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USAID-WULA NAFAA & PROJET CROISSANCE ECONOMIQUE

PESTICIDE EVALUATION REPORT & SAFE USE ACTION PLANS (PERSUAP)

JUNE 2010

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ACRONYMS

BEO	Bureau Environmental Officer
CDH	Centre pour le Developpement de l'Horticulture
CSP	Comite Sahelien des Pesticides
CFR	Code of Federal Regulations
CILSS	Comité Permanent Inter états de Lutte contre la Sécheresse dans le Sahel
DPV	Directorate of Plant Protection
EA	Environmental Assessment
EMMP	Environmental Mitigation and Monitoring Plan
ESA	Environmental and Social Assessment
EU	European Union
FAO	(United Nations) Food and Agriculture Organization
FY	Fiscal Year
GFSR	Global Food Security Response to High Food Prices
GOS	Government of Senegal
GUP	General Use Pesticide
IEE	Initial Environmental Examination
INSAH	Institut du Sahel (in Bamako)
IPM	Integrated Pest Management
IR	Intermediate Result
IRG	International Resources Group
MEO	Mission Environmental Officer
M & E	Monitoring & Evaluation
OP	organophosphate pesticides
PA	protected area
PCE	Projet Croissance Economique
PERSUAP	Pesticide Evaluation Report-Safe Use Action Plan
PIC	Prior Informed Consent
POP	Persistent Organic Pollutant
RUP	Restricted Use Pesticide
SO	Strategic Objective
SRV	Senegal River Valley
SUAP	Safe Use Action Plan
UNEP	United Nations Environment Programme
USEPA (EPA)	United States Environmental Protection Agency
USAID	Unite States Agency for International Development
VC	value chain
WASA	West Africa Seed Alliance
WHO	World Health Organization
WN	Wula Nafaa

EXECUTIVE SUMMARY

This PERSUAP was conducted in accordance with the Scope of Work (Annex A), which states that a PERSUAP should be prepared to enable the PCE [*Projet Croissance Economique*] and Wula Nafaa teams "to respond to and comply with the requirements of USAID Regulation 22 CFR 216.3(b), USAID's pesticide procedures, as well as USAID's *policy* on the use of Integrated Pest Management (IPM). One Pesticide Evaluation Report (PER, Section 2) was conducted for the two projects, and two Safe Use Action Plans (SUAP) with Environmental Mitigation and Monitoring Plans (Section 3) were prepared, one for each project.

1) Table of pesticides proposed for USAID approval

The following tables list the active ingredients requested for the *Projet Croissance Economique* (PCE) and USAID-Wula Nafaa (WN) projects. The requested active ingredients are the least toxic, while still being the most efficacious available. With the exception of Biotrap with rotenone, they are all approved for use in Senegal, and all active ingredients are registered by the US Environmental Protection Agency (USEPA). Neither PCE nor USAID-WN will assist in the procurement or use of these requested pesticides until approval is obtained from the USAID/Bureau Environmental Officer (BEO).

PCE Table 1: Active Ingredients and Pesticide Products Requested by PCE (with registration status, toxicity levels, and special concerns noted)

Red shade: does not pass initial screening due to lack of registration by USEPA or the CSP or high toxicity.

ACTIVE INGREDIENT	PRODUCT	EPA registration status: RUP/GUP	EPA & WHO Toxicity Levels	Special concerns
PCE/Mango				
1) Spinosad 2,4 g/l	SUC-CSESS APPAT 0.24 CB GF 120	GUP	WHO U EPA 3 & 0 (Success) EPA 3 (GF)	Special concerns: bees, aquatic invertebrates.
2) Malathion + Parapheromone methyl eugenol	Malatrap	GUP: all products with malathion GUP: methyl eugenol	WHO III, EPA 1-3 (malathion: most are 3, many are 2, few are 1) WHO NL EPA 3 (methyl eugenol)	Special concerns: pesticide handlers, aquatic invertebrates, tadpoles, earthworms, honeybees, beneficial arthropods.
3) Rotenone + Parapheromone methyl eugenol Not yet registered for use in Senegal	Biotrap	Most rotenone products are GUPs, few are RUPs (use of this product in a trap will be less toxic than if sprayed or broadcast.	WHO II EPA 1- 3 (rotenone) WHO NL EPA 3 (methyl eugenol)	Special concerns: risk to humans; high toxicity to fish. Rotenone is not registered by CSP, 2010; it shall not be used by PCE until registered.

ACTIVE INGREDIENT	PRODUCT	EPA registration status: RUP/GUP	EPA & WHO Toxicity Levels	Special concerns
		GUP: methyl eugenol		
4) Azadirach-tin, 10 g/l (Neem)	Suneem 1% EC	GUP	EPA 3 WHO NL	Special concerns: fish and other aquatic resources
PCE/Banana				
1) Metarhizium flavoviride anisoplae	Green muscle	GUP (similar product)	WHO NL EPA 3	Normal safety precautions
2) Sulfur	Atenea DF	All products are GUPs	EPA 1-3 (almost all products are EPA 3) WHO U	Normal safety precautions
3) Eucalyptus	Euca-lyptus oil	All products are GUPs	WHO NL EPA 2, 3	Special concerns: Highly flammable—issue for transport, storage, application, disposal
PCE/Millet and Sorghum				
1) Glyphosate	GLYPHADE R 75	GUP (product similar to Departure, registered by EPA)	WHO U EPA 3	Special concerns: amphibians, aquatic invertebrates, beneficial arthropods, earthworms
2) Propanil (480 g/l)	TOPRANIL 480 EC	GUP (product similar to Propanil 48, registered by USEPA)	WHO III EPA 3	Special concerns: birds, fish, aquatic invertebrates
3) Thiamethoxa m 20g/kg+ difenoconazol e 2g/kg	A-PRON STAR 42 WS Seed treat-ment	GUP (similar to Meridien); difenocononazole similar to other GUP products	WHO NL, EPA 3 (thia) WHO III, EPA2, 3 (difen)	Special concerns: fish and other aquatic organisms, bees, wildlife
4) Imidacloprid 350 g/kg + Thiram 100 g/kg	IMIDALM T 450 WS MOMTAZ 45 WS	Similar to Atera, GUP All thiram products are GUPs	WHO II, EPA 3 (Imid) WHO III(Thi), all are EPA 2, 3	Special concerns: human by ingestion, inhalation, and eye irritation; bees and other non-target insects, birds, fish and aquatic ecosystems
5) Spinosad	SPINTOR POUDRE	Similar products are GUPs	WHO U	Special concerns: bees, aquatic invertebrates.
PCE/Rice				
1) Propanil 360	Propanil	GUP	WHO III, EPA 3	Special concerns: birds, fish, aquatic invertebrates
2) 2,4 – amine salt or 2,4 D	Herbextra 720 SL Malo Binfaga 720g/l	GUP All similar products are GUPs	WHO II EPA 1-3 (various formulations)	Special concerns: human toxicity; birds, fish, earthworms, and groundwater contaminant
PCE/Maize (irrigated)				
None				
PCE/Maize (rainfed)				
1) Glyphosate 360 g/l	Dango-roba, Gly-phalm	GUP (for products similar to this that are	WHO U EPA 3	Special concerns: amphibians, aquatic invertebrates, beneficial

ACTIVE INGREDIENT	PRODUCT	EPA registration status: RUP/GUP	EPA & WHO Toxicity Levels	Special concerns
	360 SL, Domin-ator 360 SL	EPA registered)		arthropods, earthworms
2) Pendimethalin	Activus 500 EC	GUP (for products similar to this that are EPA registered)	WHO III EPA 3	Special concerns: fish and aquatic invertebrates

USAID-WN Table 1: Active Ingredients and Pesticide Products Requested by USAID-WN (with registration status and toxicity levels)

ACTIVE INGREDIENT	PRODUCT	EPA registration status: RUP/GUP	EPA & WHO Toxicity Levels	Special concerns
USAID-WN/Market gardens (most common crops are tomato, cabbage, pepper, okra, and lettuce)				
1) Maneb-Mancozeb	Man-cosan (PM) 70% active/1 kg	GUP (product is similar to Dithane M 45)	WHO U EPA 3	Special concerns: toxicity to fish and aquatic invertebrates, and grazing animals; and potential carcinogenic action in humans.
2) Dimethoate	Systoate (Concentrated liquid, 40% active /1 liter)	Similar to GUPs	WHO II EPA 2 (similar to Dimethoate 4ec)	Special concerns: Human health hazard; risk to handlers is high; birds, bees, and beneficial arthropods, fish, aquatic invertebrates, domestic and wild mammals. Considered a pesticide of Special Concern by USEPA (see Annex B)
3) Azadirachtin	Suneem 1% EC	GUP	WHO NL EPA 3	Special concerns: fish and other aquatic resources
USAID- WN Rice				
1) Propanil	Propanil 360 g/l	GUP	WHO III, EPA 3	Special concerns: birds, fish, aquatic invertebrates
2) 2,4 – amine salt or 2,4 D	Herbextra 720 SL Malo Binfaga 720g/l	GUP All similar products are GUPs	WHO II EPA 1-3 (various formulations)	Special concerns: human toxicity; birds, fish, earthworms, and groundwater contaminant
Possible replacements for deltamethrin, dimethoate, and carbofuran				
1) *Bacillus thuringiensis*	Batik	GUP	WHO NL EPA 3	Normal safety precautions
2) Thiame-thoxam	Actara 25 WG	GUP	WHO NL EPA 3	Special concerns: Aquatic ecosystems, bees, and terrestrial wildlife
3) Indoxacarb	Avaunt 150 EC	GUP	WHO NL EPA 3	Special concerns: risk to humans (eye irritation), birds, bees, fish, aquatic invertebrates, and domestic and wild mammals

ACTIVE INGREDIENT	PRODUCT	EPA registration status: RUP/GUP	EPA & WHO Toxicity Levels	Special concerns
4) Chlorpyri-fos-ethyl	Spiphor 5G powder	Depends on formulation; many are RUPs.	WHO II EPA 1, 2, 3: depends on formulation	Special concerns: impacts to humans, birds, bees, and all aquatic organisms, birds, bees.

2) Summary of Findings/Recommendations

Key findings from the Pesticide Evaluation Report are:

- Producers in PCE and USAID-WN value chains may use pesticides that are highly toxic and that are classified as or are similar to USEPA restricted use pesticides (RUP). Less toxic alternatives are not widely known or accepted by producers.
- Producers rarely take appropriate safety precautions when mixing, applying, storing, transporting, and disposing of pesticides.
- IPM is not widely known or implemented by value chain producers.
- USAID-WN and PCE staff are not adequately trained in safe use and IPM.

