani*

According to http://www.ipm.ucdavis.edu/PMG/r607101311.html,

Management
Early blight can be minimized by maintaining optimum growing conditions, including proper fertilization, irrigation, and management of other pests. Grow later maturing, longer season varieties. Fungicide application is justified only when the disease is initiated early enough to cause economic loss. When justified, apply fungicides as soon as symptoms appear; continued protection requires application at 7- to 10-day intervals.

Late blight, *Phytophthora infestans*
Scouting procedures & set action thresholds (The number of pests or level of pest damage requiring action to prevent damage from exceeding tolerable levels).

Mosaic Diseases Caused By Potyviruses

According to http://www.ipm.ucdavis.edu/PMG/r607101411.html,

Management
"Use seed certified free from viruses or with very low incidence of infected tubers. Use resistant cultivars where possible."

Black scurf, *Rhizoctonia spp*.

According to http://www.potatodiseases.org/rhizoctonia.html,

Monitoring and control
"Currently it is not possible to completely control Rhizoctonia diseases, but severity may be limited by following a combination of cultural and crop protection strategies. Effective management of this disease requires implementation of an integrated disease management approach and knowledge of each stage of the disease. Although the most important measures are cultural, chemical controls should also be utilized."

Cultural control
"One of the keys to minimizing disease is to plant certified seed free of sclerotia. If more than 20 sclerotia are visible on one side of washed tubers, consider using a different seed source. Tuber inoculum is more important than the soil inoculum as the primary cause of disease. Seed growers should plant only sclerotia-free seed.
Following practices that do not delay emergence in the spring minimizes damage caused to shoots and stolons and lessens the chance for infection. Planting seed tubers in warm soil (above 46°F) and covering them with as little soil as possible speeds spout and stem development and emergence reduces the risk of stem canker. Plant fields with coarse-textured soils first because they are less likely to become waterlogged and will warm up faster.

Rhizoctonia does not compete exceptionally well with other microbes in the soil. Increasing the rate of crop residue decomposition decreases the growth rate of Rhizoctonia. Residue decomposition also releases carbon dioxide, which reduces the competitive ability of the pathogen. Since the fungus is not an efficient cellulose decomposer, soil populations are greatly reduced by competing microflora and less disease is observed.

Potatoes should be harvested as soon as skin is set so minimal bruising will occur. The percent of tubers covered with sclerotia increases as the interval between vine kill and harvest is lengthened. Vine removal or burning also reduces the amount of fungus overwintering and thus the amount of inoculum available to infect future potato crops. Do not dump infested tubers on future potato fields as they can become sources of inoculum."

Biological control
"There is growing evidence that a 'bio-fumigation' treatment based on incorporating a mustard cover crop is one way to reduce Rhizoctonia incidence. Mustard residues when incorporated into the soil release cyanide-containing compounds that fumigate the soil, but at the same time they also release carbon and nutrients that are the feedstock for soil organisms. Incorporating green cover crop tissues provides energy that supports the complex web of soil organisms that compete with parasite and disease organisms. Thus mustards, and related 'brassica' plant species such as oil-seed radish, do not leave a soil void of organisms. Instead, these cover crops tend to tip the balance in the favor of beneficial organisms and against parasites and pests.

It is important to maximize growth of the cover crop using a high seed rate (15 lb. acre or more) and irrigation to improve establishment if rainfall is insufficient. A tiny seed such as mustard cannot be drilled too deep. It appears to establish well if broadcast and harrowed or irrigated into sandy soil. The bio-fumigation benefits of mustard residues are maximized if they are incorporated at or just before flowering. We suggest that residues be mowed and incorporated while still green. Mustards are rapid growing species and can become a weed in a subsequent crop, so it is important not to let this cover crop produce seed."

Cutworm, Agrotis ipsilon

According to http://www.ipm.ucdavis.edu/PMG/r607300511.html,

Management
"Cutworms are not an annual problem, nor are they a problem in every field. Weed control in and around the field before planting will reduce cutworm problems through reduction of early season host plants. Treatment thresholds have not been established. Monitor the field to detect cut plants and foliar feeding early in the season. Later in the season, inspect plants for foliage damage. Also, shake the plants over a beating cloth placed in the row and inspect the beds and furrows for larvae, and inspect shallow set and exposed tubers for damage. Treatment is necessary where worms are abundant and before the tubers are damaged."

Armyworm

Monitor. Use *Bacillus thuringiensis* spray to control.

White grubs

White grub is generally much more of a problem in fields that have been out of production for several years. No good IPM tactics.

Aphids, Green peach aphid: *Myzus persicae*; Potato aphid: *Macrosiphum euphorbiae*

According to http://www.ipm.ucdavis.edu/PMG/r607300611.html,

Management
"Management of green peach aphid and potato aphid involves an integrated program of reducing overwintering populations, controlling weeds in and around the field, and the use of foliar sprays. Monitor to schedule spray treatments."

Biological Control
"Many parasites and predators attack aphids. Among the more common predators are lady beetles and their larvae, lacewing larvae, and syrphid fly larvae. Populations of green peach aphids are reduced in winter by a parasitic fungus, *Entomophthora aphidis*. Most materials available for aphid control are highly disruptive of natural enemy populations."

Cultural Control
"Weeds along ditch banks, roads, in farm yards, and other noncultivated areas contribute directly to the aphid problem. In northern areas, mustards serve as early season host plants where aphid populations increase before spreading to other host plants, including commercial potatoes.

It is also important to control nightshades and volunteer potatoes because these plants are reservoirs for potato leafroll virus. Rogue infected potato plants to reduce the incidence of infection and spread of the disease within a field. For maximum effectiveness remove the diseased plant, the three plants on each side of the diseased plant in the same row, and the three closest plants in adjacent rows. Rogueing is most important in seed fields. Plant disease-free seed to reduce the incidence of potato leafroll virus."

Monitoring and Treatment Decisions
"Inspect fields weekly during aphid migrations. Aphids are first found on those plants along the edge of the field toward the prevailing wind, usually the north or west edge of the field. Growers should make general observations to determine if aphids are present. Sample weekly throughout the growing season. Heavy populations normally occur late in the spring. In seed potato production, a preventive program using insecticide applications at 2 to 3 week intervals may be necessary." If there are established sampling methods and population thresholds in Pakistan, use these for making treatment decisions.

Jassids (leafhoppers)

Keep weeds controlled in and around the field.

Colorado potato beetle, *Leptinotarsa decemlineata*
Use plant varieties that are resistant to potato beetle.

TOMATO

Blights
Same as above for blights of potato.

Root rot, *Fusarium and Phytophthora spp*

In the field, planting disease-free transplants is the only recommended management practice for this disease. Limit spread of infested soil by cleaning equipment between fields. Provide good drainage and prevent flooding. Avoid wide fluctuations in soil moisture, which predisposes plants to infection. Keep tops of bed dry to avoid buckeye rot of the fruit. Planting cereals as a rotation crop may reduce the level of infestation in the soil. Resistant varieties are not yet commercially available.

Fruit rot (water mold), *Pythium ultimum* and other species

According to http://www.ipm.ucdavis.edu/PMG/r783101511.html,

"Avoid late-season irrigation, especially when threat of rainfall increases. Avoid wetting the top of beds when fruit is ripening. Shorter furrow irrigation runs and higher beds may lessen risk."

Cutworm, Variegated cutworm: *Peridroma and Agrotis spp.*

According to http://www.ipm.ucdavis.edu/PMG/r783301511.html,

Management
"Destroy plant residues before planting, especially when tomatoes follow a good host crop for the cutworms. Monitor fruit in combination with the beet armyworms damage sample or take a separate sample of the fruit touching the ground to detect damage are important strategies in managing these pests.

Cultural Control
"Cutworm incidence is often associated with residue of host plants remaining in the field before seeding. As most cutworm species have a wide host range, tillage at least 2 weeks before planting will help destroy plant residue that could harbor larvae. Herbicides will provide similar control of host plant material. Because cutworm damage is often localized within a field, reseeding affected areas of a field rather than treating the whole field might prove economical."

Organically Acceptable Methods
"Cultural control is an organically acceptable management tool."

Monitoring and Treatment Decisions
"Treat only when the presence of cutworms is detected. Cutworms are usually localized within a field, so consider marking the areas where damage is observed and treating only those areas."

Armyworm, Spodoptera spp.

According to http://www.ipm.ucdavis.edu/PMG/r783300311.html,

Management
"Beet armyworms are sometimes kept under control by natural enemies and a polyhedrosis virus. Take fruit samples to determine need for treatment."

Biological Control
"A nuclear polyhedrosis virus often reduces populations in fall and winter. *Hyposoter exiguae* is the most important parasite of beet armyworm. General predators such as bigeyed bugs and minute pirate bugs feed on eggs."

Organically Acceptable Methods
"Biological control and sprays of the Entrust formulation of spinosad and *Bacillus thuringiensis ssp. aizawai* are acceptable for use in an organically certified crop."

Monitoring and Treatment Decisions
"In processing tomatoes, begin sampling fruit when it has reached 1 inch or more in diameter. Treatment is not necessary prior to this size as the damaged fruit will fall from the plant and little yield loss will occur. Pick at least 100 fruit at random while walking through the field, being careful not to select red fruit when the majority of fruit are green. If damaged fruit are found, determine the amount of damage present and the size and species of the worms. Count fruit as damaged if it has any hole deeper than 0.1 inch (2.5 mm), if the hole is contaminated with feces, or if any larvae are present in the fruit. The treatment threshold is 3.25% damaged fruit. A sequential sampling technique is available to help reduce the number of samples required to reach a treatment decision.

In fresh market tomatoes, begin sampling when fruit appears. Pheromone traps are useful for determining when major flights occur, but not for predicting damage. A 5-minute timed search is useful in determining the need for treatment. On average, if one or more larvae or egg masses are found in 5 minutes, treatments may be justified. Picking large numbers of fruit each week and assessing percent damage may not be economically feasible. Ground applications provide maximum effectiveness of the pesticide."

Aphids

According to http://www.ipm.ucdavis.edu/PMG/r783301711.html,

Management
“Monitor potato aphids from 6 to 8 weeks before harvest as well as the level of parasitism and the activity level of predators. Treatments may be necessary if natural enemy activity is low and populations are increasing.”

Biological Control
“Naturally occurring parasites and predators of the potato aphid are common and can provide control. Monitor the proportion of aphid mummies relative to unparasitized aphids and the numbers of predators such as lady beetles, lacewing larvae, and syrphid larvae. If the proportion of mummies is increasing or predators appear to be gaining control and aphid populations are not yet damaging, avoid sprays that will disrupt these natural enemies.”
Tolerant Varieties
“There is considerable difference in tomato variety susceptibility to potato aphid feeding. Varieties containing the MI gene, which confers resistance to nematodes, have been reported to be more tolerant of potato aphid infestations. However, this resistance no longer appears to be as effective as it once was, particularly against the pink form of the potato aphid.”

Organically Acceptable Methods
“The use of tolerant varieties, biological control, and sprays of herbal oils, pyrethrin, or insecticidal soap are acceptable for use on an organically certified crop. Repeated applications may be necessary for control.”

Monitoring and Treatment Decisions
“Monitor potato aphids from bloom to early fruit set by picking the highest open flower on 30 plants selected at random throughout the field. Record on a monitoring form (100K, PDF) the presence or absence of potato aphids on each leaf, while noting natural enemies. Treatment is warranted if 50 to 60% or more of the leaves are infested. During late fruit set, combine monitoring for potato aphid with monitoring for tomato fruitworm : pick the leaf below the highest open flower on 30 randomly selected plants from throughout the field. Record observations on a monitoring form (100K, PDF). If 50% of these leaves are infested during the period 6 to 8 weeks before harvest, the resulting loss is about 1 ton per acre. Good spray coverage is important in controlling high populations. Ground sprays using hollow-cone nozzles or air-assist sprayers will provide the best canopy penetration. Higher spray volumes are also helpful.”

Jassids (leafhoppers)

Keep weeds controlled in and around the field.

Tomato fruitworm (fruit borer), *Helicoverpa (Heliothis) zea*
Careful monitoring for eggs and small larvae, treat before large numbers of larvae enter fruit, where they are protected from sprays, biocontrol agents Trichogramma parasitic wasps and other natural enemies often destroy significant numbers of eggs, so monitor for these (presence and quantity), sprays of Bacillus thuringiensis and the Entrust formulation of spinosad.

Alternaria, *Alternaria alternata f. sp. lycopersici*
Use resistant tomato varieties.

Phytophthora, *Phytophthora parasitica* and *P. capsici*
Provide good soil drainage and prevent flooding. Avoid wide fluctuations in soil moisture. use crop rotation. Resistant varieties are not yet commercially available.

Fusarium, *Fusarium oxysporum f. sp. lycopersici*
Use resistant tomato varieties. Monitor for and control root knot nematode infestations—nematode feeding reduces plant resistance to Fusarium wilt. Use crop rotation to reduce inoculum level.

ONION

Onion maggot, *Delia antiqua*
Monitor adult fly populations with yellow sticky traps. High organic matter and fresh manure in the soil attract the flies. Avoid planting fields that have high un-decomposed organic matter, such as ones that were just pasture or weedy. Don't repeatedly plant onion after onion; Rotate onion with other crops.

Mole cricket, *Gryllotalpa spp*
Biological control using parasitic wasps, flies and nematodes has worked well in Florida.

Purple blotch, *Alternaria porri*

Maintain soil moisture using raised bed production and drip irrigation. Monitor and spray when needed.

Root rots

Maintain soil moisture using raised bed production and drip irrigation. Monitor and spray when needed.

Thrips, *Thrips tabaci*

According to http://www.ipm.ucdavis.edu/PMG/r584300111.html,

"Biological Control
Natural enemies, including predaceous mites, minute pirate bugs, and lacewings are often found feeding on thrips. These beneficials are very susceptible to insecticide sprays, however, and may not be important in fields where insecticides have been used.

Cultural Control
Avoid planting onions near grain fields, if possible, because thrips numbers often build up in cereals in spring. Overhead irrigation and rainfall provide some suppression of thrips populations, but treatments are often still necessary.

Organically Acceptable Methods
Biological and cultural controls as well as sprays of the Entrust formulation of spinosad are acceptable for use on organically certified crops.

Monitoring and Management Decisions
Although thrips feeding during the early bulbing stage is the most damaging to yields, thrips must be controlled before onions reach this stage so that populations do not exceed levels that can be adequately controlled. Onions can tolerate higher thrips populations closer to harvest; however, in the case of hand-topped onions, thrips can be extremely annoying to harvest crews and treatment closer to harvest may be desirable."

Bollworm

Use mating disrupting pheromone release. Use BT spray when first instar larvae are present.

Budworm, *Heliothis virescens*

Biological Control
Many predators and parasites combine to substantially maintain Heliothis populations at low levels. Insecticide sprays for other pests will disrupt this natural control.

Organically Acceptable Methods
Biological controls, cultural practices that promote early harvest, and sprays of Bacillus thuringiensis are acceptable for use on organically grown onions.

Armyworm, *Spodoptera* species

Monitor. Use *Bacillus thuringiensis* spray to control only when pest is present.

FRENCH BEANS

Root rot, *Fusarium* species

Cultural Control
Long-term (3 years) crop rotation out of beans may reduce soil inoculum. Provide optimal growing conditions, avoiding stress caused by excess water, prolonged drought, soil compaction, etc. Although no bean line is immune, some cultivars are more tolerant to the disease than others.

Fruit borer

Scout and monitor. Use *Bacillus thuringiensis* spray to control only when pest is present.

Aphids

See above under aphids.

PEAS

Powdery mildew

According to http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn7406.html,

Use Resistant Varieties
"In some cases, varieties resistant to powdery mildew may be available. If available, plant resistant varieties of cantaloupe, cole crops, cucumber, melons, peas, pumpkins, and squash. If you plant more susceptible varieties, you may need to take control measures.

Cultural Practices
Plant in sunny areas as much as possible, provide good air circulation, and avoid applying excess fertilizer. A good alternative is to use a slow-release fertilizer. Overhead sprinkling may help reduce powdery mildew because spores are washed off the plant. However, overhead sprinklers are not usually recommended as a control method in vegetables because their use may contribute to other pest problems."

Pod borer

Scout and monitor. Use *Bacillus thuringiensis* spray to control only when pest is present.

Leaf miner, *Liriomyza species*

According to http://www.ipm.ucdavis.edu/PMG/r584300511.html,

Use Biological Control
"Natural enemies, especially parasitic wasps, are commonly found reducing leafminer numbers. These parasitic wasps are very susceptible to insecticide sprays, however, and may not be important in fields where insecticides have been used.

Cultural Control
Leafminers attack a wide variety of crops. Close proximity to crops such as lettuce, celery, or spinach will increase the potential for damage by leafminers in other crops like peas. It is also important that fields being planted to peas that were previously in one of these susceptible crops be worked thoroughly and that sufficient time be allowed to pass before planting into these fields to allow pupae in the soil to emerge.

Organically Acceptable Methods
Biological controls are often effective in controlling this pest in organically grown onion and garlic crops. Supplemental or inundative releases of parasites are rarely economically justified. Cultural controls as described above are critical. Neem products are allowed as restricted use materials.

Monitoring and Management Decisions
Because large populations of adults do not always lead to large larval populations, make management decisions based on the level of larval infestations on the plants."

CAULIFLOWER

Fusarium wilt

According to http://www.ipm.ucdavis.edu/PMG/r108100611.html,

Known infested fields should be planted to cauliflower only in winter or early spring. Some cauliflower cultivars may be more tolerant to Verticillium wilt than others. Avoid introducing the pathogen into clean fields. Planting broccoli, a non-host of V. dahliae, may help reduce pathogen levels; decaying broccoli residue, when disced into the soil, either gives off natural chemicals that can kill V. dahliae or alters the soil microflora so that V. dahliae survival is reduced.

Aphids

According to http://www.ipm.ucdavis.edu/PMG/r108300811.html,

Management
"Cultural practices and biological control agents can reduce aphid infestations and delay or prevent the need for pesticide use. Try to delay using insecticides for as long as possible while maintaining yields and quality. Most fields require at least one application against aphids at preheading; however, if you can delay applications until just before head formation, you will save the expense of additional applications and may also be able to maintain the natural enemies that will keep caterpillar pests, including loopers, imported cabbageworms, armyworms, and diamondback moths, below economically damaging levels.

Biological Control
Cabbage aphids have many natural enemies and these can sometimes control low populations; however, short crop life, use of pesticides for other pests, the tendency for the aphids to be deep within the head, and various other factors make it difficult for natural enemies to keep rapidly rising aphid populations from reaching economic levels. Important natural enemies include lady beetles, syrphid fly larvae, fungal diseases, and the parasitic wasp, Diaeretiella rapae. Protect habitat for natural enemies so that they can survive and increase their population levels.

Cultural Control
Destroy crop remnants immediately after harvest and remove or control alternate hosts, including mustards and related weeds, around field borders. Infestations on Brussels sprouts can start in seedling beds, so be sure transplants are clean before taking them to the field. Roguing (removal and destruction) of infested plants from the field can be effective early in the crop cycle.

Organically Acceptable Methods
Biological and cultural control are organically acceptable, as well as sprays of insecticidal soap, which can give partial control. Soap sprays, however, may be phytotoxic under some conditions, especially in Brussels sprouts and cabbage. For most effective control, apply during foggy conditions.

Monitoring and Treatment Decisions
Check each field at least twice a week. A sequential sampling program is available for Brussels sprouts. Sample upwind field borders and edges next to other crucifers first; this is where aphids tend to appear first. If no aphids are found, you may not need to take field samples. Take field samples in a zigzag pattern. Remember to check all quadrants of the field because aphid populations are often clumped.

Cabbage, broccoli, and cauliflower. Check for cabbage aphid in the youngest, highest, and innermost leaves of young plants. After heading, check the flowering parts of broccoli and cauliflower and pull back wrapper leaves of cabbage. Also check for natural enemies. Broccoli and cauliflower crops can tolerate up to 100 aphids per plant up to heading. Once heads begin to form, cabbage aphids must be controlled even if only a few are present. Because of the overlapping growth of their leaves, cabbage crops require more careful management and have less tolerance for aphids even during the early vegetative stages; treat as soon as 1 to 2% of plants are infested with one or more aphids. After treating, recheck fields frequently and treat if populations reappear."

Diamond-back moth

According to http://www.ipm.ucdavis.edu/PMG/r108301311.html,

Management
"Natural enemies and insecticides applied to control other pests keep the diamondback moth under satisfactory control in most fields, but keep records of diamondback moth as you monitor for other caterpillars.

Biological Control
Natural enemies often effectively control diamondback moth. *Ichneumonid* wasps are often effective parasites and *Trichogramma* wasps may attack diamondback eggs. Various predators such as ground beetles, true bugs, syrphid fly larvae, and spiders can be important factors in controlling populations. Microbial diseases are not known to be a significant mortality factor.

Organically Acceptable Methods
Biological control and sprays of Bacillus thuringiensis and the Entrust formulation of spinosad are organically acceptable management tools.

Monitoring and Treatment Decisions
Check fields during the seedling stage, at thinning, and just before heading. Also, record diamondback larvae numbers when you make your twice-weekly samples for other caterpillar pests. In cabbage fields, regularly monitor wrapper leaves for damage after heading. Adult moths frequently migrate from fields being harvested or disced under, so carefully check border rows if populations were high in adjacent fields. No treatment levels have been developed for diamondback moth; however, treatment may be required if significant injury to growing points is occurring."

CUCUMBER

Powdery mildew

According to http://www.ipm.ucdavis.edu/PMG/r116100711.html, "Plant resistant varieties, follow good sanitation practices, and control weeds. Carefully monitor fields, even those with powdery mildew resistant varieties, because there is recent evidence that plant resistance-breaking races are present. If multiple fungicide applications are needed to control powdery mildew, alternate materials with different modes of action especially if using fungicides with medium to high resistance potential (azoxystrobin-Quadris, myclobutanil-Rally, pyraclostrobin/boscalid-Pristine, trifloxystrobin-Flint, and trifumizole-Procure). Apply a treatment when disease symptoms first occur and repeat if symptoms reappear."

Downy mildew

According to http://www.ipm.ucdavis.edu/PMG/r116101611.html, "Use resistant cucumber varieties. There are low levels of resistance in some varieties of melons and watermelons. Avoid overhead irrigation. Apply a treatment when disease symptoms first occur and repeat if symptoms reappear."

Aphids, green peach aphid

According to http://www.ipm.ucdavis.edu/PMG/r116300611.html,

"Management
Silver reflective mulches have successfully been used to repel aphids from plants, thus reducing or delaying virus transmission. In some areas of the state, row covers have also been successfully used. Biological control can have a significant impact on aphid population so be sure to evaluate predator and parasite populations when making treatment decisions.