These and other findings in the PER are addressed by mitigation measures in the SUAP. Mitigation focuses on phasing out highly toxic active ingredients; evaluating less toxic alternatives; and developing and implementing a Training Plan that targets each project's stakeholders and beneficiaries, as well as project staff. In addition, a mitigation measure included in the USAID-WN SUAP recommends the training and use of applicator service providers to minimize impacts to value chain (VC) producers who typically purchase, transport, store, apply, and dispose of pesticides, but rarely take safety precautions.

PART 1. INTRODUCTION TO THE PERSUAP

1.1 Background: regulatory requirements for a PERSUAP

In accordance with 22 CFR 216 (USAID's Environmental Procedures), all USAID activities are subject to evaluation via, at a minimum, an Initial Environmental Examination (IEE), and if significant environmental effects are expected, an Environmental Assessment (EA). Because of the high risk potential of pesticide use, USAID's Environmental Procedures require that, as part of the IEE, 12 factors (the "Pesticide Procedures") outlined in 22 CFR 216.3 (b)(1)(i) (a through l) be addressed. The 12 factors must be addressed in a separate section of an IEE in which economic, social, and environmental risks and benefits of the planned pesticide use are evaluated to determine if a significant environmental impact will result. This section of an IEE has come to be known as a PERSUAP – a Pesticide Evaluation Report-Safe Use Action Plan. The PERSUAP focuses on the particular circumstances of the program being evaluated and the activities that involve pesticide use and/or procurement, the pesticide management choices available, and the implementation of a safe use action plan (the SUAP) that is designed specifically for the subject program.

USAID's Environmental Procedures, also known as "Reg. 216," state 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). "Assistance for the procurement or use" is interpreted broadly to include assistance in handling, transport, storage, mixing, loading, application, clean up of spray equipment, and disposal of pesticides, as well as providing fuel for transport of pesticides, and providing technical assistance in pesticide use and management. "Assistance for the use of pesticides" is said to occur if recommendations are given for specific pesticides, including a recommendation to procure certain pesticides. "Assistance for the use" includes training curricula with information on safe pesticide use if it involves discussing specific pesticide products or specific agro-chemicals even if training does not involve actual application of pesticides. This definition of "assistance for the use of pesticides" applies throughout this PERSUAP.

This PERSUAP was conducted in accordance with the Scope of Work (Annex A), which states that a PERSUAP should be prepared to enable the PCE [*Projet Croissance Economique*] and Wula Nafaa teams "to respond to and comply with the requirements of USAID Regulation 22 CFR 216.3(b), USAID's pesticide procedures, as well as USAID's *policy* on the use of Integrated Pest Management (IPM). These services [of the Environmental & Social Assessment (ESA) Professional who is undertaking the PERSUAP] will make it possible for the project[s] to comprehensively contribute to environmental and human health and safety on this project[s], while conserving natural resources and achieving project goals."

1.2 PERSUAP methodology

International Resources Group (IRG) procured the services of an ESA Professional (K. Menczer) to work with the PCE and USAID-WN projects to prepare this PERSUAP and to integrate the mitigation measures and recommendations in the *Safe Use Action Plan* into an Environmental Mitigation and Monitoring Plan (EMMP). The ESA Professional travelled to Senegal to work with the PCE and USAID-WN teams, spending one week in Dakar with PCE, and one week in Kaolack with USAID-WN.

She visited agricultural input supply stores in Dakar and Kaolack. While in-country, she worked closely with both teams to prepare this PERSUAP. At the end of the in-country work, she held a debrief for the USAID mission.

During development of this PERSUAP, PCE's Value Chain Leaders and Monitoring & Evaluation (M & E) Specialist were the prime contacts on that project; Wula Nafaa's Kaolack-based specialists (Agriculture Sector Team Leader, Water Resources Management, Agricultural Production, and Agricultural Production Grant Management) were points of contacts for gathering the USAID-WN information.

Following the ESA Professional's departure from Dakar, she continued to coordinate with both teams until the PERSUAP was finalized. Once the PERSUAP is approved by the USAID/Bureau Environmental Officer (BEO, Africa Bureau), key staff of both projects will be trained to implement their respective EMMPs.

1.3 The Global Food Security Initiative

The U.S. President's Global Food Security Response to High Food Prices (GFSR) was designed to address the impact of high global food prices on the economies of developing countries. The GFSI aims to mitigate the impact by increasing agricultural productivity and alleviating barriers to the movement and procurement of food, both locally and regionally, in key vulnerable countries in Africa. Senegal is particularly vulnerable to the rise in global food prices given that the larger part of food staples consumed in the country is imported; therefore, Senegal is a focal country under the GFSR. The GFSR places a particular focus on staple foods and improved access to agricultural inputs and finance.

The GFSR focus complements and reinforces USAID/Senegal's Strategic Objective (SO) 11 strategic framework, and for the present time the GFSR is being pursued as part of the SO 11 portfolio under an "increased food security" rubric. SO11 (described in the Mission's strategic plan) is "Increased Economic Growth through Trade and Natural Resource Management." SO 11 expects to expand economic opportunities by helping citizens generate income from local resources, connect to markets, manage the country's natural resources, and govern more effectively. Activities to achieve the overall SO focus on four Intermediate Results (IRs): IR1: Increased trade capacity; IR2: Improved sustainable management of natural resources and biodiversity; IR3: Improved enabling environment for sustainable growth; and IR4: Improved transparent and accountable management of resources

1.4 The PCE Project: objectives and components

In 2009, International Resources Group (IRG) signed Task Order 5 (Increased Food Security in Senegal) under the SAGIC (Accelerated Growth and Increased Competitiveness in Senegal) IQC. SAGIC has been transformed into the Economic Growth Project, *Projet Croissance Economique* (PCE), under which TO 5 is being implemented. By way of TO 5, over a 4 ½-year period, PCE aims to increase food security in Senegal through the GFSR results:

GFSR 1: Increasing agricultural production and productivity

GFSR 2: Alleviating transportation, distribution, and supply chain bottlenecks

GFSR 3: Promoting sound market-based principles

The activities to be implemented as part of GFSR 1 (the result under which assistance for the use or procurement of pesticides will occur) are expected to result in the increase, even doubling, of production of key staple food crops by 2013, and aim for a 12% increase in the immediate term of 2009/2010.

The PCE components of interest for the PERSUAP are:

Component 2: Value Chain Program

Key elements to be addressed in this component are improved supply chain management for cereal value chains to realize increasingly competitive quality, quantity and pricing of raw materials and to secure raw material supplies. In the case of export/cash crop value chains (VC), emphasis will be placed on expanding and diversifying value-added products and final product markets, capitalizing on both domestic and export market opportunities.

Cereal value chains

Focus areas include, but are not limited to the following:

- ***Irrigated rice*** – Zone of concentration is the Senegal River Valley (SRV) with pilot activities in the Anambé irrigated zone. PCE will consolidate raw material supply chains, with a focus on marketing, milling, and positioning locally-produced rice to better penetrate domestic market segments. The irrigated rice VC will include a focus on traceability, quality assurance, packaging, and labeling to begin to clearly segment supply for a range of domestic rice markets to maximize value addition, margins, and promote local investment.

- ***Rainfed rice*** – While the program for irrigated rice will focus on the harvest/post-harvest-processing-marketing of high quality finished rice, the rainfed program will initially focus on stabilizing and improving yields though the introduction of improved agronomic packages and facilitating access to inputs.

- ***Rainfed maize*** – The major objective is to develop a VC with the capacity to competitively respond to domestic market demand by establishing a supply chain platform that will increasingly ensure the availability of high quality raw materials according to buyer standards.

- ***Irrigated maize*** – The focus is a pilot program to assess opportunities to develop intensive, commercially viable maize production that can meet market demand and promote private sector investment.

- ***Millet/Sorghum*** – Initial activities are intended to address the major constraints associated with inadequate quantities of high quality, homogeneous millet grain available year-round for processing with a focus on improving production, and productivity through the introduction of improved varieties, more economically sound cultural practices, improved post-harvest handling and storage, and facilitating "forward contracting" between several targeted producer groups and processing businesses.

- ***Fonio*** – The focus for this VC is the marketing of fonio. PCE will collaborate with USAID-WN to support fonio VC development. Fonio will not involve the use or procurement of pesticides.

CASH-CROP, EXPORT ORIENTED VALUE CHAINS:

- ***Mango*** – The mango program will focus on three major themes: (1) promote the production of quality mangos though efforts to control fruit flies at the production level by improved maintenance of orchards and at the level of conditioning facilities, possibly by hot water treatment; (2) support certification procedures for exports; and (3) promote the processing of mangos for domestic markets – this will involve finalizing the feasibility study for a processing unit and facilitating linkages with financial partners (banks) to undertake investments.

- ***Banana*** – Work in this VC involves: (1) finalize and present banana VC Study; (2) design and implement a competitiveness study for the banana VC; (3) improve productivity and production by introducing agronomic best practices and improving the quality of and extend the use of healthy plants.

- ***Seed Value Chain*** –The seed VC will emphasize the sustainable development of sources of high quality foundation seed, the multiplication of high quality seed by professional seed producers, and improved seed delivery systems. In this VC, PCE is guided by the Government of Senegal/DISEM guidelines for the production of certified seed from the time of sowing until bagged and labeled for sale. The seed VC may work with the West African Seed Alliance (WASA), although details of the collaboration have yet to be determined. WASA has its own PERSUAP that it is required to comply with.

Other VCs include the following, none of which will include assistance for the use or procurement of pesticides:

- Bissap
- Cashew
- Sesame
- Livestock products
- Dairy

Component 3: Capacity-Building and Applied Research

PCE will develop capacities of various partners and stakeholders, including:

- Primary producers to organize as market operators
- Entrepreneurs to efficiently manage business and integrate value chains
- Small actors to influence the operating environment
- Supported partners to develop sustainability strategies

This component could include capacity strengthening of partners to train in pesticide use and safe practices, including IPM.

1.5 USAID-Wula Nafaa: objectives and components

The general objective of USAID-WN is to contribute to the reduction of poverty and to sustainable local development by increasing revenues of rural producers and communities. This is to be accomplished by assisting local authorities to become more autonomous and by promoting integrated, participatory, decentralized management of natural resources.

USAID-WN's components are:

- Wealth Creation
- Agriculture
- Improved Governance/Potable Water and Sanitation

- Biodiversity and Sustainable Management of Natural Resources
- Policy and Communication
- Cross-cutting activities (Administration, Small Grants, Monitoring-Evaluation-Reporting-Analysis)

This PERSUAP is specifically concerned with the *Agriculture* component, added to the USAID-WN project through an agreement signed in August 2008 between IRG and USAID. The *Agriculture* component seeks to achieve growth in the production of staples and the revenues generated by cash crops by capitalizing on ecological, human, and economic potential in areas of intervention. The *Agriculture* component began by drawing up an action plan for July-August 2009 during a partners' meeting in Dakar. Since then, technical personnel have joined the project (the head of the *Agriculture* component, the irrigation specialist, the specialist in agricultural production, and field facilitators); intervention zones have been identified; the pre-selection of sites for 2009-2010 activities took place; and conservation farming demonstrations on a pilot basis were introduced.

In keeping with the approach of USAID-WN, which is based on the triad Nature - Wealth - Power, the *Agriculture* component's aim is to improve agricultural production in rural areas and to improve access to markets to fight against food insecurity. The component is structured around two overall objectives and six results. Those involving assistance for the use or procurement of pesticides are the following:

Objective 1. To increase agricultural productivity and production

Result 1: Improved new water management systems

This result involves managing water for irrigated production for both local consumption of rice and for cash crops through horticulture. Horticultural activities target sites that are already being used for rain-season rice culture, thus providing an off-season utilization of worked sites.

Result 2: Improved agricultural and animal production

Based on results of VC analyses, products and activities related to better agricultural practices, such as improved seed production and fertility management, will be implemented. Among the techniques and technologies that will be covered are improved rice varieties for lowlands and for plateaus (Nérica rice); conservation farming; and adequate protection of protected areas from agricultural incursions.

Result 3: Better integration of small producers' production into the market for a selected number of key products

On the basis of the VC analyses carried out by USAID-WN and PCE, regional training and animation modules are used so that the best opportunities for revenue-generating products can be identified and prioritized. Under this result, business development services are supported, such as the following:

- Private services that offer agricultural inputs or equipment. Other opportunities to be considered are labor, hulling, pedal or hand pumps for wells around gardens, private tree nurseries for market fruit such as cashew, grafted jujube, and peppers, and chemical treatment of crops by private service providers.
- Access to financial services.
- Improved links with the market for better product flows.

Objective 2. Promotion of sound market principles and implementation of sound agriculture practices and food policies

Result 1: Better use of rules related to production and utilization of technologies by small producers

Some VCs apply techniques and technologies that require certain precautions be taken. Examples are the application of chemical treatments in gardens and conservation methods for cereal products. Activities are targeted at market chains and their specific inputs, techniques, and technologies.

1.6 Assistance for the Use or Procurement of Pesticides by PCE and USAID-WN Projects

Both PCE and USAID-WN use the value chain approach. The following VCs will involve assistance for the use or procurement of pesticides:

PCE: millet and sorghum, maize (irrigated), rice, and the export/cash crops of mango and banana.

USAID-WN: rice (irrigated and rainfed) and market gardens (various vegetables, most common are tomato, cabbage, pepper, okra, and lettuce)

PCE and USAID-WN staff will provide "assistance for the procurement or use, or both," of pesticides in the following situations:

- Both projects will prepare Best Practice Guidelines for pesticide use and integrated pest management. These may include references to specific pesticides that should be used to control specific pests and diseases.
- Both projects will have demonstration and research sites. These will involve the use of pesticides, and may involve procurement of pesticides.
- Both projects will support local firms to provide training in pesticide use and best practices (including IPM).
- Both projects will have radio programs that will discuss good agricultural practices, including best practices in pesticide use.
- PCE will provide technical assistance and training to rural agricultural advisory services and other intermediaries (ANCAR, ISRA, etc.) as part of PCE's "cascading approach." PCE trains these local service providers who will then train producer organizations and individual farmers. Training may include use of pesticides, safe use precautions, and IPM.
- PCE and possibly USAID-WN will support construction of storage facilities for maize and cereal crops, and pesticides may be used in these to protect stocks.
- USAID-WN will work directly with market garden farmers to promote use of less toxic pesticides and best practices. Currently, USAID-WN is funding six community gardens that feed about 1,000 people.
- USAID-WN will work directly with nurseries that supply market garden farmers with vegetable crops and tree crops to help them improve their stock. This will include providing advice on pesticides that can be used within a nursery situation.
- USAID-WN has an agricultural production grant fund which supports activities at the six community gardens (this number could expand), rehabilitation/construction of dams for rice production, and may fund purchase of pesticides and/or technical assistance and training in the safe use of pesticides and IPM.

WN's intervention zones are shown on the maps in Figures 1 and 2. PCE's intervention zones were unavailable in map format.

1.7 Coordination with other USAID SO Level Environmental Documentation

The *Economic Growth through Trade and Natural Resource Management* IEE (June 19, 2009) with attached PERSUAP (Development and Promotion of Integrated Management of Mango Pests in Senegal) evaluated Malatrap, Biotrap, Success APPAT, and neem (Suneem), products also being proposed for use by PCE on mangos. Since that IEE/PERSUAP was prepared, Suneem 1% EC has been registered in Senegal (January 2010 version *Comite Sahelien des Pesticides* – CSP). Rotenone (a component of Biotrap) remains unregistered for use in Senegal. By January 2011, the PCE Export Production Specialist expects sale and use of malathion to be prohibited in Senegal (by the CSP version January 2011).

The Integrated Management of Mango Pests' PERSUAP received approval to use the pesticides noted (Table 1 below) under research conditions. This PERSUAP is proposing use of these pesticides by the PCE mango VC in non-research conditions. PCE will be working with the Integrated Management of Mango Pests' project to ensure results of research are incorporated into the PCE mango VC (see Part 3, the Safe Use Action Plan).

As stated in the Mango Pests' PERSUAP, the objective is to test whether such products ("such products" in this case means the chemicals applied as blanket sprays by large-scale growers for controlling fruit flies or other insect pests such as thrips) can be replaced with less toxic alternatives and achieve equivalent or superior results. PCE is requesting approval (see Part 2, the Pesticide Evaluation Report) to use these less toxic substances.

1.8 International Pesticide Management Agreements/Treaties Signed by Senegal

Senegal is a signatory to the following treaties and agreements; USAID-funded projects must comply with actions stipulated by these agreements.

Prior Informed Consent (PIC) Procedure-the Rotterdam Convention

Senegal ratified the Rotterdam Convention in July 2001. The United Nations Environment Programme (UNEP) and the UN's Food and Agriculture Organization (FAO) had jointly implemented the original PIC procedure, which operated until the adoption of the Rotterdam Convention (officially known as the Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade).

The objectives of the Convention are:

- to promote shared responsibility and cooperative efforts among Parties in the international trade of certain hazardous chemicals in order to protect human health and the environment from potential harm; and
- to contribute to the environmentally sound use of those hazardous chemicals, by facilitating information exchange about their characteristics, by providing for a national decision-making process on their import and export, and by disseminating these decisions to Parties.

Figure 1. Wula Nafaa Agricultural Component Zone

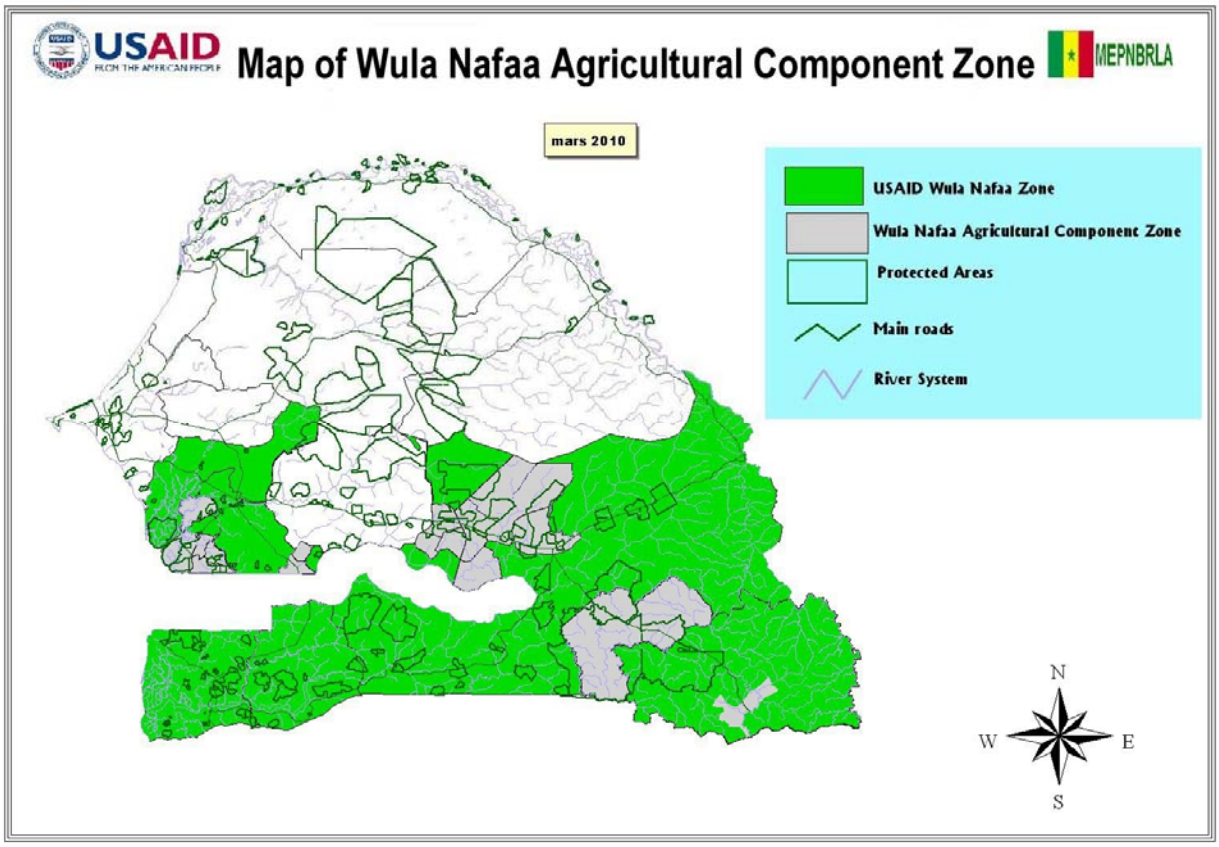
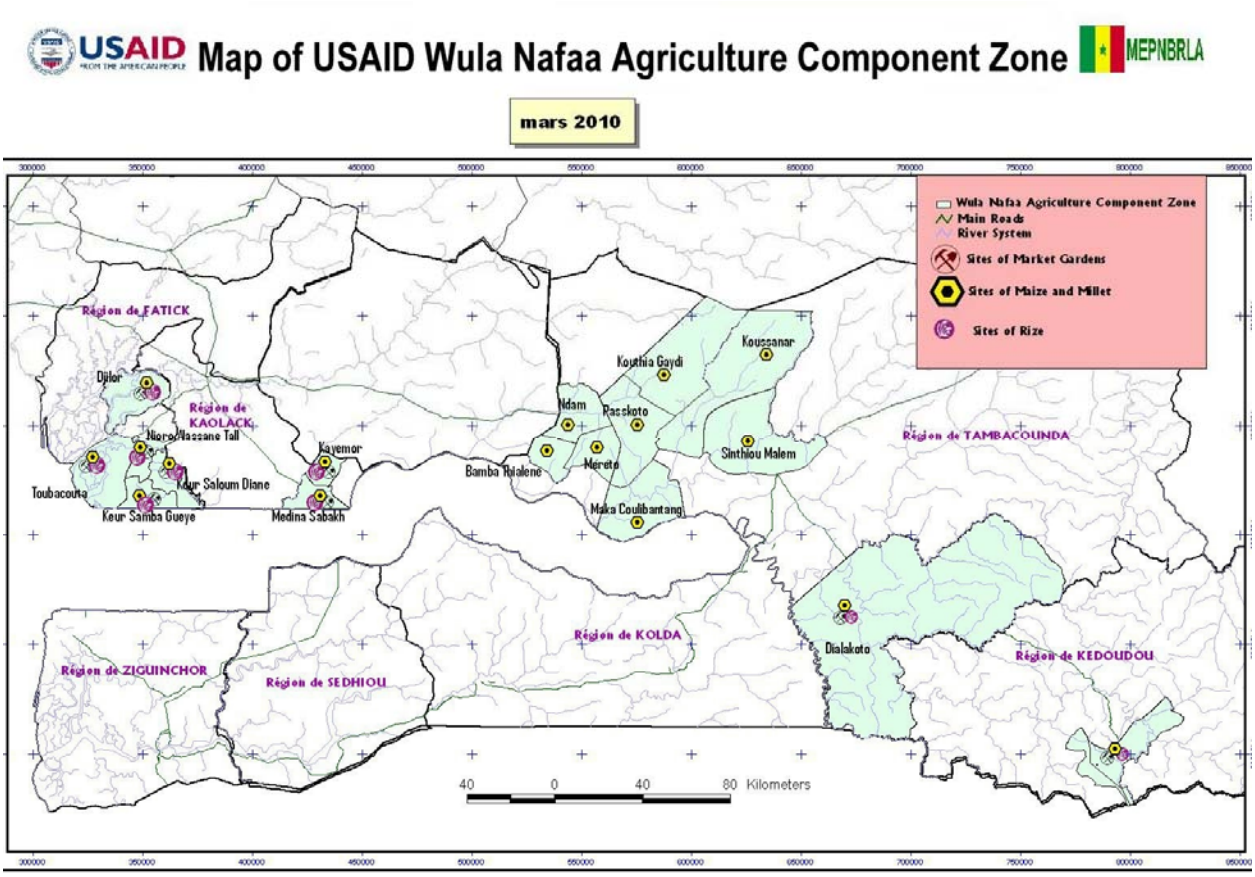