Biological Control
Naturally-occurring populations of the lady beetles may provide effective control in early spring. Releases of this beetle are not effective, however, because it generally does not remain in the field following release. Other general predators, such as lacewing and syrphid larvae, and parasitic wasps, including Aphidius, Diaeretiella, and Aphelinus species, also attack aphids. Biological control is not effective in reducing virus transmission by this aphid.

Cultural Control
Silver reflective plastic mulches applied at planting are effective in repelling aphids from plants, thereby reducing or delaying virus infection. Mulches help plants get off to a healthy start, and are effective until expanding foliage covers the reflective surface. Mulches may need to be removed in the desert areas when summer temperatures are excessive for optimal growth of plants. However, in cooler areas, mulches have not caused plant damage in the summer; in fact, they improve soil moisture and nutrient retention, which may further aid plant productivity.

Control weeds along ditch banks, roads, in farm yards, and other noncultivated areas that contribute directly to the aphid problem. Planting a habitat for beneficial insects, such as sweet alyssum, around the field may be helpful. Delay planting until warm temperatures (80° to 85°F) occur and the spring flight of aphids is over. Do not over fertilize with nitrogen.

Organically Acceptable Methods
Biological and cultural controls and treatments of insecticidal soaps and certain narrow range oils are acceptable to use in an organically certified crop.

Monitoring and Treatment Decisions
The decision to treat for aphids is based mainly on visual counts; measurable thresholds have not been researched. It is important to treat early to insure that the aphids do not build up to high levels. Early treatment does not prevent virus introduction; treating, however, may help reduce spread of the virus if aphid colonies are present. Be aware, however, that parasites and predators, if present, may prevent an infestation from becoming established throughout a field, thus eliminating the need to treat."

Fruit fly (vinegar flies), Drosophila spp.

According to http://www.ipm.ucdavis.edu/PMG/r116302311.html, "Vinegar flies breed in any fermenting or decaying fruit but do not affect undamaged fruit. Remove or disc under damaged fruit to reduce the population. Harvest rapidly and early to reduce exposure of fruit to infestation. Sanitation is key to control."

Oil crops

CANOLA (RAPESEED)

IPM at: http://www.canola-council.org/berthabiological.aspx

Armyworm

Monitor and forecast presence. Control weeds in and around field. Use crop rotation, early swathing, and fall cultivation (except where soil is very susceptible to erosion).

Aphids

Monitor and forecast presence. Several beneficial insects, like the ladybird beetle and lacewing feed primarily on aphids. Aphid populations increase as aphid populations increase, usually in numbers sufficient to control the aphids. Application of pesticides is not economical, given that damage is usually limited to the last few pods formed, which contribute little to yield. Spraying may also reduce the numbers of beneficial insects which generally provide natural control of this insect.

Fiber crops

COTTON

Bollworms/Armyworms/Budworms, various species
Use BT cotton. Quickly destroy crop residue immediately following harvest. Plow-down requirements and cross disc or plow to a depth of at least 15 cm. Winter irrigate (flood field) in December and rotate to small grains or newly seeded alfalfa. Early spring irrigation to promote early moth emergence (before cotton squares). Use pheromone release/mating disruption.

Fruit and Edible Nuts

APPLE

Coddling moth, *Cydia (Laspeyresia) pomonella*
Sanitation-remove infested & dropped apples, oil spray on apples when females fly, mass trapping, trunk banding, mating disruption, pruning for height.

San Jose scale, *Diaspidiotus (Quadraspidiotus) perniciosus*
Monitor & use degree-day models, biocontrol, dormant oil sprays.

Green Apple Aphid, *Aphis pomi*
Biocontrol, insecticidal soap, dormant oil spray.

European Red Mite, *Panonychus ulmi*

Monitoring & timing of dormant oil sprays, irrigate & reduce dust, abamectin bacterial product.

Apple Lygus bug

According to http://www.ipm.ucdavis.edu/PMG/r4300411.html,
"Management
The potential for a lygus bug population to cause damage is difficult to assess. Lygus bugs may be present in substantial numbers in the orchard and cause no damage; however, they can often cause damage and may attack fruit at any time from petal fall to harvest. Annual preventive treatments are costly and subject to failure because lygus bugs have been quick to develop resistance to chemicals. In orchards with a history of lygus damage, monitor fruit at least biweekly between petal fall and harvest to assess need for treatment.

Biological Control
The role of predators and parasites in controlling lygus in orchards has not been investigated, but in cotton and strawberries, beneficials have been shown to be helpful.

Cultural Control
Eliminate or suppress weed host plants before fruit forms on trees and thereafter throughout the growing season to minimize lygus populations. Yellow starthistle, Russian thistle, tarweed, sweet clover, wild mustard, lambsquarters, pigweed, shepherd's-purse, wild radish, and vetch are important hosts. Do not mow cover crops or weeds when lygus bugs are present or they will move into the trees."

Scab of apple, *Venturia inaequalis*
Timing: early control with sulfur or lime-sulfur, monitoring/degree day-humidity modeling/prediction, fall foliar fertilizer application.

Powdery mildew, *Podosphaera leucotricha*
Timing: early control with sulfur or lime-sulfur, monitoring/degree day-humidity modeling/prediction, fall foliar fertilizer application, pruning off diseased parts.

Sooty blotch

PEAR

Codling moth, *Cydia (Laspeyresia) pomonella*
Sanitation-remove infested & dropped apples, oil spray on apples when females fly, mass trapping, trunk banding, mating disruption, pruning for height.

Leafroller moth, *Platynota stultana*
Sampling/monitoring, spray Bacillus thuringiensis (BT).

Pear Psylla, *Cacopsylla (Psylla) pyricola* (secondary pest after coddling moth spray)
Monitor, predict, and maintain low populations, biological control, resistant rootstock, sprays with dormant petroleum oil, insecticidal soap, azadirachtin, kaolin clay.

Scab of pear, *Venturia pirina*
Monitor, predict outbreaks with degree-day temperature/humidity model, Reduce or prevention of primary infections in spring, apply lime sulfur in delayed dormant period, cultivate leaves into soil.

Fireblight, *Erwinia amylovora*

According to http://www.ipm.ucdavis.edu/PMG/r603100211.html,

"Management
Fire blight development is influenced primarily by seasonal weather. Warm spring weather, accompanied by intermittent rain and hail, is ideal for disease development. Other influences on disease development are the varieties and rootstocks used in the orchard, location of the orchard, application of too much nitrogen fertilizer, heavy pruning, or over-irrigation. Management relies on maintaining trees in the proper range of vigor, applying blossom sprays of antibiotics or copper that are supplemented with the A506 bacteria, and most importantly, promptly finding, removing, and destroying blight strikes.

Blossom applications of copper materials or the antibiotic streptomycin and terramycin are necessary in pear-growing areas to reduce the spread of fire blight bacteria. The timing of the first application is critical…average daily temperatures or degree-hours are used to schedule fire blight sprays. For detailed information on these methods, see Integrated Pest Management for Apples and Pears, 2nd ed., UC ANR Publ. 3340.

Biological Control
The antagonistic bacteria *Pseudomonas fluorescens* (Blight Ban A506) is commercially available to prevent colonization of the blossoms by *Erwinia amylovora* during bloom. It is most effective when used in conjunction with antibiotic treatments such as streptomycin.

Cultural Control
One active overwintering canker located high in a tree can cause infection of surrounding trees, and a few such cankers per acre will render a preventive spring/summer spray program ineffective. Remove and destroy holdover cankers and diseased limbs by cutting at least 8 to 12 inches below signs of visible injury. This helps to stop disease movement in the tree and reduces the source for new infections. Be sure to sterilize pruning shears and saws whenever they come into direct contact with diseased tissues and periodically throughout pruning.

Organically Acceptable Methods
Organically acceptable methods include cultural and biological controls along with sprays of terramycin, streptomycin, some copper products, and Bordeaux.

Monitoring and Treatment Decisions
Several mean temperature and degree-hour models are available to assist in predicting infection periods and the need for control. All are based on the minimum and maximum temperature thresholds above and below which bacterial growth and subsequent infection ceases."

San Jose scale, *Diaspidiotus (Quadraspidiotus) perniciosus*
Monitor & use degree-day models, biocontrol, dormant oil sprays.

Fruit fly, Rhagoletis pomonella

According to http://www.ipm.ucdavis.edu/PMG/r603301911.html,

"Apple maggot is a minor pest of pears. If spray treatments are needed, they are aimed at the adult stage.

Biological Control
Because the apple maggot feeds within fruit, biological control agents have not been very effective.

Organically Acceptable Methods
Baited sprays such as GF-120 are organically acceptable.

Monitoring and Treatment Decisions
Emergence and dispersal of adult flies must be carefully monitored to effectively time treatments. Sticky traps, including yellow rectangles and red spheres, are used in other areas to monitor adults and time treatments. Unfortunately, only provisional economic thresholds are available for apple maggots, even in areas where it has long been a pest. You can detect the first emergence of adults by hanging yellow sticky traps in abandoned orchards or unsprayed apple trees in infested areas. To detect the beginning of egg laying, hang red sticky spheres in apple trees, then treat as soon as the first fly is found…some orchards are now being treated regularly for apple maggots, the first maggot spray is applied 7 to 10 days after the first fly has emerged. Later sprays follow at 10-to 14-day intervals as long as adults are active and are being caught in traps."

Spinosad and Nu-Lure Insect Bait impregnated with phsomet are low-impact chemical controls.

Pear Rust, *Gymnosporangium libocedri*

Remove alternate host plants near orchard.

PEACH/APRICOT/PLUM

Oriental fruit moth, *Grapholitha molesta*

Degree-day & pheromone trap monitoring, mating disrupting pheromones and sprays of the "Entrust" formulation of spinosad, biological control & sunflower planting.

Green Peach Aphid, *Myzus persicae*
Dormant oil sprays.

Stem borers

For peach tree borer, pheromone traps are available to monitor adult emergence.

For shothole borer, according to http://www.ipm.ucdavis.edu/PMG/r602301511.html, "Maintaining healthy trees and preventing sunburn are the keys to preventing damage by shotholeborer. Painting the trees with white wash or a 50:50 mixture of white interior latex paint and water will help prevent sunburn and possibly inhibit egg laying. Avoid pruning during summer, and prune trees so that scaffolds are shaded to prevent sunburn. Remove horizontal scaffolds when pruning/thinning young trees.

Protect newly planted or newly grafted trees from sunburn by painting the trunk and graft with white interior latex paint or using tree wrappers around the trunk. If paint is used, be sure to mix it with water; undiluted latex paint can kill young trees. Thin the latex paint to a mixture of one-half water and one-half latex paint and paint the trunk from 2 inches below ground level to 2 feet above.

Prune to eliminate areas in older trees infested with shothole borer. Remove severely infested trees. Burn or remove all infested wood from the orchard before the growing season starts. Do not leave pruned limbs or stumps (healthy or infested) near orchards (for example, in woodpiles) as populations can emerge from these materials before they dry out, and beetles will then migrate into orchards. There are no insecticide treatments recommended for this insect."