Figure 2. Wula Nafaa Agricultural Component Zone (close-up)



The Convention creates legally binding obligations for the implementation of the PIC procedure. There are 40 chemicals listed in Annex III of the Convention and subject to the PIC procedure, including 25 pesticides, four severely hazardous pesticide formulations, and 11 industrial chemicals. Many more chemicals are expected to be added in the future. The PIC Procedure can be a powerful tool to regulate pesticides (See PERSUAP Annex B for the list of chemicals in Annex III; use of these chemicals should be strongly discouraged by PCE and USAID-WN).

The Stockholm Convention on Persistent Organic Pollutants

Senegal became a party to the Stockholm Convention in July 2004. The Stockholm Convention on Persistent Organic Pollutants (POPs) is a global treaty to protect human health and the environment from chemicals that remain intact in the environment for long periods, become widely distributed geographically, and accumulate in the fatty tissue of humans and wildlife. Given their long-range transport, no one government acting alone can protect its citizens or its environment from POPs. In response, the Stockholm Convention, which was adopted in 2001 and entered into force in 2004, requires Parties to take measures to eliminate or reduce the release of POPs into the environment. See Persistent Organic Pollutants, a Global Issue, a Global Response The Foundation for Global Action on Persistent Organic Pollutants: The United States Perspective (164 pp, 15.0MB) Stockholm Convention home page and http://chm.pops.int/Convention/POPsReviewCommittee/Chemicals/tabid/243/language/en-US/Default.aspx for chemicals currently under review. Annex B contains a list of POPs in the POP treaty; use of these chemicals should be strongly discouraged by PCE and USAID-WN.

Other pesticides of global concern are organophosphate pesticides (OPs), which are among the most acutely toxic pesticides; most of these chemicals are classified by the USEPA as toxicity class I (highly toxic) or toxicity class II (moderately toxic). In addition, some OPs cause developmental or reproductive harm, some are carcinogenic, and some are known or suspected endocrine disruptors. OPs of primary concern are included in Annex B of the PERSUAP. No OPs of primary concern are approved for use by PCE and USAID-WN; because of the significant hazards of using these pesticides, PCE and USAID-WN should actively discourage farmers from using the OPs in Annex B.

PART 2. THE PESTICIDE EVALUATION REPORT (PER)

In accordance with 22 CFR 216, any USAID-funded project that includes assistance for the procurement or use, or both, of pesticides, shall prepare an IEE, which includes a separate section in which 12 factors are discussed. Part 2 responds to the 12 factors (a through l) of USAID's Pesticide Procedures.

(a) The USEPA registration status of the requested pesticide

Table 1 includes all pesticides and products that PCE and USAID-WN projects submitted to the PERSUAP author for screening, as well as suggested replacement pesticides for those active ingredients that failed to pass the initial screening (see below). Included in Table 1 are active ingredients and products that the projects request permission to promote, recommend, use in training, use at demonstration sites, and in some cases procure. Pesticides that were found to be too highly toxic or are not registered for use by the USEPA or the CSP are also shown in the table, but do not pass this initial screening (described further below). The table shows USEPA registration status, WHO and USEPA toxicity levels, and states whether a product is a restricted use pesticide (RUP) or a general use pesticide (GUP) – these terms, as well as World Health Organization (WHO) and USEPA toxicity levels are explained in Annex C.

Table 1 is the initial screening of requested pesticides. **In compliance with Reg. 216, any active ingredient that is not registered by the USEPA (for the same or similar uses) fails the initial screening and is not requested by this PERSUAP for use in the PCE and USAID-WN projects.** These active ingredients appear in red shade in Table 1. **Active ingredients that are WHO toxicity level Ia and Ib or products that are EPA toxicity class 1 are considered too highly toxic for use in these projects, and also appear in red shade below.** These pesticides fail the initial screening.

Pesticides of toxicity levels USEPA 2 or WHO II are being requested for use in these projects, and they are evaluated in subsequent sections of the Pesticide Evaluation Report (b through l) to determine whether they should be approved by this PERSUAP.

Also as required by Reg. 216, no RUPs are being requested by this PERSUAP; only products that are GUPs and products that are similar to USEPA GUPs (formulation and percent active ingredient) are allowed. In accordance with Reg. 216, an Environmental Assessment must be conducted and approved to get approval to use an RUP that is restricted based on environmental concerns; if restricted based on user hazard, an evaluation of the hazards to users and mitigation measures are required. However, typically, for USAID/Africa Bureau, the risks of using/procuring RUPs are considered too great to allow their use in USAID projects.

USEPA rates pesticide products, not the active ingredient, by toxicity class (EPA 1-4) and also rates products as RUPs or GUPs. In several cases, pesticide products registered in Senegal and most widely used in the country are imported from France or are made in-country, and are not registered by the USEPA. In these cases, for the initial screening in Table 1, if similar products were found that are registered by USEPA they are noted in the table, and these were used to determine whether the Senegal-registered product would be considered an RUP or GUP, and to determine the EPA toxicity class.

In addition to registration status, USAID's Pesticide Procedures state that pesticides approved for use in a USAID program must be registered for the same or similar uses by USEPA (without restriction, i.e., not an RUP). "Registered for the same or similar uses by USEPA" means that the pesticides requested must be registered for use on similar crops and for similar pests/diseases. Given that some of the target crops included in the PCE and USAID-WN projects are not grown in the United States, the USEPA typically will not register a pesticide for use on that crop. In the case of pests and diseases, while some may be similar, often a pest is a different species than found in the United States, and for which the pesticide is registered to control. However, for practical purposes, "same or similar use" is considered broadly as a similar family of crops; and the pest or disease was considered similar if it is in the same family. The requested pesticides in Table 1 all can be considered to be "registered for the same or similar uses by USEPA" (22 CFR 216.3(b)(1).

Products not registered for use in Senegal are not being requested in this PERSUAP – they fail the initial screening; these are also shown in red in Table 1. The *Comite Sahelien des Pesticides* (CSP) list of January 2010 was used to determine registration status in Senegal. While rotenone is not registered for use in Senegal, this PERSUAP requests approval to use/recommend Biotrap (with rotenone as the active ingredient) once it is registered (The USAID-supported IPM CRSP is researching Biotrap with rotenone, and the intention is to have this product approved for use in Senegal as a replacement for Malatrap, a more toxic product).

Table 1: Initial Screening of Active Ingredients and Pesticide Products for Registration Status and Toxicity Levels

Red shade: does not pass initial screening due to lack of registration by USEPA or the CSP or high toxicity. Yellow shade: pesticides of concern for which specific mitigation is recommended in the PERSUAP (see Section 3, Safe Use Action Plan). [As the PER proceeds from (b) through (l) other concerns are raised for which additional mitigation is recommended in the SUAP.]

ACTIVE INGREDIENT	PRODUCT	EPA registration status & RUP/GUP	EPA & WHO Toxicity Levels	Issues/Notes/If not registered by CSP, Jan 2010:note below
PCE/Mango				
1) Spinosad 2,4 g/l	SUC-CSESS APPAT 0.24 CB GF 120	GUP	WHO U EPA 3 & 0 (Success) EPA 3 (GF)	Approved for use by June 2009 PERSUAP (research)
2) Malathion + Para-pheromone methyl eugenol	Mala-trap	GUP: all products with malathion GUP: methyl eugenol	WHO III, EPA 1-3 (malathion: most are 3, many are 2, few are 1) WHO NL EPA 3 (methyl eugenol)	Approved for use by June 2009 PERSUAP. Malathion is expected to be prohibited in Senegal by CSP 2011. Methyl eugenol: no risks associated with this substance (USEPA factsheet)
3) Rotenone + Para-pheromone methyl	Biotrap	Most rotenone products are GUPs, few are RUPs (use of this product in a trap will be less toxic than if sprayed or	WHO II EPA 1- 3 (rotenone) WHO NL EPA 3	Approved for use by June 2009 PERSUAP (research). Product will replace Malatrap once malathion is prohibited. Rotenone is not registered by CSP, 2010; it shall not be used

ACTIVE INGREDIENT	PRODUCT	EPA registration status & RUP/GUP	EPA & WHO Toxicity Levels	Issues/Notes/If not registered by CSP, Jan 2010:note below
eugenol		broadcast. GUP: methyl eugenol	(methyl eugenol)	by PCE until registered. Rotenone is highly toxic to fish; disposal is an issue that must be addressed in SUAP.
4) Azadirach-tin, 10 g/l (Neem)	Suneem 1% EC	GUP	EPA 3 WHO NL	Approved for use by June 2009 PERSUAP.
PCE/Banana				
1) Metarhizium flavoviride anisoplae	Green muscle	GUP (similar product)	WHO NL EPA 3	
2) Sulfur	Atenea DF	All products are GUPs	EPA 1-3 (almost all products are EPA 3) WHO U	
3) Eucalyptus	Euca-lyptus oil	All products are GUPs	WHO NL EPA 2, 3	(Highly flammable—issue for transport, storage, application, disposal)
PCE/Millet and Sorghum				
1) Glyphosate	GLYPHADE R 75	GUP (product similar to Departure, registered by EPA)	WHO U EPA 3	
2) Propanil (480 g/l)	TOPRANIL 480 EC	GUP (product similar to Propanil 48, reg'd by EPA)	WHO III EPA 3	
3) Thiamethoxa m 20g/kg+ difenoconazol e 2g/kg	A-PRON STAR 42 WS Seed treat-ment	GUP (similar to Meridien); difenocononazole similar to other GUP products	WHO NL, EPA 3 (thia) WHO III, EPA2, 3 (difen)	
4) Imidacloprid 350 g/kg + Thiram 100 g/kg	IMIDALM T 450 WS MOMTAZ 45 WS	Similar to Atera, GUP All thiram products are GUPs	WHO II, EPA 3 (Imid) WHO III(Thi), all are EPA 2, 3	
5) Spinosad	SPINTOR POUDRE	Similar products are GUPs	WHO U	
6) Fenitrothion/ primiphos-methyl	Sumithion Actellic (500 g/l p-m)	Actellic: 2 products cancelled by EPA; 1 is GUP	Actellic: EPA 1(this product is similar to the product registered by CSP (Jan 2010) WHO II	Sumithion not registered in Senegal (CSP 2010); EPA 1 not approvable in PERSUAP
7) phosphure d'aluminium (570 g/l) fumigant (Aluminum	DETIA GAS EX-B	RUP	WHO Ib	Not approvable in a PERSUAP: RUP and WHO 1b

ACTIVE INGREDIENT	PRODUCT	EPA registration status & RUP/GUP	EPA & WHO Toxicity Levels	Issues/Notes/If not registered by CSP, Jan 2010:note below
phosphide)				
PCE/Rice				
1) Propanil 360	Propanil	GUP	WHO III, EPA 3	
2) 2,4 – amine salt or 2,4 D	Herbextra 720 SL Malo Binfaga 720g/l	GUP All similar products are GUPs	WHO II EPA 1-3 (various formulations)	
PCE/Maize (irrigated)				
1) Cyperme-thrin			WHO 1b (parent chemical.)	Too highly toxic; not approvable in PERSUAP
PCE/Maize (rainfed)				
1) Ametrine 250 g/l + Atrazine 250 g/l + glyphosate 60g/l.	Atrafor		Ametryne, WHO III Atrazine, WHO U Glyphosate, WHO U	Atrafor not registered by CSP, Jan 2010; not approvable in PERSUAP
2) Pendimethalin 400 g/l	Activus 500 EC	GUP (for products similar to this that are EPA registered)	WHO III EPA 3	
3) Glyphosate 360 g/l	Dango-roba, Gly-phalm 360 SL, Domin-ator 360 SL	GUP (for products similar to this that are EPA registered)	WHO U EPA 3	
4) Thirame 15%, Benomyl 7% + Carbofuran 10%	Spinox		Carbofuran cancelled by EPA	Carbofuran, not approvable in PERSUAP
5) Permethrine 100g/l	PERCAL 100 EC			Product not registered for use in Senegal, CSP, Jan 2010; no Permethrin-only product is registered in Senegal
USAID-WN/Market gardens (most common crops are tomato, cabbage, pepper, okra, and lettuce)				
1) Maneb-Mancozeb	Man-cosan (PM) 70% active/1 kg	GUP (product is similar to Dithane M 45)	WHO U EPA 3	
2) Deltamethrin	Decis 25 EC (25 g/l)	RUP (similar to Decis 0.2 ec	WHO II EPA 1	RUP is based on aquatic toxicity: an EA would be needed for USAID approval.
3) Dimethoate	Systoate (Concentrated liquid, 40% active /1 liter)		WHO II EPA 2 (similar to Dimethoate 4ec)	Organophosphate On PAN website, dimethoate is an "OP of primary concern"
4) Azadirachtin	Suneem 1% EC	GUP	WHO NL EPA 3	

ACTIVE INGREDIENT	PRODUCT	EPA registration status & RUP/GUP	EPA & WHO Toxicity Levels	Issues/Notes/If not registered by CSP, Jan 2010:note below
(Neem)				
5) Furadan	Carbofuran, 10% active/1 kg		WHO 1b Furadan/carbofuran cancelled by USEPA	Not approvable in a PERSUAP
USAID- WN Rice				
1) Propanil	Propanil 360 g/l	GUP	WHO III, EPA 3	
2) 2,4 – amine salt or 2,4 D	Weedon (720 gr/Liter) Herbextra 720 SL Malo Binfaga 720g/l	GUP All similar products are GUPs	WHO II EPA 1-3 (various formulations)	Weedon not registered by CSP 2010
Possible replacements for deltamethrin, dimethoate, and furadan				
Bacillus thuringiensis	Batik	GUP	WHO NL EPA 3	Registered in Senegal; available in Senegal; possible replacements for deltamethrin and dimethoate in market gardens.
Thiame-thoxam	Actara 25 WG	GUP	WHO NL EPA 3	
Indoxacarb	Avaunt 150 EC	GUP	WHO NL EPA 3	
Chlorpyri-fos-ethyl	Spiphor 5G powder	Depends on formulation; many are RUPs.	WHO II EPA 1, 2, 3: depends on formulation	Registered in Senegal; available in Senegal; possible replacement for furadan in market gardens. While not a low toxicity product, it is less toxic than furadan, which is commonly used.

(b) Basis for selection of the requested pesticides

Table 2 shows the reasons why PCE and USAID-WN selected the requested pesticides. The responses were provided by PCE and USAID-WN value chain leaders/agricultural specialists.

Only pesticides from Table 1 that passed the preliminary screening (registered by USEPA and by the CSP, EPA and WHO toxicity classes > I), are evaluated further in Table 2 (and in (c) through (l) below). There is one exception—Biotrap with rotenone as the active ingredient. This pesticide is included in subsequent *Pesticide Factors* because due, in part to the efforts of the USAID IPM CRSP, it will likely be approved for use in Senegal within the timeframe of PCE, and because in some cases (not aquatic toxicity, however), it is less toxic than the alternative, Malatrap (with malathion as the active ingredient).

Table 2: Basis for Selecting the Requested Pesticides

ACTIVE INGREDIENT	PRODUCT	Basis for selection
PCE/Mango		
Spinosad 2,4 g/l	SUCCSESS APPAT 0.24 CB GF 120	This set of pesticides is being tested by the Integrated Management of Spinosad, malatrap, and biotrap are considered highly effective; while neem is usually effective, but cannot be relied on for broad spectrum control. All four pesticides requested for use on mangos are widely available in Senegal and are relatively inexpensive. As compared with many of the traditional pesticides used, these pesticides are relatively safe, especially spinosad and azadirachtin. Malathion and rotenone are more highly toxic, but when used in a trap, they are less likely to present risks to the environment and human health. Storage and disposal of pesticides used in trap form remain concerns; these are addressed by the Mango Pest Management CRSP, and mitigation measures developed for that USAID-funded project will also be implemented by PCE (see SUAP).
Malathion + Parapheromone methyl eugenol	Malatrap	
Rotenone + Parapheromone methyl eugenol	Biotrap	
Azadirachtin, 10 g/l (Neem)	Suneem	
PCE/Banana		
1) Metarhizium	Green muscle	Highly effective against grasshoppers and locusts; available, inexpensive; and relatively safe as compared with commonly used alternatives. This is a biological insecticide.
2) Sulfur	Atenea DF	Relatively safe to use, and effective against fungus
3) Eucalyptus	Eucalyptus oil	A natural pesticide and relatively non-toxic; important for overcoming pest resistance; available and inexpensive; and because it is traditionally used against insect pests on banana.
PCE/Millet and Sorghum		
1) Glyphosate	GLYPHADER 75	Together these two products provide effective weed control. Both products are widely available, and they are well-known to farmers and agricultural service agents. Glyphosate is a broad-spectrum, non-selective systemic herbicide.
2) Propanil (480 g/l)	TOPRANIL 480 EC	
3) Thiamethoxam 20g/kg+ difenoconazole 2g/kg	APRON STAR 42 WS Seed treatment	These two pesticides are considered less dangerous than other options, are recommended by agricultural service agents, and are widely available.
4) Imidacloprid 350 g/kg + Thiram 100 g/kg	IMIDALM T 450 WS MOMTAZ 45 WS	
5) Spinosad	SPINTOR POUDRE	Necessary and highly effective for seed treatment; less toxic than other seed treatment options.
PCE/Rice		
1) Propanil 360	Propanil	Efficacious, available, and cost-effective. These are used on rice only if manual weeding and other non-chemical measures are unable to control undesirable weeds. They are traditionally used in rice growing areas in Senegal. 2, 4-D is useful because it is a broad-spectrum, non-selective systemic herbicide.
2) 2,4 – amine salt or 2,4 D	Herbextra 720 SL Malo Binfaga 720g/l	
PCE/Irrigated Maize		

ACTIVE INGREDIENT	PRODUCT	Basis for selection
None		
PCE/Rainfed Maize		
1) Glyphosate 360 g/l	Dangoroba, Glyphalm 360 SL, Dominator 360 SL	Glyphosate is highly effective when manual weeding alone is unable to control weeds. It is available and relatively inexpensive. Glyphosate is a broad-spectrum, non-selective systemic herbicide.
Pendamethaline	Activus 500 EC	Proposed by PCE as a replacement for Atrafor, which is not registered by the CSP. Activus is available in Senegal, and is a less toxic alternative to Atrafor.
USAID-WN/ Market Gardens		
1) Maneb-Mancozeb	Mancosan (PM) 70% active/1 kg	Available, safe to use, highly effective, traditionally used by gardeners, short delay between application and harvest (3 days)
2) Dimethoate	Systoate (Concentrated liquid, 40% active /1 liter)	Used at the beginning of production (typically followed by Decis close to the harvest, to avoid the resistance, however Decis is not approved for use in this PERSUAP—see Table 1); available; highly effective, but a long delay needed between application and harvest. With Decis, these pesticides are highly effective against a broad array of pests; without Decis, dimethoate is less effective.
3) Azadirachtin	Suneem 1% EC	Used with other insecticides as a "repulsive" insecticide to minimize need for more highly toxic pesticides.
USAID-WN/Rice		
1) Propanil	Propanil 360 g/l	Efficacious, available, and cost-effective. These are used on rice only if manual weeding and other non-chemical measures are unable to control undesirable weeds. They are traditionally used in rice growing areas in Senegal. 2, 4-D is useful because it is a broad-spectrum, non-selective systemic herbicide.
2) 2,4 – amine salt or 2,4 D	Herbextra 720 SL Malo Binfaga 720g/l	
Requested Replacement Pesticides		
1) Bt	Batik	These pesticides are being proposed as possible replacement pesticides for deltamethrin, dimethoate, and carbofuran. They are less toxic than the pesticides currently being used. Bt, thiamethoxam, and indoxacarb can be used to control a large variety of pests on many different vegetables (useful in USAID-WN's market gardens). They are available and highly effective when used in conjunction with an IPM approach. Chlorpyrifos-ethyl was recommended by an agro-input supply shop owner in place of furadan. There are no other viable alternatives, and it is yet to be determined if this will be effective.
2) Thiamethoxam	Actara 25 WG	
3) Indoxacarb	Avaunt 150 EC	
4) Chlorpyrifos-ethyl	Spiphor 5G powder	

(c) The extent to which the proposed pesticide is part of an IPM program

For this PERSUAP, PCE and USAID-WN VC staff were asked to provide information on IPM measures used to control key pests on their VCs. Each staff member who oversees a VC provided this information. Then, separately, with the PERSUAP author, the staff of PCE and of USAID-WN discussed the measures; whether they are widely used and effective; and the IPM training that farmers, extension staff, and other service providers have had in the past.