Peach Twig borer, *Anarsia lineatella*

According to http://www.ipm.ucdavis.edu/PMG/r602300611.html, "Within an IPM program, the preferred management strategy for peach twig borer is well-timed treatments of environmentally sound insecticides around bloom time. These include Bacillus thuringiensis, spinosad (Entrust, Success), methoxyfenozide (Intrepid), and diflubenzuron (Dimilin). Bloom time applications integrate well with brown rot treatment, thus helping to cut application costs. Bloom sprays are preferred over in-season sprays in an IPM program because they have less adverse impact on beneficials and nontarget organisms.

Alternatively, peach twig borer can be controlled with a spray in the delayed dormant season to kill overwintering larvae in the hibernacula. Organophosphates and pyrethroid insecticides have traditionally been used but these should be avoided because they pose surface water quality concerns and may pose some risks to raptors, aquatic invertebrates, beneficials, and other nontarget organisms. Dormant sprays of oil plus spinosad (Entrust, Success) or diflubenzuron (Dimilin) do not present these environmental problems. Dormant sprays of oil alone or oil

combined with an insecticide, however, have the advantage of controlling some other stone fruit pests, especially mites and San Jose scale. (Oil alone does not control peach twig borer.) Mating disruption during the growing season can also be used to supplement dormant sprays."

Termite

Management:
Sanitation: destruction of infested plants
IGRs (insect growth regulators): Gentrol, Nyguard, Precor, Nylar, Hydroprene, Methoprene)
Baits: wood stakes treated with borates
Deep plowing, dig out queen, grinding fish bones and placing dry meal underground to attract ants that reduce termites, insecticide seed treatment.
Hand dig out nest to kill queen, insecticide poured into nest, use composted instead of fresh mulch.

Root rots

For *Armillaira* root rot, according to http://www.ipm.ucdavis.edu/PMG/r602100811.html, "Avoid planting peach orchards where forest or oak woodland has recently been cleared or where there is a history of Armillaria root rot. All rootstocks can be attacked by Armillaria mellea but some are less affected than others. Maintain the vigor of the trees to help resist Armillaria attack. Infested sites can be fumigated, but often this procedure will not prevent recurrence of the disease. Physical barriers to contain infection centers have been used successfully in orchards. Four-foot trenches are dug around the infection center and plastic tarp is laid inside the trench wall from bottom to top before the soil is replaced. The tarp prevents healthy roots from coming in contact with diseased ones, thus preventing spread of the disease."

For *Phytophthora* root rot, according to http://www.ipm.ucdavis.edu/PMG/r602101111.html, "The most effective ways to manage Phytophthora root and crown rot are to select a good planting site, select an appropriate rootstock, and properly manage irrigation water. Avoid over irrigating in spring and fall when soil temperatures are most conducive to disease development and water use by the tree is low.

Powdery mildew

According to http://www.ipm.ucdavis.edu/PMG/r602100511.html, "Management of powdery mildew on peaches focuses on protecting fruit from infections. Watch for the disease during routine monitoring. Avoid growing peaches near apple varieties that are highly susceptible to powdery mildew, such as Jonathan, Gravenstein, and Rome Beauty. If nearby apples are expected to cause mildew problems on peaches, control the disease on apples or apply a fungicide to peaches at jacket split."

Shot hole disease, *Clasterosporium carpophilum*
Sanitation.

Leaf curl, *Taphrina deformans*
Bordeaux mixture, pruning diseased parts.

Gummosis (canker)

According to
http://www.mobot.org/gardeninghelp/plantfinder/IPM.asp?code=58&group=21&level=s,

"1. Be careful not to damage trunks with lawn mowers or other yard and garden equipment. Fungal spores enter the tree through injured tissue where they germinate and penetrate the tissue. This is the primary mode of infection.

2. Take steps to prevent winter injuries. Plant in well-drained soils or amend soils to improve drainage as needed. Avoid planting in open or windy areas to reduce desiccation. Select winterhardy cultivars matched to your hardiness zone. Paint the lower branches and trunks of 1–3 year old trees with white latex paint to reduce cold damage.

3. Proper care and maintenance. Prevent insect boring damage by maintaining the health of the tree. Prune and dispose of diseased branches in late winter. Burn infected wood, if possible.

4. Plant more resistant varieties. None of these are immune, but fungal development is slower if the disease becomes established."

CITRUS

Citrus canker

According to http://www.ipm.ucdavis.edu/PMG/r107100411.html, "Management of Phytophthora gummosis focuses on preventing conditions favorable for infection and disease development. All scion cultivars are susceptible to infection under the right environmental conditions.

Cultural Control
Plant trees on a berm or high enough so that the first lateral roots are just covered with soil. Correcting any soil or water problems is essential for a recovery. In addition to improving the growing conditions, you can halt disease spread by removing the dark, diseased bark and a buffer strip of healthy, light brown to greenish bark around the margins of the infection. Allow the exposed area to dry out. You can also scrape the diseased bark lightly to find the perimeter of the lesion and then use a propane torch to burn the lesion and a margin of 1 inch (2.5 cm) around it. Recheck frequently for a few months and repeat if necessary.

Organically Acceptable Methods
Cultural controls and copper treatments are acceptable for use on organically certified citrus.

Monitoring and Treatment Decisions
Late stages of Phytophthora gummosis are distinct, but early symptoms are often difficult to recognize. Yet early detection and prompt management actions are essential for saving a tree. If 50% or more of a trunk or crown region on a mature tree is girdled, it is more economical to replace the tree than to try to control the infection.

When establishing a new orchard, carefully check the lower trunk and rootstock of new trees for any symptoms of gummosis before you plant. When trees are wrapped in burlap, open and inspect a representative sample (at least 10% of the trees). When planting or replanting in soil infested with Phytophthora, or when a susceptible rootstock has to be used, fumigation may be helpful.

Inspect your orchard several times a year for disease symptoms. Look for signs of gumming on the lower trunk and crown, and for soil buildup around the crown; do not allow bud unions to get buried. Wrappers on young trees should be lifted or removed for inspection. When you detect gum lesions, check soil and drainage conditions. Systemic fungicides can control Phytophthora gummosis and copper sprays can be used to protect against infection."

Citrus Die Back (transmitted by Asian Citrus Psyllid, *Diaphorina citri***)**

Classical biological control using parasitoids of the psyllid vector should contribute to the suppression of psyllid populations.

Citrus Leaf-miners, *Phyllocnistis citrella*

According to http://www.ipm.ucdavis.edu/PMG/r107303211.html,

"Management
Mature Citrus Orchards (more than 4 years old). While the new flush of mature trees may be heavily damaged by citrus leafminer and look unsightly, yield and tree growth will be unaffected. Therefore, insecticide treatments are generally not needed for mature citrus orchards. Worldwide, citrus leafminer populations are fairly well-controlled by parasitic wasps. Do not spray citrus with broad-spectrum insecticides and avoid other practices that disrupt natural enemies whenever possible to encourage natural enemies. Citrus peelminer and leafminer share many of the same parasites including Cirrospilus and Pnigalio species.

Young Citrus Orchards (more than 4 years old). Because citrus leafminer can retard the growth of young trees, apply insecticides to nursery citrus trees and new plantings of citrus. Imidacloprid (Admire) applied through the irrigation for young trees or to the soil of potted citrus provides the longest period of control (1 to 3 months). The length of control depends on tree spacing and soil and irrigation conditions. Time applications of Admire to protect periods of flushing.
Foliar insecticides suppress citrus leafminer for shorter periods of time (several weeks) compared to Admire. Foliar treatments are effective for only 2 to 3 weeks because citrus leafminer adults lay eggs on new flush growth that was not present at the time of treatment. Oil has been shown to

work as a temporary oviposition deterrent in nursery settings but should be used with care to avoid phytotoxicity. Diflubenzuron (Micromite) is effective primarily against eggs and larval stages."

San Jose scale, *Diaspidiotus (Quadraspidiotus) perniciosus*
Monitor, biocontrol, dormant oil sprays.

Red Mite, *Panonychus citri*
Keep trees irrigated or watered well, biological control, do not over-spray pesticides, natural viral control. Dicofol and pyridaben are less toxic to predators than other miticides. Oil sprays.

Black spot, *Guignardia citricarpa*
Prevent by spraying. No good IPM methods.

WALNUT

Bacterial blight, *Xanthomonas campestris pv. juglandis*

According to http://www.ipm.ucdavis.edu/PMG/r881100111.html, "Control of this disease depends on the application of protective sprays to newly developing nuts. In orchards with histories of walnut blight damage, protective treatments at 7- to 10-day intervals during prolonged wet springs are necessary for adequate protection. In areas or years with less intensive rainfall, spray intervals can be stretched, and weather reports can help with spray timing.

Make the first application when the first pistillate flower emerges. The pistillate flowers are the small nutlets that form after a few leaves emerge. Additional sprays should be applied as discussed above. Walnuts are susceptible to blight infections well beyond the pistillate bloom period whenever free moisture occurs. Additional sprays are often necessary, but they must be applied before rain for maximum benefit. The total number of sprays required depends on the judgment of the grower based on disease history and climatic conditions. The success of alternate row spraying during early bloom and leafing depends upon the ability of the machinery to deliver sufficient copper material with good coverage to trees of both target rows."

Stem borer

Prune out all badly infested wood and burn or remove it from the orchard before the growing season starts. Spraying for this insect is not recommended.

Fruit borer

According to http://www.ipm.ucdavis.edu/PMG/r881301111.html,

“A good sanitation program is essential for navel orangeworm management. There are three phases to the program:

Reduce overwintering populations by removing remaining nuts from trees and flailing or burning all crop waste containing nuts. This includes removing all mummy nuts found in the trees during the dormant period, all windfall and huller waste materials found in the field, and all waste materials cleaned up from bins, hulling and drying equipment, and buildings after harvest and dehydration.

Reduce damaged nuts that allow entry of naval orangeworm and population increase during the season by controlling both walnut blight and codling moth, especially second generation.

Harvest as early as possible. Use of ethephon to advance husk splitting is advantageous, particularly during heavy worm populations or prolonged dry falls.

Dry nuts immediately and either fumigate on the farm, if stored, or ship immediately to a facility where fumigation will be performed.”

Termites
Same as above for termites.

GRAPES

Downy mildew, *Plasmopara viticola*

According to http://www.ipm.ucdavis.edu/PMG/r302101111.html,

“Preventive management consists of effective soil drainage and reduction of sources of overwintering inoculum. In a vineyard that depends on sprinkler irrigation, extend the interval between irrigations as long as possible.

Fungicides for use against downy mildew can be categorized as either preventive or curative. The preventive fungicides (mancozeb, maneb, and copper compounds) must be applied before an infection period begins. New growth following application will not be protected. Include a spreader/sticker agent to prevent the material from washing off with rain. In vineyards with a history of downy mildew, apply early season copper sprays as part of a preventive program, especially during wet springs.”

Powdery mildew,

According to http://www.ipm.ucdavis.edu/PMG/r302100311.html,

“Season-long control is dependent upon reducing early-season inoculum and subsequent infection. Thus treatment must begin promptly and be repeated at appropriate intervals. Timing of the first treatment depends on fungicide used and growth stage. Frequency of treatment thereafter depends on fungicide choice and weather conditions. Monitor and use the risk assessment index (RAI) model to determine necessary spray intervals. Treatment may be discontinued for wine and raisin grapes when fruit reaches 12 Brix but should be continued up to harvest for table grapes.

All powdery mildew fungicides, with the exception of oil, are best used as protectants. Discontinue the use of soft chemistry products (sulfurs, biologicals, systemic acquired resistance products, and contact materials) when disease pressure is high because by themselves they will not provide adequate control. If eradication is necessary, a light summer oil may be used anytime in the season if there is no sulfur residue present (i.e. at least 2 weeks after a sulfur treatment). Basal leaf removal can improve coverage and efficacy of powdery mildew fungicides on clusters.

Organically Acceptable Methods
Sulfur, Serenade, Sonata, and Organic JMS Stylet Oil are acceptable on most organically certified grapes; check with your certifier for details.

Monitoring and Treatment Decisions
In spring, the overwintering cleistothecia produce ascospores, which are the primary source of infection. Ascospores are released when 0.1 inch of rain or irrigation is followed by 13 hours of leaf wetness when temperatures are between 50 and 80°F. Seven to 10 days after this initial infection, monitor vineyards for the presence of powdery mildew by collecting 10 to 15 basal leaves from 20 or so vines at random and examining the undersurface for powdery mildew spores. If spores are found, then monitor disease development by using the powdery mildew risk assessment index.

Resistance Management
Alternating fungicides with different modes of action is essential to prevent pathogen populations from developing resistance to fungicides. This resistance management strategy should not include alternating or tank mixing with products to which resistance has already developed. Do not apply more than two sequential sprays of a fungicide before alternating with a fungicide that has a different mode of action.”

Jassids (leafhoppers, vectors of disease)

According to http://www.ipm.ucdavis.edu/PMG/r302300111.html,

“Although leafhoppers infest most vineyards, they may not require chemical treatment because vines can tolerate fairly high populations without harm, and predators and parasites may be able to maintain leafhopper populations below tolerance levels. Grape leafhopper populations may occasionally reach damaging levels and require treatment. If chemical control of leafhopper is necessary, wait until the second (summer) generation, whenever possible, before treating.

Biological Control
Egg parasites, including Anagrus epos and other Anagrus spp., are commonly found in vineyards during part of the season. These parasites may be more abundant in vineyards that are adjacent to prune, plum and almond orchards, and riparian areas where other leafhoppers that overwinter in the egg stage reside. Anagrus spp. can parasitize these eggs and survive the winter. After a leafhopper egg is parasitized it becomes visibly red. Unfortunately, this parasite is not as effective on variegated leafhopper eggs as it is on those of the grape leafhopper. Sulfur sprays applied for fungal control are very toxic to Anagrus spp.

General predators of grape leafhoppers include spiders, green lacewings (Chrysopa spp.), minute pirate bugs (Orius spp.), lady beetles (Hippodamia spp.), and predaceous mites. The predaceous mite, Anystis agilis, is an important predator of first instar nymphs. Although many growers have experimented with releases of lacewings for leafhoppers, control of economic populations has not been achieved in university field trials.

Cultural Control
Removing basal leaves or lateral shoots during berry set and the 2-week period following (before adult leafhoppers emerge), as recommended for Botrytis bunch rot management, will normally reduce peak leafhopper populations during the season by 30-50%. This coupled with Anagrus activity may preclude the need for insecticide treatment even when leafhoppers exceed the thresholds below. Time leaf removal to coincide with first generation nymphal development up to and including the 5th instar but just before adults are present. Also, leaf removal will improve coverage and efficacy of pesticides. In warmer growing areas, be careful not to remove excessive numbers of leaves, which can lead to sunburned fruit. Preventing overly vigorous vine growth will also help suppress leafhoppers.

If the vineyard is accessible before bud break and erosion is not a risk, remove weeds in vineyards and surrounding areas before vines start to grow in spring to reduce adult leafhopper populations that might disperse to new grape foliage.

Organically Acceptable Methods
Biological and cultural control methods, including basal leaf removal, assist in control. Narrow range oils, insecticidal soaps, or kaolin clay may give partial control when nymphs are small. Soaps may spot table grapes and should only be used before bloom on this crop.

Monitoring and Treatment Decisions
About 4 weeks after bud break, or whenever nymphs first appear, begin sampling for leafhoppers. Randomly select 20 vines in each block of the vineyard, each at least a few vines in from the end of the row.”

Attachment 3: Terms of Reference/Scope of Work

Pesticide Evaluation Report and Safer Use Action Plan (PERSUAP) Consultant

Start date: April 2007
Duration of assignment: Not to exceed 20 days
Location: Remote assignment with possibility of field trip to Pakistan

Project Description

Improving Livelihoods and Enterprise Development (I-LED) is a $28 million three-year program that assists individuals and communities affected by the October 8, 2005 earthquake to resume and expand their economic activities. It is an integral component of USAID/Pakistan's Earthquake Reconstruction and Recovery Program (PERRP), a long-term initiative for the reconstruction and recovery of the health and education sectors along with restoration of economic livelihoods in the earthquake stricken areas of the Siran and Kaghan Valleys located in North West Frontier Province (NWFP) and Bagh District located in Azad Jammu Kashmir (AJK).

I-LED has three components: Reconstruction of Existing Livelihoods, Value-Chain Development, and Local Economic Development. Through a mix of technical assistance, voucher and cash for work initiatives, training and strategically targeted matching enterprise grants, CNFA in collaboration with Relief International (RI), seeks to facilitate the successful transition from relief and reconstruction to broad based economic growth and increased employment. The net result of I-LED will be the establishment of a solid base for continued economic development through restored livelihoods and enterprises and expanding employment and enterprise opportunities.

Reconstruction of Existing Livelihoods

Within the targeted program areas encompassing 27 Union Councils in Bagh District, 12 Union Councils in Kahgan Valley and 5 Union Councils in Siran Valley, a process of intense community engagement is being employed to identify specific livelihood reconstruction needs and opportunities to be addressed and the mechanisms to be used in meeting those needs. A very ambitious allocation of over $5 million dollars for livelihood activities, including distribution of agricultural inputs such as pesticides, has been made.

Objectives of the Assignment

There are two major objectives for this assignment:

Objective 1. Complete a Pesticide Evaluation Report (PER). The (PER) section addresses the 12 informational elements required in USAID's Pesticide Procedures. The 12 elements include:

- USEPA registration status of the proposed pesticide
- Basis for selection of the pesticide
- Extent to which the proposed pesticide use is, or could be, part of an IPM program
- Proposed method or methods of application, including the availability of application and safety equipment
- Any acute and long-term toxicological hazards, either human or environmental, associated with the proposed use, and measures available to minimize such hazards
- Effectiveness of the requested pesticide for the proposed use

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- Compatibility of the proposed pesticide use with target and non-target ecosystems
- Conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils
- Availability of other pesticides or non-chemical control methods
- Host country's ability to regulate or control the distribution, storage, use, and disposal of the requested pesticide
- Provision for training of users and applicators
- Provision made for monitoring the use and effectiveness of this pesticide

Objective 2. Complete a Safer Use Action Plan (SUAP). The SUAP puts the conclusions reached in the PER into a plan of action, including assignment of responsibility to appropriate parties connected with I-LED's pesticide activities.

Consultancy Description

1. Working under the supervision of the I-LED Country Director and in collaboration with the Livelihood Manager, the consultant will complete a PERSUAP that will guide I-LED's work with pesticides.
2. The consultant will be based in I-LED's Islamabad office but will be required to travel to I-LED's regional offices in Mansehra and Bagh Districts.

Scope of work

The consultant will complete a PERSUAP that is compliant with USAID's Pest Management Guidelines and that provides a detailed plan for safe and responsible project implementation.

Objective 1

- Review project documents, particularly the Work Plan, Grants Manual, and Training Master Plan.
- Conduct research to address the 12 informational elements of USAID's Pesticide Procedures.
- Complete PER.

Objective 2

The SUAP must:

- Be programmatically linked to national pesticide registration and pest management programs
- Ensure formal national registration of pesticides
- Define and assure safe use practices
- Assure accessibility of protective clothing and equipment needed.
- Emphasize operational research & monitoring & evaluation
- Identify Roles and Responsibilities:
- Integrate Mitigation Measures
- Disposal provisions for used pesticide containers

Deliverables

1. PER
2. SUAP

Qualifications

- Track record of completing PERSUAPs for USAID programs.
- Familiarity with USAID's Pest Management Guidelines
- US citizenship.
- Experience of working in Pakistan an advantage.

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Attachment 4: Pesticide Disposal Options

Pesticide Disposal

If you end up with excess pesticide concentrate, dilute it as directed on the label; then apply it to an area listed on the label. You can dispose of excess pesticide mix by applying it to an area listed on the label. Do not apply more than is recommended. You can also store leftover pesticide until you are able to take it to a hazardous-waste collection site.

An empty pesticide container is not as empty as you might think; a significant amount of pesticide residue can remain inside of it. Triple-rinse an empty container of liquid pesticide before you toss it into the trash. Here's how: First, when you are down to the last amount of pesticide concentrate, drain the pesticide container into your spray tank for at least 30 seconds.

Fill the empty container one-fifth to one-fourth full of water and rinse thoroughly. Use this rinse water as dilution water for the pesticide concentrate in the sprayer. If the dilution rate allows you to pour all the rinse water into the sprayer, drain it into the sprayer for at least 30 seconds.

Follow the procedure in Steps 2 and 3 two more times. Then spray the pesticide mixture on areas listed on the label. Do not exceed the label's application rate.

Container Disposal

All empty pesticide containers must be destroyed, and never re-used. It is extremely dangerous to use them for anything else. Consult the pesticide label, the manufacturer, or the manufacturer's representative for specific recommendations regarding container cleanup and disposal. The following are general guidelines. There are two basic methods for cleaning pesticide containers prior to disposal. Both require that the container be turned upside down and allowed to drain into the spray tank for at least 30 seconds, followed by adding water to the container and rotating it well to wet all surfaces, then draining it again into the spray tank as an additional dilutent.

- Triple Rinse Method: Add a measured amount of water or other specified dilutent so that the container is one-fifth to one-fourth full. Rinse container thoroughly, pour into a tank, and allow it to drain for 30 seconds. Repeat three times. The water rinsate can be used to mix with or dilute more of the same pesticides or it can be sprayed on the target crop.
- Pesticide Neutralization Method: Empty organophosphate and carbamate containers can be neutralized by adding alkaline substances. The following procedure is recommended for 200-liter barrels. Use proportionally less material for smaller containers.

1. Add 20 liters of water, 250 milliliters of detergent, and one kilogram of flake lye or sodium hydroxide.
2. Close the barrel and rotate to wet all surfaces.

3. Let stand for 15 minutes.
4. Drain completely and rinse twice with water. The rinsate should be drained into a shallow pit in the ground located far away from wells, surface water, or inhabited areas.

Containers cleaned by any of the above methods are still not safe to use for any other purpose. Glass containers should be broken and plastic or metal containers punctured or crushed. Containers can then be buried in an isolated area at least 50 cm below ground surface.

Container Type	Disposal Statements
Metal Containers (non-aerosol)	Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of container in a sanitary landfill, or by other procedures approved by state and local authorities.
Paper and Plastic Bags	Completely empty bag into application equipment. Then dispose of empty bag in a sanitary landfill or by incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.
Glass Containers	Triple rinse (or equivalent). Then dispose of in a sanitary landfill or by other approved state and local procedures.
Fiber Drums with Liners	Completely empty liner by shaking and tapping sides and bottom to loosen clinging particles. Empty residue into application equipment. Then dispose of liner in a sanitary landfill or by incineration if allowed by state and local authorities. If drum is contaminated and cannot be reused, dispose of it in the manner required for its liner.
Plastic Containers	Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.
Compressed Gas Cylinders	Return empty cylinder for reuse (or similar wording).
Foil outer pouches of water soluble packets (WSP)	Dispose of the empty outer foil pouch in the trash, as long as WSP is unbroken.