In discussions with PCE staff, it was evident that use of IPM among producers in PCE VCs is spotty, and there is no overarching strategy for IPM. There continues to be considerable need for training of all

actors in the VCs, including PCE staff, who while they are aware of IPM practices, their knowledge is limited. PCE uses intermediaries (the cascade system) to provide information and services to producers and producer organizations. One of the services that these intermediaries have provided in the past, and could provide with PCE support is training in IPM. Green Senegal and Ceres Locustox are two service providers that PCE currently works with that provide information and training in IPM. CropLife and DPV also have expertise in IPM training. However, first, there is a need to evaluate the level of knowledge and type of training of the realm of IPM trainers to ensure that PCE gets the best and most effective IPM training available. Training on several levels may be needed: the trainers (CropLife, etc.) may need training, PCE staff in the field and in headquarters, and ANCAR and other rural agricultural services who most interface with producers and producer organizations will need to be trained. The SUAP includes recommendations for safe use and IPM training, as well as other measures to strengthen application of IPM (see Part Three)

USAID-WN staff interact directly with rice and market garden producers. For market gardens, the guiding framework for pesticide use and IPM is a manual developed by the *Centre pour le Developpement de l'Horticulture* (CDH). However, this has several shortcomings—the manual fails to make clear that pesticides are the control of last resort, and the manual includes recommendations for highly toxic pesticides, some of which are no longer registered in Senegal. In addition, the IPM measures in the manual are grouped with the recommended pesticides, so it is unclear that non-chemical measures should be the first resort. Also, information about monitoring/surveillance and recordkeeping for IPM is minimal. For the rice VC, traditional IPM measures are used (see Table 3). There is a critical need for technical assistance and training in the application of IPM measures for USAID-WN staff and their VC producer stakeholders and beneficiaries. The SUAP contains recommendations for training to address this need.

Table 3 describes the current IPM measures for the most common pests and diseases found in each of the PCE and WN VCs. These IPM measures are recommended by agricultural services, Senegal-based research institutes, and/or are traditionally used by producers. USAID-WN staff recommend these measures directly to rice and market garden producers. PCE staff have been and will continue to rely primarily on service providers to give this information to VC partners.

Table 3: IPM Measures: the extent to which the use of proposed pesticides are part of an IPM program

Pests: Insects/ Diseases	Pesticides	IPM measures
Rice (Wula Nafaa & PCE)		
Weeds	propanil, 2,4-D	Use clean rice seed, without weed seeds; use herbicides only post-emergence--only use when weeds are present; manual weeding and plowing when possible so there are fewer weeds in the rice fields; implement good water management and ensure soil drainage so as not to encourage weeds. For rice in the southern part of the country, the USAID-WN plan is to rotate between rice (rainy season) and market gardens (dry season). Crop rotation should reduce pest prevalence.
Mangos (PCE)		
Fruit flies	Spinosad, malatrap, biotrap, neem	Good field sanitation and surveillance (These IPM measures were provided by the mango VC leader; the Mango Pests' PERSUAP has additional and very detailed and valuable information on IPM for fruitflies. The SUAP includes a recommendation to coordinate with that project.)
Bananas (PCE)		
Grasshoppers and locusts	Metarhizium	Good field sanitation and surveillance
Powdery mildew	Sulfur	Good field sanitation and surveillance

Pests: Insects/ Diseases	Pesticides	IPM measures
Insects: broad spectrum	Eucalyptus	Good field sanitation and surveillance
Millet & sorghum (PCE)		
Weeds	Glyphosate Propanil	Manual weeding; conservation farming: mulching, fertilizing, good water and soil management
Ants	Thiamethoxam + difenoconazole Imidacloprid & thiram (Imdalm and Momtaz)	No IPM for seed treatment
Insects that attack stored grain	Spinosad	To protect cereal stock, grain is spread on a black plastic sheet in the sun and covered with transparent plastic. The heat kills insects that attack stored grains. If this is not successful, spinosad is used as a last resort.
Irrigated Maize (PCE)		
None		
Rainfed Maize (PCE)		
Weeds, pre and post-emergence	Glyphosate and Pendamethlin	Good water management, good field sanitation, manual weeding
WN: Market gardens		
Fungus diseases : Alternariose, cercosporiose, cladosporiose, Rouille (fungus caused by bacteria or mushroom), Septoriose et stemphyliose ; and mildew, Pink Rot (one of the most common diseases of vegetables)	Maneb/Mancozeb	Use of crop rotation, planting schedules, spacing, and other good practices using the SIGESCO maraichage method ("SIGESCO for gardens"—SIGESCO is Simulation Management Accounting, and is a tool to help train farmers learn to rotate families of crops, and plan for input needs, such as fertilizers, pesticides, and other inputs from planting to harvest). Other IPM measures include use of resistant varieties and use of pesticides as a last resort.
caterpillars, verts des fruits, thrips, and beetles	Deltamethrin replacements: Bt, thimethoxam, Indoxacarb	Crop rotation using SIGESCO method, fallows, and farmer training in repulsive natural products (neem), use of resistance varieties, good water management, and use of pesticides as a last resort.
Pucerons, mouches des cucurbitacées (curcubits), and red spider	Dimethoate: possible replacements once phased out: Bt, thimethoxam, Indoxacarb	Crop rotation using SIGESCO method, fallows, use of "repulsive" natural products (neem), use of resistant varieties, good water management, and use of pesticides as a last resort.
Used to control soil insects (nematodes, diplopodes, fourmis) and for the treatment of pépinières.	Chlorpyrifos-ethyl	Crop rotation using SIGESCO method, fallows, use of "repulsive" natural products (neem), use of resistant varieties, good water management, and use of pesticides as a last resort.

(d) Proposed method or methods of application including availability of appropriate application and safety equipment

In general, application equipment and safety equipment are available in urban and peri-urban centers at agro-chemical supply stores. In the Senegal River Valley (SRV), masks, gloves, and boots are available, but are highly underutilized. In the south, safety equipment may not be available.

The PERSUAP team visited agricultural supply stores in Kaolack and Dakar. All stores had handheld and backpack sprayers, and masks. The team also noted that at markets in urban and peri-urban areas, and in rural markets, application equipment and basic safety equipment is available, such as boots and

gloves. Proper masks are rarely available. Most of those interviewed for this PERSUAP stated that small farmers rarely use safety equipment; that gloves and boots are the most common safety equipment used; and that container labels regarding safety gear are rarely complied with. In part this is due to the heat—safety equipment is uncomfortable when worn in hot and humid conditions; in part it is because of the cost; and in part because some farmers fail to fully understand the risks (one interviewee, an agricultural supply shop owner, stated that farmers often tell him that a pesticide kills small insects, but because he's big, the pesticide can't hurt him).

The SUAP includes recommendations to promote the use of safety equipment, and the proper maintenance of application equipment.

Table 4: Current method of application of requested pesticides

Pesticide	Method of Application
Mango	
1) Spinosad	SUCCSESS APPAT 0.24 CB is applied on the basis of square meters of leaf surface at a rate of 21 liters/hectare with 4 applications/campaign every 10 days during the period of high infestation during the growing season. It is an alimentary trap used for male and female fruitflies.
2) Malathion + Parapheromone methyl eugenol	Contains both an attractant and an insecticide. It is placed at a high level in a tree; one trap with malatrap or biotrap is used for every ten trees. The traps are emptied every seven days and the active ingredient is replaced every 15 days.
3) Rotenone + Parapheromone methyl eugenol	
4) Azadirachtin, 10 g/l (Neem)	1% of 1 liter of protein hydrolysates in 20 liters of water, applied per hectare as bait for both male and female fruitflies.
Banana	
1) Metarhizium	Metarhizium is disseminated by spores produced in mushrooms. This is placed in a lipid suspension, and after germination, it penetrates the cuticle of the insect and begins to develop inside the host which, once infected, reduces its feeding and movement before causing the insect to dry out in 6 to 10 days.
2) Sulfur	ATENEA DF : This is applied at two key periods: At the foliage stage as a preventative; and at flowering to the closure of the flower clusters. Treatments are done every 8-10 days maximum, at a dose of 8-10 kg/ha for a preventative treatment. It is important that the mixture penetrate the roots as well as cover the flower clusters. It is used to control powdery mildew.
3) Eucalyptus	Used as a spray
PCE/Millet and Sorghum	
1) Glyphosate	Backpack sprayer (manual for smallholder farmers; motorized for larger acreages and tree crops)
2) Propanil (480 g/l)	Backpack sprayer (manual for smallholder farmers; motorized for larger acreages and tree crops)
3) Thiamethoxam 20g/kg+ difenoconazole 2g/kg	Seed treatment
4) Imidacloprid 350 g/kg + Thiram 100 g/kg	Seed treatment
5) Spinosad	Used for stocks that are to be used for feed
Rice (PCE and USAID-WN)	

1) Propanil 360 gr/liter of MA 2) 2,4 – amine salt or 2,4 D	In the SRV, these herbicides are applied through the irrigation system for irrigated rice. In the SRV and in the south, for rainfed rice, very simple backpack sprayers are used. In the south, farmers use backpack sprayers obtained from Sodefitex, the industrial cotton firm operating in the region. In the north there is a well established network of support services for maintenance; whereas in the south, these services are lacking.
PCE/Maize (irrigated)	
None	
PCE/Maize (rainfed)	
1) Glyphosate 360 g/l & pendamethalin 500 EC	Applied to un-weeded fields no later than 48 hours after sowing.
USAID-WN/Market gardens	
1) Maneb-Mancozeb	**Wettable powder, spayed as a preventive**
2) Dimethoate	Liquid concentrate, sprayed, preventative, and at flowering
3) Azadirachtin	Foliar spray
1) Bt 2) Thiamethoxam 3) Indoxacarb 4) Chlorpyrifos-ethyl	(1-4) These pesticides are proposed as replacement pesticides, and have not yet been used on market gardens. It is assumed they will be applied using backpack sprayers or hand held sprayers, which are the most common methods of application, in general. These are usually hand-pressurized rather than motorized.