Attachment 5: Botanical Pesticides, Repellents, and Baits Regulated by EPA, as EPA-listed

Name	Other Names	Use	Toxicity	EPA Tracking Number
Allium sativum	Garlic	Repels insects	Low	128827
Allyl isothiocyanate	Oil of Mustard	Kills & repels insects	Questionable	004901
Anise Oil		Repels vertebrates	Low	004301
4-allyl anisole	Estragole	Kills beetles	Low	062150
Azadirachtin	*Azadirachta indica* Neem tree extract	Kills & repels insects	Low, IV	121701
Bergamot		Repels vertebrates		129029
Canola Oil	*Brassica Napus*	Kills many insects	Low	011332
Capsaicin	*B. Campestris* *Capsicum frutescans*	Repels vertebrates	Low, III	070701
Castor Oil		Repels vertebrates	Low	031608
Cedarwood Oil		Repels moth larvae	Low	040505
Cinnamaldehyde	*Ceylon and Chinese* cinnamon oils	Kills insects, fungi & repels vertebrates*	Low	040506
Citronella Oil		Repels insects & vertebrates	Low	021901
Cloves, Crushed			Low	128895
Dihydroazadirachtin	Neem tree extract *Azadirachta indica*	Kills & repels insects	III-IV	121702
Eucalyptus Oil		Repels insects, mites fleas & mosquitoes	Low	040503
Eugenol	Oil of cloves	Kills insects**	Low	102701
Geraniol	Oil of rose isomeric w/ linalool	Repels vertebrates**	Low	597501
Geranium Oil			Low	597500
Indole	from all plants	Trap bait: corn root-worm beetles	Low	25000-
Jasmine Oil			Low	040501
Jojoba Oil		Kills & repels whitefly kils powdery mildew	Low	067200
Lavandin Oil		Repels clothes moth	Low	040500

Lemongrass		Repels vertebrates	Low	040502
Linalool	Oil of Ceylon isomeric w/ geraniol	Repels insects, ticks, mites & spiders	Low	128838
Maple lactone		Roach trap bait	Low	004049
Methyl salicylate	Oil of wintergreen	Repels moths, beetle & vertebrates	May be Toxic in large quantity	76601-
Mint	Herb	Kills aphids	Low	128892
Mint Oil		Kills aphids	Low	128800
Mustard Oil		Repels insects, spiders & vertebrates	Low	004901
Neem Oil		Kills whitefly, aphids	Low	025006
1-Octen-3-ol	From clover, alfalfa	Trap bait: mosquitoes	Low	69037-
Orange		Repels vertebrates	Low	040517
p-Methane-3,8 diol	*Eucalyptus sp.*	Repels biting flies, mosquitoes	Low	
2-Phenylethyl-propionate	From peanuts	Kills insects, ticks, mites & spiders	Low	102601
Pyrethrum	*Chrysanthemum sp.*	Stored products use	III	
Red pepper	Chilli	Repels insects	Low	070703
Rosemary	Herb		Low	128893
Rotenone	*Derris sp., Tephrosia*	Controls ticks	III	
Ryania	*Ryania speciosa*	Kills thrips, coddling moth, corn borers		
Sabadilla	*Schoenocaulon sp.*		III	
Sesame Oil	*Sesamum indicum*	Pyrethroid synergist	Low	
Soybean Oil	Soja	Kills insects, mites	Low	031605
Thyme	Herb	Controls aphids	Low	128894
1,2,4 Trimethoxy-benzene	From squash	Trap bait: corn rootwo-rm, cucumber beetles	Low	40515-
Verbenone	From pine trees	Repels bark beetles	Low	128986

1. This table does not necessarily describe all plant oil active ingredients.
2. More detailed information available for most of the oils: http://www.epa.gov/pesticides/reregistration/status.htm
3. Natural Source: Only one or a few sources are listed. Most of these chemicals are found in many different plants.

* attracts corn rootworm beetles, ** attracts Japanese beetles

Attachment 6: A General IPM Planning and Design Protocol

The design of an IPM program can be developed with all of the fundamental parts of any good management plan. The vital parts of a plan include a definition of the targeted primary (small or large-holder farmers) and secondary (marketers, processors, transporters, and consumers) beneficiaries, implementation partners (farmers, laborers, extension personnel, national, regional and international organizations), listed production constraints (problem identification) and IPM strategies for dealing with them.

Elements of IPM Program

Since IPM is not generally an active part of crop production in Guinea, a basic understanding of the steps or elements needed in an IPM program is addressed below.

Step 1: Evaluate and use non-pesticide management options first.
Use both preventive and responsive/curative options that are available to manage pest problems. Farmers may prevent pests (and avoid requiring pesticides) by the way they select plants, prepare the site, plant and tend growing plants. Along with prevention, farmers may respond to or cure the problem via physical, mechanical or biochemical methods.

General Preventive Interventions:

Plant selection
- choose pest-resistant strains
- choose proper locally-adapted plant varieties
- diversify plant varieties or inter-crop plants
- provide or leave habitat for natural enemies

Site preparation and planting
- choose pest-free or pest-avoidance planting dates (e.g., early planting in rainy season avoids stem borers in cereals)
- enhance/provide shade for shade-grown crops
- assign crop-free (fallow) periods and/or rotate crops
- install buffer zones of non-crop plants and/or physical barriers
- improve soil health
- use and appropriate planting density
- rotate crops
- low-till, no-till

Plant tending/cultivation practices
- fertilize and irrigate appropriately
- remove weeds while small and before sowing crop

Responsive/Curative Interventions:

Physical/mechanical control
- remove or destroy diseased plant or plant parts & pests

- weed
- install traps

Biochemical control

- pheromones (very effective, but not currently easily accessible or economical, however, they are becoming more so)
- homemade botanical pesticides
- repellents

Biological control

- release or augment predators
- release or augment parasites/parasitoids
- release or augment microbial pesticides

Step 2: Assess IPM Needs and Establish Priorities. In planning IPM project consider crop protection needs, farmers' perceptions of pest problems, pesticide use history and trends, availability of IPM technology, farming practices, access to sources of IPM expertise, support for IPM research and technical assistance, and training needs for farmers and project field extension workers.

Next, identify strategies and mechanisms for fostering the transfer of IPM technology under various institutional arrangements, mechanisms, and funding levels. Define what is available for immediate transfer and what may require rapid and inexpensive adaptation and validation research. During the planning stages of an IPM program, the inputs from experienced IPM specialists will be extremely useful. If possible, set up an initial planning workshop to help define and orient implementation activities, and begin to assign individual responsibilities.

Step 3: Learn and value farmers' indigenous IPM tactics, and link with and utilize all local resources/partners. Most farmers are already using their own forms of IPM, many of which are novel, self-created, adapted for local conditions, and many of which work well. These include: mechanical and physical exclusion; crop rotation, trap crops, cover crops, and green manures; local knowledge of strategic planting or harvesting times; water, soil and fertilizer resource management; intensive intercropping with pest-repellent plants; leaving refuge habitat for natural enemies; soil augmentation and care leading to healthy nutrient cycling; transplanting; and weeding.

Accurate assessments of these farmer technologies, as well as of actual losses due to different constraints in farmers' fields are a must, before designing a crop production and pest management program. Crop loss figures provided by small and large farmers alike, and thus projected and reported by international organizations, are often inaccurate, and thus overestimated.

Step 4: Identify key pests for each target crop. Although hundreds of species of organisms can be found in a crop at any one time, only a few of them may cause substantial crop losses, and be considered pests. Become familiar with the key pests of target crops, whether they are primary or secondary pests, how to positively identify them. Monitor their population size, the kind of damage that they cause, and their life cycle. These usually amount to a relatively small

number of species on any one crop and can include any combination of insects, pathogens, weeds, diseases, and vertebrates. A few other species, known as secondary or occasional pests, attain damaging status from time to time; especially if over-spraying occurs and kills natural predators that naturally regulate their populations.

The vast majority of insect species found in any one crop are actually predators and parasites of the plant-feeding species. Many small-holder farmers are not aware of these distinctions and must be taught to correctly identify the more common beneficial species, as well as pests, found in their crops. Incorrect identification of beneficial insects, predators or neutral insect species, may lead to unnecessary pesticide applications. This diagnostic phase requires sampling and careful observation. Usually, most key pests are fairly well known by local farmers and government extension personnel. However, a few species may be poorly known or understood because they occur at night, are hidden, or small. These include soil-inhabiting species such as nematodes and insect larvae (wireworms, white grubs, cutworms), mites, and pathogens (viruses, bacteria, mycoplasma, fungi). In addition, farmers usually do not understand the role of some insects as vectors of plant diseases.

Step 5: Do effective activities and training to promote IPM. A number of activities are very effective in promoting IPM in developing countries:

Learning-by-doing/discovery training programs
The adoption of new techniques by small- and large-holder farmers occurs most readily when program participants acquire knowledge and skills through personal experience, observation, analysis, experimentation, decision-making and practice. First, frequent (usually weekly) sessions are conducted for 10–20 farmers during the cropping season in farmers' fields by trained instructors or extension agents. Because these IPM training sessions take place in the farmers' own environment, (1) they take advantage of the farmers' own knowledge; and (2) the farmers understand how IPM applies to their own farms.

Of these IPM training sessions, four or five analyze the agroecosystem. They identify and describe conditions such as soil type, fertility, and needs, weather, crop stage, each pest, their natural enemies, and relative numbers of both. Illustrations and drawings are provided, as necessary. Extensionists apply a Socratic method, guiding farmers with questions to discover important insights and supplying information only when absolutely necessary.

Farmers may also experiment with insect zoos where they can observe natural predators of their pests in action and the impact of pesticide on both. Knowledge and skills necessary for applying IPM are best learned and understood through practice and observation, understanding pest biology, parasitism, predation and alternate hosts; identifying plant disease symptoms; sampling population size; and preparing seed beds.

Recovering collective memory
Pest problems often emerge because traditional agricultural methods were changed in one way or another, or lost. These changes can sometimes be reversed. This approach uses group discussions to try to identify what changes might have prompted the current pest problem.

Smallholder support and discussion groups
Weekly meetings of smallholders, held during the cropping season, to discuss pest and related problems can be useful for sharing the success of various control methods. However, maintaining attendance is difficult except when there is a clear financial incentive (e.g., credit).

Demonstration project
Subsidized experiments and field trials at selected farms can be very effective at promoting IPM within the local community. These pilots demonstrate IPM in action and allow comparison with traditional synthetic pesticide-supported cultivation.

Educational material-Guinea
In many countries, basic written and photographic guides to pest identification and crop-specific management techniques are unavailable or out of date. Such material is essential. Videos featuring graphic pictures of the effects of acute and chronic pesticide exposure, and interviews with poisoning victims can be particularly effective. A study in Nicaragua found videos to be the most important factor in motivating farmers to adopt IPM.

Youth education
Promoting and improving the quality of programs on IPM and the risks of synthetic pesticides has been effective at technical schools for rural youth. In addition to becoming future farmers, these students can bring informed views back to their communities.

Organic food market incentive
Promoting organic certification for access to the lucrative and rapidly growing organic food market can be a strong incentive to adopt IPM.

Step 6: Partner successfully with other IPM implementers. Many IPM project consist of partnerships between two or more organization, e.g., donors, governments, PVOs and NGOs. If these partnerships are not forged with care, the entire project may be handicapped. The following design steps are considered essential.

Articulate the partnership's vision of IPM
Organizations may forge partnerships based on a common commitment to "IPM"—only to discover too late that that their visions of IPM differ considerably. It is important that partners articulate a common, detailed *vision* of IPM, centered on the crops and conditions the project will encounter.

Confirm partner institutions' commitment
Often, organizations make commitments they do not intend to (or are unable to) fulfill completely. The extent of commitment to IPM integration into project, design, and thus implementation depends strongly upon the following key variables:

- **IPM program integration into larger project**. The IPM program is likely to be part of a larger "sustainable agriculture" project. The IPM program must fit into a partner's overall

program. The extent of this integration should be clearly expressed in the proposed annual work plan.

- **Cost sharing**. The extent of funds (or in-kind resources) is a good measure of a genuine partner commitment.
- **Participation of key IPM personnel.** Large partner organizations should have staff with expertise in IPM who are assigned specifically to IPM work. In strong partnerships, these staff members are actively involved in the partnership.

Step 7: Monitor the fields regularly. The growth of pest populations usually is related closely to the stage of crop growth and weather conditions, but it is difficult to predict the severity of pest problems in advance. The crops must be inspected regularly to determine the levels of pests and natural enemies and crop damage. Current and forecast weather should be monitored. Farmers, survey personnel, and agricultural extension staff can assist with field inspections. They can train other farmers to be able to separate pests from non-pests and natural enemies, and to determine when crop protection measures, are necessary.

Step 8: Select an appropriate blend of IPM tools. A good IPM program draws from and integrates a variety of pest management techniques. IPM does not require predetermined numbers or combinations of techniques, nor is the inclusion or exclusion of any one technique required for IPM implementation. Flexibility to fit local needs is a key variable. Pesticides should be used only if no practical, effective, and economic non-chemical control methods are available. Once the pesticide has been carefully chosen for the pest, crop, and environment, it should be applied only to keep the pest population low. When dealing with crops that are already being treated with pesticides, IPM should aim first at reducing the number of pesticide applications through the introduction of appropriate *action thresholds*, while promoting appropriate pesticide management and use practices and shifting to less toxic and more selective products and non-chemical control methods. In most cases, NGOs/PVOs will probably need to deal with low to moderate levels of pesticide use. Either way, an IPM program should emphasize preventive measures and protect a crop, while interfering as little as possible with the production process.

Step 9: Develop education, training, and demonstration programs for extension workers. Implementation of IPM depends heavily on education, training, and demonstration to help farmers and extension workers develop and evaluate the IPM methods. Hands-on training conducted in farmers' fields (as opposed to a classroom) is a must. Special training for extension workers and educational programs for government officials and the public are also important.

Step 10: Monitor and Evaluate. First, develop data collection tools, and then collect baseline data at the beginning of the project to identify and determine the levels of all variables that will need to be tracked. These may include numbers and types of pests, predators, and soil microorganisms; relative numbers of all non-target animals (birds, lizards, etc.) that may be negatively impacted if pesticides are used; soil and water samples to determine levels of pesticide residue; soil samples to learn dominant soil types and to predict soil nutrition, requirements, and fertilizer/pesticide activities; pesticides, application and safety equipment available; and, amounts and type of training received by target audiences.

Develop methods for measuring the effectiveness of each IPM tactic used, and of their sum in reducing pest damage and crop losses. Also, develop methods for monitoring environmental health (maintaining and encouraging high levels of predators and soil microorganisms) and human health if pesticides are used. Kits are available for determining the level of cholinesterase-inhibiting pesticides to which farmers and applicators have been exposed. Make checklists for farmers to use when applying pesticides that indicate the type of application and safety equipment used (see Attachment 12), and the rates at which pesticides were applied.

Attachment 7: Pesticide Use Checklist (PUC) for PVOs, NGOs, and others

The following checklist is intended to assist in identifying potential environmental problems with pesticide use. It will also help in guiding project management to ensure that pesticides are not used inappropriately. Since pesticide use is mainly an issue with agricultural projects involving trees or food production, livestock projects, and health projects (control of mosquitoes, schistosomiasis pathogens, tsetse fly, etc.), particular care should be taken with those sectors. The same caution should be used anytime pesticides are employed as part of project activities in any sector.

1. Check off all ways in which pesticides will be used.

	By Project Staff	By Project Recipient	Others (Specify)
Demonstration	_____	_____	_____
Research	_____	_____	_____
Training	_____	_____	_____
Vector Control	_____	_____	_____
Others (list)	_____	_____	_____

2. Check the technical expertise of the people to be handling pesticides:

	Staff	Project Recipients	Others (specify)
Well-trained	_____	_____	_____
Moderately trained	_____	_____	_____
Not trained	_____	_____	_____
Others (explain)	_____	_____	_____

3. Pesticides are needed to manage pests on (check one or more):

_____ Crops
_____ Livestock
_____ Others; please specify: _____

4. Can your staff identify the main pest organisms?

_____Yes _____No

5. Do you know which pesticides are needed?

_____Yes _____No
Pesticide Use Checklist

6. List pesticides needed, indicating each commodity (crop type, livestock type, tree, etc.) and specify pests (name of specific insects, diseases, weeds, storage pests, etc.) needing control, using the format shown below.

Commodity	Pest	Pesticide Common Name	Trade Name

7. Pesticide Storage Facilities

a) Do you have a storage facility on the project site designated solely for pesticides?
_____Yes, describe:
_____No

b) Is the storage shed well lit, ventilated, and safe from flooding?
_____Yes _____No

c) Are pesticides kept away from food, feed, or water?
_____Yes _____No

d) Are storage facilities secure and kept locked when not in use?
_____Yes _____No

e) Are all pesticides kept in their original, labeled containers?
_____Yes _____No

f) Are warning signs posted outside the storage sheds?
_____Yes _____No

g) Are pesticides stored away from flammable/combustible materials?
_____Yes _____No

h) Is there a well-established procedure to clean up spills?
_____Yes, namely:
_____No

8. Safe Use of Pesticides

a) Do you have a place to mix the pesticides safely?
_____Yes, describe:
_____No

b) Do you have protective clothing (e.g. rubber boots, coveralls, gloves, masks, eye protection)?
_____Yes, describe:
_____No

c) Is the protective clothing being used?
_____Yes, describe:
_____No

d) Do you have measuring and mixing equipment?
_____Yes, describe:
_____No

e) Is the measuring and mixing equipment being used?
_____Yes, describe:
_____No

f) Do you have a supervisor in the project designated to oversee all pesticide operations?
_____Yes, who?:_____;
Level of training? _____
_____No

g) Is your staff familiar with appropriate pesticide disposal procedures?
_____Yes _____No

h) Describe how you plan to dispose of pesticide containers:
metal? _____
glass? _____
plastic? _____
paper? _____
cardboard? _____

i) Is the health of the laborers using organo-phosphorous or carbamate compounds monitored?
_____Yes _____No

j) Is your staff familiar with first-aid procedures for pesticide poisoning?
_____Yes _____No

k) Are emergency procedures in place in case of accidental poisonings?
_____Yes: Briefly
describe_____
_____
_____No

l) Are there procedures for observing restricted entry intervals after applications?
_____Yes _____No

9. Application Equipment

a) Describe equipment you will be using to apply the pesticide.

b) Is there a trained person on the project whose job will be to maintain application equipment, including nozzles and sieves?
_____Yes _____No

c) Are spare parts available in local stores?
_____Yes _____No

Pesticide Use Checklist for
10. General Pest Management Concerns

a) Have you identified pesticide-related risks in your project area and analyzed whether pesticide use is justified, affordable, and can be adequately managed and supervised?
_____Yes _____No
_____N/A

b) Will your staff be training other people in pest management and pesticide use?
_____Yes, whom?
_____No

c) Are funds available for necessary materials, training methods, and follow-up included in your project paper?
_____Yes, estimated costs? _____
_____No

11. IPM approach

a) Is the project promoting the adoption of preventive, non-chemical management measures?
_____Yes _____No
If yes, indicate which (crop rotation, biocontrol, use of resistant cultivars, crop diversification, tillage, sanitation, manual weed destruction, etc):_____
_____

b) Are pesticides being applied only as last-resort measures and based on action threshold criteria? Are there pest monitoring procedures being used to determine the need for pesticide treatments?
_____Yes _____No

c) Can farmers and project extensionists readily distinguish pest from non-pest organisms? Can they recognize common beneficial species (pollinators, predators, and parasitoids)?
_____Yes _____No

Pesticide Use Checklist
12. Environmental Impact

a) Are there wildlife sanctuaries, preserves, or any other protected habitats in or near the project implementation area that might be affected by pesticide use?

_____Yes, namely:
_____No

b) Are there water bodies (lakes, lagoons, reservoirs, rivers, streams, estuaries, etc.) near the project areas
that might be subject to pesticide contamination through drift, runoff, or spills?
_____Yes. Describe:
_____No

c) Are wildlife and domestic animals protected from poisoned baits?
_____Yes. How?
_____No

13. Pesticide monitoring

Is there a system in place for tracking pesticide use activities, including frequency of applications, techniques,
chemicals used, doses, target pests, effectiveness, criteria for applying, and safe use practices?
_____Yes
_____No

14. Literature Needs

Have you included literature needs in your activity?
_____Yes
_____No

Pesticide Use Checklist

15. Check off areas where additional assistance may be needed:

	Consultancy	Training
Pest identification	_____	_____
Pesticide selection	_____	_____
Handling pesticides (transport, mixing, loading, application, equipment clean up, disposal)	_____	_____
Application equipment	_____	_____
IPM	_____	_____
Pesticide storage	_____	_____
Protective clothing	_____	_____
Measuring & mixing equipment	_____	_____
Training (designate activity)	_____	_____
Literature	_____	_____
Training materials	_____	_____
Other (specify)	_____	_____

Attachment 8: Protective Clothing and Equipment Guide

EPA Recommended Worker Protection Standards

HANDLER PPE FOR WORKER PROTECTION STANDARD PRODUCTS				
Route of Exposure	**Toxicity Category by Route of Exposure of End-Use Product**			
	I DANGER	II WARNING	III CAUTION	IV CAUTION
Dermal Toxicity or Skin Irritation Potential[1]	Coveralls worn over long-sleeved shirt and long pants Socks Chemical-resistant footwear Chemical-resistant Gloves[2]	Coveralls worn over short-sleeved shirt and short pants Socks Chemical-resistant footwear Chemical-resistant Gloves[2]	Long-sleeved shirt and long pants Socks Shoes Chemical-resistant Gloves[2]	Long-sleeved shirt and long pants Socks Shoes No minimum[4]
Inhalation Toxicity	Respiratory protection device[3]	Respiratory protection device[3]	No minimum[4]	No minimum[4]
Eye Irritation Potential	Protective eyewear[5]	Protective eyewear[5]	No minimum[4]	No minimum[4]

1 If dermal toxicity and skin irritation toxicity categories are different, PPE shall be determined by the more severe toxicity category of the two. If dermal toxicity or skin irritation is category I or II, refer to the pesticide label/MSDS to determine if additional PPE is required beyond that specified in Table.
2 Refer to the pesticide label/MSDS to determine the specific type of chemical-resistant glove.
3 Refer to the pesticide label/MSDS to determine the specific type of respiratory protection.
4 Although no minimum PPE is required for these toxicity categories and routes of exposure, some specific products may require PPE. Read pesticide label/MSDS.
5"Protective eyewear" is used instead of "goggles" and/or "face shield" and/or "shielded safety glasses" and similar terms to describe eye protection. Eye glasses and sunglasses are not sufficient eye protection.