(e) Acute and long-term toxicological hazards, either human or environmental, associated with the proposed use and measures to minimize hazards

In Table 4, the acute and chronic human and environmental toxicological hazards are listed for each pesticide that passed the initial screening in Table 1. Special concerns are also noted (medium toxicity ranking and above). Mitigation measures, which are expected to minimize concerns (column 3) are recommended in the SUAP, Part 3.

Table 4: Acute and Long-term Human & Eco-Toxicty

NT: not toxic; RNT: relatively non-toxic; ST: slightly toxic; MT: medium toxicity; HT: highly toxic

Active Ingredient	Human & Environmental Toxicological Hazards	Concerns
1) Spinosad	NT orally or dermally, or via inhalation. No body organs affected. No reproductive effects; non-mutagenic; non-teratogenic; non-carcinogenic; not a known endocrine disruptor. HT to bees; MT to ST to fish; ST to HT to aquatic invertebrates; NT to birds, livestock/domestic mammals, aquatic plants, beneficial arthropods. No data on earthworms	Special concerns: bees, aquatic invertebrates.
2) Malathion + Methyl eugenol	Malathion: Acute oral – slightly toxic Dermal – slightly toxic; Inhalation – relatively toxic Can cause slight to substantial but temporary eye irritation May cause allergic contact dermatitis Chronic possibly affecting mammalian reproduction, being mutagenic, carcinogen, potential endocrine disruptor HT to fish, bees, amphibians, aquatic invertebrates, beneficial arthropods, earthworms May pose a risk of groundwater or surface water contamination in environmental situations which may be less conducive to breakdown.	Special concerns: Pesticide handlers, aquatic invertebrates, tadpoles, earthworms, honeybees, beneficial arthropods.

	Methyl eugenol: From USEPA factsheet: No risks are associated with use of these natural substances in food or elsewhere. In fact, the chemicals are considered so safe that there generally is no need to set an upper limit on the amounts that can be found in food. However, these chemicals are often used in bait traps that also contain toxic chemicals to kill the trapped insects. Therefore, instructions on the bait products need to be followed carefully to ensure they are used safely	
3) Rotenone	Inhalation risk: MT to humans; acute dermal: MT; teratogenic effects: inconclusive; mutagenic: inconclusive; carcinogenic: inconclusive; Chronic: HT; ST to birds; VHT to fish and other aquatic resources; NT to bees; not expected to be a groundwater contaminant	Special concerns: risk to humans; high toxicity to fish.
4) Azadirachtin	Acute oral – relatively nontoxic; Dermal – slightly toxic; Inhalation -- relatively nontoxic; A mild skin irritant; No chronic toxicity noted HT to fish; MT to aquatic invertebrates; RNT to bees, beneficial arthropods; Potential for mobility in the soil is very low and accumulation in the environment is not expected	Special concerns: fish and other aquatic resources
5) Metarizium	Not acutely or chronically toxic to humans; ST to fish and other aquatic resources and to amphibians; RNT to non-target insects; unlikely groundwater contaminant	None
6) Sulfur	Acute oral – relatively nontoxic; Dermal – slightly toxic; Inhalation – relatively nontoxic; irritating to the skin, eyes, and mucous membranes; No chronic effects noted ST to fish; RNT to birds, aquatic invertebrates, bees, beneficial arthropods Sulfur is a natural component of the environment and is slowly converted to sulfate in soil by autotrophic bacteria. Elemental sulfur leaches in soil as sulfate at a slow rate.	None
7) Eucalyptus	Acute inhalation toxicity; acute dermal toxicity; no chronic toxicity to humans observed; unknown toxicity to other mammals, birds, and aquatic resources; unlikely groundwater contaminant	None
8) Glyphosate	Acute oral – RNT; Dermal – RNT; Inhalation –RNT; Eye irritant; Minimal chronic effects documented MT to amphibians, aquatic invertebrates, beneficial arthropods and earthworms; ST to fish RNT to birds, bees; Hazard from drift to nearby crops/ vegetation/biodiversity Highly soluble (12000 mg/l) but does not leach appreciably due to high soil adsorption Half life in soil highly variable (3-174 d)	Special concerns: amphibians, aquatic invertebrates, beneficial arthropods, earthworms
9) Pendimethalin	Inhalation, absorbed by skin, skin irritant: ST; eye irritant: MT; No chronic health effects noted to date; currently being tested for carcinogenicity (unknown, but doubtful); NT to birds; HT to fish and aquatic invertebrates; NT to bees and non-human mammals.	Special concern: fish and aquatic invertebrates
10) Propanil	Acute oral – RNT; Dermal – RNT; Inhalation – ST Not irritating to skin or eyes; No chronic health effects noted to date MT to birds, fish, aquatic invertebrates Degraded by microbes in soil. Moderately soluble in water (130 mg/l) not a groundwater contaminant as degrades in a few days	Special concern: birds, fish, aquatic invertebrates
11) Thiamethoxam +	Thiamethoxam: Acute-unknown; unknown dev/reprod toxin and	Special concerns: fish and

Difenoconazole	endocrine disruptor; likely carcinogen; not a cholinesterase inhibitor. HT to aquatic organisms and bees; MT to wildlife. Difenoconazole: Acute oral – RNT; Dermal – ST; Inhalation – RNT; irritating to skin; risk of serious but reversible damage to eyes; not teratogenic or mutagenic HT to fish, aquatic invertebrates; MT to aquatic plants; RNT to birds, bees Strongly adsorbs to soil particles, low potential to leach; Relatively persistent in soil	other aquatic organisms, bees, wildlife
12) Imidacloprid + Thiram	Imidacloprid: Acute oral – MT; dermal – ST; inhalation – ST; Mild dermal irritant; may be weakly mutagenic; minimal carcinogenic risk HT to birds, bees, beneficial arthropods; MT to fish There is a potential for the compound to move through soil due to high solubility (500 mg/l) but has moderate binding affinity to organic materials in soils (half-life in soil is 48-190 d) Thiram: Acute oral – RNT; Dermal – ST; Inhalation – RNT; Moderate eye irritant; prolonged exposure could lead to progressive lung disease HT to fish; MT to aquatic inverts; ST to birds; RNT to bees Minimal threat to groundwater due to short half life (<1 week) Does not accumulate in the soil	Special concerns: human by ingestion, inhalation, and eye irritation; bees and other non-target insects, birds, fish and aquatic ecosystems
13) 2, 4 –D or 2, 4-amine salt	Serious eye and skin irritation toxicity. Headache, nausea and weakness from inhalation. Ingestion causes abdominal pain, burning sensation, diarrhea, vomiting, unconsciousness and weakness. Possible chronic exposure teratogenic and carcinogenic affects. Moderately toxic to birds. May kill fish and earthworms. Slightly toxic to insects and amphibians. Slight affect on bees. Has *potential* to enter ground water.	Special concerns: human toxicity; birds, fish, earthworms, and groundwater contaminant
14) Maneb-Mancozeb	Acute oral – relatively nontoxic; Dermal – relatively nontoxic; Inhalation – relatively nontoxic May cause mild irritation of nose, throat, eyes and skin; Probable human carcinogen Endocrine disruption; Chronic usage may cause sensitization rashes; HT to fish, aquatic invertebrates; MT to bees, aquatic plants; RNT to birds; Moderate potential to contaminate groundwater due to short half life (6-15d); Does not accumulate in the soil	Special concerns: toxicity to fish and aquatic invertebrates, and grazing animals; and potential carcinogenic action in humans.
15) Dimethoate	Acute oral – MT; Dermal – ST; Inhalation – ST; Contact with the skin may be irritating and dermatitis and dermal sensitization may occur may produce a transient corneal injury. Potential endocrine disruptor, affects reproductive system, teratogenic and mutagenic, possible carcinogen HT to birds, bees, beneficial arthropods; MT to fish, aquatic invertebrates, domestic and wild mammals Soluble in water (25 g/l) and thus has potential to enter groundwater. Low persistence in the soil	Special concerns: Human health hazard; **r**isk to handlers is high; birds, bees, and beneficial arthropods, fish, aquatic invertebrates, domestic and wild mammals. Considered a pesticide of Special Concern by USEPA (see Annex B)
16) Bt	Acute oral –RNT; Dermal – RNT; Inhalation –RNT; Solvents may irritate the eyes; No chronic toxicity noted in mammals RNT to bees, fish, birds, mammals, aquatic invertebrates, beneficial arthropods Potential to enter groundwater is very low.	None

	Does not accumulate in the environment.	
17) Thiamethoxam	Acute-unknown; unknown dev/reprod toxin and endocrine disruptor; likely carcinogen; not a cholinesterase inhibitor. HT to aquatic organisms and bees; T to wildlife.	Special concerns: Aquatic ecosystems, bees, and terrestrial wildlife
18) Indoxacarb	Moderate eye irritation. Can be absorbed through skin. Harmful if inhaled. No teratogenic, reproductive, or carcinogenic effects. Highly toxic to bees. Can kills mammals, birds, fish and aquatic invertebrates.	Special concerns: risk to humans (eye irritation), birds, bees, fish, aquatic invertebrates, and domestic and wild mammals.
19) Chlorpyrifos-ethyl	Cholinesterase inhibitor. Organophosphate that attacks central nervous system, cardiovascular system, and respiratory system. Muscle twitch, weakness, tremor, headache, nausea, vomiting, diarrhea, dizziness, tightness of chest, pin-point (very small) eye pupils, blurred vision, convulsions, seizure. Suspected endocrine disruptor. Not likely carcinogen. Kills amphibians, worms, crustaceans, fish, mollusks, nematodes, flatworms, aquatic insects, phytoplankton and zooplankton. Toxic to birds and bees. Harms aquatic plants.	Special concerns: impacts to humans, birds, bees, and all aquatic organisms, birds, bees.

(f) Effectiveness of the requested pesticide for the proposed use

One of the criteria that PCE and USAID-WN staff used to select the pesticides they proposed in this PERSUAP (Table 1) is effectiveness. In the subsequent analyses in the PERSUAP, in some cases, effectiveness had to be compromised in favor of a less toxic pesticide. For example, furadan, cypermethrin, deltamethrin, and aluminum phosphide are highly effective, yet they were considered too highly toxic by the PERSUAP team to request approval for in the PCE and USAID-WN projects (these pesticides failed to pass the initial screening in Table 1).