Attachment 9: Toxicity of pesticides: EPA and WHO classifications

General Toxicity

Pesticides, by necessity, are poisons, but the toxicity and hazards of different compounds vary greatly. Toxicity refers to the inherent intoxicating ability of a compound whereas hazard refers to the risk or danger of poisoning when the pesticide is used or applied. Pesticide hazard depends not only on toxicity but also on the chance of exposure to toxic amounts of the pesticide. Pesticides can enter the body through oral ingestion, through the skin or through inhalation. Once inside the body, they may produce poisoning symptoms, which are either acute (from a single exposure) or chronic (from repeated exposures or absorption of smaller amounts of toxicant).

EPA and WHO Toxicity Classifications

Basically, there are two systems of pesticide toxicity classification. These are the USEPA and the WHO systems of classification. It is important to note that *the WHO classification is based on the active ingredient only, whereas USEPA uses product formulations to determine the toxicity class of pesticides.* So, WHO classification shows relative toxicities of all pesticide active (or technical) ingredients, whereas EPA classification shows actual toxicity of the formulated products, which can be more or less toxic than the active ingredient alone and are more representative of actual dangers encountered in the field. The tables below show classification of pesticides according to the two systems.

a) USEPA classification (based on formulated product = active ingredient *plus inert and other ingredients*)

Class	Descriptive term	Mammalian LD_{50}		Mammalian Inhalation LC_{50}	Irritation		Aquatic invert/fish (LC_{50} or EC_{50})[2]	Honey bee acute oral (LD_{50})
		Oral	Dermal		Eye[1]	Skin		
I	Extremely toxic	≤50	≤200	≤0.2	Corrosive	Corrosive	< 0.1	
II	Highly toxic	50-500	200-2000	0.2-2.0	Severe	Severe	0.11-1.0	< 2 µg/bee
III	Moderately toxic	500-5000	2000-20000	2.0-20	No corneal opacity	Moderate	1.1-10.0	2.1-11 µg/bee
IV	Slightly toxic	≥5000	≥20000	≥20	None	Moderate or slight	10.1-100	
	Relatively non-toxic						101-1000	
	Practically non-toxic						1001-10,000	> 11 µg/bee
	Non-toxic						> 10,000	

[1] Corneal opacity not reversible within 7 days for Class I pesticides; corneal opacity reversible within 7 days but irritation persists during that period for Class II pesticides; no corneal opacity and irritation is reversible within 7 days for Class III pesticides; and Class IV pesticides cause no irritation

[2] Expressed in ppm or mg/l of water

b) WHO classification (based only on active or 'technical' ingredient)

Class	Descriptive term	Oral LD_{50} for the rat (mg/kg body wt)		Dermal LD_{50} for the rat (mg/kg body wt)	
		Solids	Liquids	Solids	Liquids
Ia	Extremely hazardous	≤5	≤20	≤10	≤40
Ib	Highly hazardous	5-50	20-200	10-100	40-400
II	Moderately hazardous	50-500	20-2000	100-1000	400-4000
III	Slightly hazardous	≥501	≥2001	≥1001	≥4001
U	Unlikely to present acute hazard in normal use	≥2000	≥3000	-	-

Attachment 10: Basic first aid for pesticide overexposure

Get medical advice quickly if you or any of your fellow workers have unusual or unexplained symptoms during work or later the same day. Do not let yourself or anyone else get dangerously sick before calling a physician or going to a hospital. It is better to be too cautious than too late.

First aid is the initial effort to help a victim while medical help is on the way. If you are alone with the victim, make sure the victim is breathing and is not being further exposed to the poison before you call for emergency help. Apply artificial respiration if the victim is not breathing.

Read the first aid instructions on the pesticide label, if possible, and follow them. Do not become exposed to poisoning yourself while you are trying to help. Take the pesticide container (or the label) to the physician. Do not carry the pesticide container in the passenger space of a car or truck.

Poison on skin
- Act quickly
- Remove contaminated clothing and drench skin with water
- Cleanse skin and hair thoroughly with detergent and water
- Dry victim and wrap in blanket.

Chemical burn on skin
- Wash with large quantities of running water
- Remove contaminated clothing
- Cover burned area immediately with loose, clean, soft cloth
- Do not apply ointments, greases, powders, or other drugs in first aid treatment of burns

Poison in eye
- Wash eye quickly but gently
- Hold eyelid open and wash with gentle stream of clean running water
- Wash for 15 minutes or more
- Do not use chemicals or drugs in the wash water; they may increase the extent of injury

Inhaled poison
- Carry victim to fresh air immediately
- Open all doors and windows so no one else will be poisoned
- Loosen tight clothing
- Apply artificial respiration if breathing has stopped or if the victim's skin is blue. If patient is in an enclosed area, do not enter without proper protective clothing and equipment. If proper protection is not available, call for emergency equipment from your fire department

Poison in mouth or swallowed
- Rinse mouth with plenty of water
- Give victim large amounts (up to 1 quart) of milk or water to drink

- Induce vomiting only if instructions to do so are on the label

Procedure for inducing vomiting

- Position victim face down or kneeling forward, Do not allow victim to lie on his back, because the vomit could enter the lungs and do additional damage
- Put finger or the blunt end of a spoon at the back of victim's throat or give syrup of ipecac
- Collect some of the vomit for the physician if you do not know what the poison is
- Do not use salt solutions to induce vomiting

When *not* to induce vomiting

- If the victim is unconscious or is having convulsions
- If the victim has swallowed a corrosive poison. A corrosive poison is a strong acid or alkali. It will burn the throat and mouth as severely coming up as it did going down. It may get into the lungs and burn there also
- If the victim has swallowed an emulsifiable concentrate or oil solution. Emulsifiable concentrates and oil solutions may cause severe damage to the lungs if inhaled during vomiting

Attachment 11: Recommended Distribution

CNFA I-LED Pakistan and Washington

Mohammad Riaz
Tim Ekin
Paul Sippola
Marcus Winter

USAID Pakistan

CTO for I-LED, Marilee Kane
MEO, Aazar Bhandara

USAID/ANE/Washington

John Wilson, ANE BEO
Barney Popkin, ANE Senior Environmental Advisor

Attachment 12: Websites Useful for Pesticide Searches

http://www.pesticideinfo.org (PAN most complete pesticides database)
http://extoxnet.orst.edu/pips/ghindex.html (Extoxnet Oregon State database)
http://www.epa.gov/ecotox/ (EPA Ecotox Database)
http://www.cdpr.ca.gov/docs/epa/m2.htm (link to OPP site)
http://cfpub.epa.gov/oppref/rereg/status.cfm?show=rereg (EPA Registr.Eligib.Decisions)
http://www.epa.gov/pesticides/biopesticides/ai/all_ais.htm (EPA regulated biopesticides)
http://www.epa.gov/opppmsd1/RestProd/rupjun02.htm (EPA restricted use pesticides)
http://www.epa.gov/pesticides/health/tox_categories.htm (EPA Toxicity Classifications)
http://www.epa.gov/opppmsd1/PPISdata/index.html (EPA pesticide product information)
http://www.chemfinder.camsoft.com (chemical database & internet search, free & fee)
http://www.hclrss.demon.co.uk/index.html (compendium of pesticide common names)
http://www.agf.gov.bc.ca/pesticides/f_2.htm (all types of application equipment)
http://www.hclrss.demon.co.uk/class_insecticides.html pesticides classification and common names compendium

Electronic information on pesticides was collected by the consultant using several websites: www.epa.gov for compliance; www.who.int/ipcs/publications/pesticides for WHO classification; www.kellysolutions.com for formulations registration status information; www.greenbook.net and www.cdms.com for efficacy information and Material Safety Data Sheets found on pesticide labels; as well as the PAN www.pesticideinfo.org and EXTOXNET http://extoxnet.orst.edu/pips/ghindex.html websites for specific toxicological, registration and environmental data.
http://www.foodaidmanagement.org/pdfdocs/usaiddoc/FldGuide2000Text1.PDF (good doc on outline of how to do environmental assessments, beyond compliance)

Hard copy information on toxicity class and nontarget hazard was referenced from technical manuals reviewed in the U.S. such as The Pesticide Manual by Tomlin (1997), Farm Chemical Handbook (2005), Agricultural Chemicals Books by Thomson (1995-8), The Agrochemicals Handbook by the Royal Society of Chemistry UK (1991), The UK Pesticide Guide by the British Crop Protection Council (1998), and The UK Pesticide Guide (1999).

CABI Site for Crop Protection Compendium (CPC)
http://www.cabi.org/compendia/cpc/index.htm to enter CABI CPC for crop/pest reccs.

Pesticide Toxicity to Honey Bees
http://www.entm.purdue.edu/Entomology/ext/targets/e-series/EseriesPDF/E-53.pdf
http://www.ohioline.osu.edu/hyg-fact/2000/2161.html (Ohio State Extension site)

Pesticide Toxicity to Natural Enemies (Beneficials)
http://www.ipm.ucdavis.edu/PMG/r108900111.html

Biological Pesticides List
http://www.koppert.com (a Dutch biologicals company doing business internationally)

http://www.biobest.be (a Belgian biologicals company doing business internationally)
http://www.epa.gov/pesticides/biopesticides/ai/all_ais.htm (EPA's biopesticide list)
http://www.bio-bee.com/english/welcome.html (a biopesticide company in Israel)

Minimum Residue Limits for Pesticides & Veterinary Drugs in Food
http://faostat.fao.org/faostat/collections?version=ext&hasbulk=0&subset=FoodQuality

PERSUAPs Sites
http://www.encapafrica.org/sectors/pestmgmt.htm (PERSUAPS guidance)
http://www.wateriqc.com/millenium_conference/Proceedings/powerpoint_presentations/Day_4/1030rossier.pps#285,10,Critical Pesticide Management Issues (EA History PPT)

International Conventions
http://www.pops.int/ (POPs website)
http://www.pops.int/documents/convtext/convtext_en.pdf (POPs Convention text)
http://www.chem.unep.ch/pops/pdf/redelipops/redelipops.pdf (reduce & eliminate POPs)
http://www.pic.int/ (PIC website)

methyl-bromide site
http://www.epa.gov/ozone/mbr/harmoniz.html

Audio-Visual IPM and SPU resources
http://entweb.clemson.edu/pesticid/publictn/resource.htm

Attachment 13: List of Pesticides Banned in Pakistan

Active Ingredients

B.H.C
Binapacryl
Bromophos ethyl
Captafol
Chlordimeform
Chlorobenzilate
Chlorthiophos
Cyhexatin
Dalapon
DDT
Dibromochloropropane + Dibromochloropropene
Dicrotophos
Dieldrin
Disulfoton
Endrin
Ethylene dichloride + Carbontenachloride
Leptophos
Mercury Compound
Mevinphos
Toxaphene
Zineb
Heptachlor
Methyl Parathion
Monocrotophos (all formulations)
Methamidophos (all formulations)

Formulations

1.	Dichlorvos	(above 500 g / l)
2.	Phophamidon	(above 500 g / l)

Pesticides Not Registered

Aldrin (POP/PIC)
Mirex (POP)
Chlordane (POP/PIC)
Dinoseb (PIC)
Ethylene di bromide (PIC)
Parathion (PIC)
Fluroacetate (PIC)