Resistance to pesticides was also considered in the final pesticide selections for this PERSUAP. If pests develop resistance, the requested pesticides of course would be less effective; additional pesticides may then be needed. However, given the available and registered pesticides in Senegal (the list of registered pesticides is relatively short, and choices are limited), and the need to choose less toxic options, the requested pesticides are expected to be as effective as possible—especially when used within an IPM framework. Factor (l) discusses expectations for monitoring the effectiveness of the requested pesticides.

(g) Compatibility of the proposed pesticide with target and non-target ecosystems

The effect of each requested pesticide on non-target ecosystems depends in part on toxicity; whether the pesticide is broad spectrum; whether it is systemic; and how persistent the pesticide is in the environment (its half-life). While pesticide effects on non-target ecosystems and organisms is a concern in all cases, it is particularly a concern where there is important biodiversity such as protected areas (parks and forests), wetlands, and other aquatic resources.

Table 4 addresses the effects of requested pesticides on non-target organisms; and mitigation to address the "special concerns" is recommended in Part 3, the SUAP.

As shown on Figures 1and 2 some project sites are in the Senegal River Valley; and other project intervention sites are near streams, rivers, and wetlands. Both USAID-WN and PCE have project sites in the vicinity of "bas-fonds" wetlands. Coastal estuaries penetrate deep into the country as far as Kaolack, and provide rich habitat for fish and other wildlife. These wetland and estuary systems are very sensitive to perturbations, and contamination from mis-used pesticides could have adverse effects on

wildlife and the human livelihoods that depend on these systems. For pesticide use that could affect wetlands and waterways, safeguards will be needed to ensure that aquatic resources are not affected.

This PERSUAP denies approval for all RUPs that are restricted based on environmental hazard—these are products that represent the greatest threat to non-target ecosystems. This PERSUAP also recommends the use of least toxic alternatives to the most toxic pesticides that were originally requested by PCE and USAID-WN. It also recommends biological pesticides, which are expected to be less of a risk to non-target ecosystems. Use of these less toxic alternatives within an IPM framework and the proposed training (recommended in the SUAP) should minimize the effects on non-target ecosystems.

(h) Conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils

The SO level IEE provides background information on Senegal's climate, stating that the country has a harsh climate with generally high temperatures, and low to moderate rainfall. The rainy season is limited to a seasonal monsoon, wetter in the south than in the north. The average rainfall varies between 200 – 400 mm from July to September in the north, 400 – 700 mm in the center, and 700 – 1000 mm from May to October in the south. Water supply in the country is erratic, dependent largely on rainfall that varies greatly in amount, distribution, and frequency from year to year. Groundwater reserves are still relatively abundant.

Typical of tropical climates, the heat and humidity affect the willingness of farmers to wear appropriate protective gear; this is discussed in the SUAP and recommendations are provided.

The monsoon rains increase soil erosion and run-off of pesticides, and the heat and humidity affect the breakdown of pesticides. This is mitigated, to the extent possible, by requiring the least toxic pesticides for use in PCE and USAID-WN; and also by requiring specific safeguards when using pesticides near aquatic resources and other areas of ecological importance (see SUAP).

Figures 1 and 2 show the locations of USAID-WN project sites (this information was unavailable for PCE intervention sites). The maps illustrate the influence of the SRV on the country—and the clustering of irrigated rice in the Valley. The SRV is particularly at risk from pesticides used unwisely. As mentioned above, however, given the locations of project sites in relation to water resources (Figures 1 and 2), all farmers should be trained to take precautions when mixing, storing, applying, and disposing of pesticides. The SUAP includes mitigation measures to address this.

The USAID/Senegal Biodiversity and Tropical Forest Assessment (FAA118/119, March 2008) provides information on the status of the country's protected areas (PA):

A considerable amount of unprotected biodiversity occurs outside the forest areas in the *terroirs*, but additional measures, such as physical barriers (fences) or agreements with local communities (local conventions and/or local charters), are needed to protect this biodiversity. The forest area includes classified areas (forest area of the State) and protected areas (forests in the areas of land which are the responsibility of local authorities). The national forest estate covers 31.7% of the country and includes classified forests, reforestation and restoration perimeters, integral nature reserves, national parks and reserves. These are distributed as follows: 213 classified forests of 6,237,648 hectares total area, of which 20 are sylvo-pastoral reserves (1,514,000 ha), 8 are hunting (*cynégétique*) areas (1,976,315 ha), 5 national parks, plus 10 integral and special reserves which cover an area of 1,613,790 ha, or about 8% of the national territory. Some parks or classified forests were established as biosphere reserves (Niokolo Koba, the Sine-Saloum Delta, and classified forest of Samba Dia), or World Heritage for Humanity sites (Niokolo Koba and Djoudj Parks).

Some producer organizations have bylaws which describe their operating procedures and producer-member responsibilities. Some of these bylaws (local conventions) can—and they do—include agreements to protect biodiversity and requirements to use pesticides safely. Bylaws are discussed in the SUAP in regard to their potential as vehicles for safe pesticide use.

As Figures 1 and 2 show, PAs are scattered across the country, and project sites are near some of the PAs. Farmers will need to take precautions against drift and pesticide runoff, and will have to be trained to monitor to ensure that biodiversity and natural resources in general, including aquatic and terrestrial wildlife species, are not being affected by pesticide use. The SUAP includes recommendations to mitigate potential impacts on biodiversity.

(i) Availability and effectiveness of other pesticides or non-chemical control methods

The list of registered pesticides in Senegal is fairly restrictive. A total of 120 products are registered, several of them containing the same active ingredient or mix of active ingredients. Of these, the most effective—and least toxic—pesticides are being requested in this PERSUAP. Pesticides are being requested in conjunction with an IPM program which emphasizes the use of non-chemical controls, and the use of pesticides as a last resort.

(j) Requesting country's ability to regulate or control the distribution, storage, use, and disposal of the requested pesticides

The Mango Pest Management's PERSUAP provides information about pesticide registration in Senegal, which is excerpted herein:

Pesticides in Senegal are registered through the regional *Comité Sahelien des Pesticides* managed by the *Institut du Sahel* (INSAH) in Bamako. INSAH is the science and policy body for agriculture within the *Comité Permanent Inter états de Lutte contre la Sécheresse dans le Sahel* (CILSS). CILSS comprises nine countries in West Africa working on common problems in agriculture, natural resources management, and climate science. The committee accepts registration dossiers from manufacturers or importers and reviews them for provisional and possible full registration. Import authorizations must be sought at the country level, but a registration decision by the CSP is valid for all CILSS countries.

Senegal law permits use of pesticides not registered in Senegal for food commodities that are destined for export as long as the pesticides comply with rules of the importing country.

For PCE, this may be important for the export crops' VC (bananas and mangos). Rotenone is requested as component of Biotrap; but its use would only be allowed by this PERSUAP once rotenone is registered for use in Senegal. However, if PCE obtains the necessary approvals to use rotenone (as part of the Biotrap product) for use on export crops (mango), it would automatically be approved by this PERSUAP (the only reason Biotrap is not approvable in this PERSUAP is that it lacks CSP registration). As part of the SUAP, PCE is required to report on status of approval of rotenone/Biotrap. If approval is granted by the Government of Senegal (GOS), producers who intend to export to the U.S. or Europe must follow U.S. or European Union (EU) regulations regarding pesticide selection, pre-harvest interval, and maximum residue limits.

Although the CSP serves as a regional registration authority, Senegal nonetheless has a national pesticide registration committee. Guidelines for the operation of the committee are still in development. The focus of the national committee's work is authorizing importation of pesticides registered by CSP.

The CSP's roles are to:

- Consider requests for approval for action

- Maintain a register of approvals and authorizations
- Establish a list of banned pesticides or severely restricted pesticides
- Perform an inventory of pesticides used or sold in the CILSS countries
- Define the methods of controlling the composition, quality, and product evaluation with respect to humans, animals, and the environment
- Establish a list of public institutions authorized to perform tests
- List the laboratories authorized to perform analyses
- Maintain links with national committees of Pesticide Management

Imports of pesticides into Senegal are only allowed with the approval from the Directorate of Plant Protection or the Permanent Secretariat. Most pesticides sold in Senegal are made locally by SENCHIM and SPIA. This is mainly due to the cost of transport (especially in the case of products of low concentration such as dusting powders) and the tax burden for formulations imported from abroad. This was confirmed when visiting pesticide shops as part of this PERSUAP; the majority of products were produced in Senegal. Products from France were also found; and Decis (deltamethrin), produced in the U.S., was the only U.S. product in any of the shops visited.

Senegal's legislation governing pesticide import and registration is strong, but enforcement varies. The pesticide shops checked during preparation of this PERSUAP carried only CSP-registered pesticides. However, as the PCE and USAID-WN projects reported, borders are fluid, and illegal pesticides come over Senegal's borders with the Gambia and Mauritania, often in re-packaged containers. Some containers will claim the product is something it is not – it will be a counterfeit product; other containers will have no information at all. Producers who purchase these products have no reliable information about the chemical they are using and precautions that should be taken when transporting, mixing, storing, applying, and disposing of it.

For transport of pesticides, Senegal's legislation requires a sturdy vehicle along with a permit from DPV, but according to the PCE and USAID-WN projects, pesticides are carried in all kinds of vehicles.

Pesticides are required to be sold only by authorized dealers in authorized locations. However, there are many instances of pesticides being sold house-to-house even though this is illegal.

Obsolete pesticides are a problem in Senegal. Current sources of POPs are obsolete stocks in Senegal and illegal international traffic into the country. POPs are not legally imported and used in Senegal. There is no recycle/collection location where unused and expired pesticides are collected and safely disposed of.

In general, the CSP and Senegal have adequate procedures and strong legislation governing registration and import of pesticides. But once the pesticide is imported, there is little control over how it is transported, where and how it is sold, whether it is re-packaged (it is unlikely to be sold re-packaged in an authorized shop, but when sold through other means, the pesticide may not be sold in its original container), how it is applied and monitored, stored, and disposed of.

Because of these shortcomings, this PERSUAP recommends mitigation measures that the projects shall put in place to ensure that transport, storage, application, and disposal occur in a safe manner that will not harm human health or the environment; and that pesticide use is monitored.

(k) Provisions made for training of users and applicators

Several in-country training programs exist, and in-country expertise in safe use is strong. Ceres Locustrix, DPV, CropLife, and Green Senegal have strong safe use training programs; and especially Ceres Locustrix and CropLife have strong IPM training programs. Directorate of Plant Protection (DPV) is a public sector stakeholder in the PCE and USAID-WN projects, and can be enlisted to provide training. Ceres, CropLife, and Green Senegal are potential partners, and can also be used for training. For PCE, the focus is to strengthen these intermediaries so they can provide services, such as training and technical assistance in pesticide use and IPM, to producers, agro-chemical shop owners, and other actors. USAID-WN can obtain this expertise through their grant program or can work with PCE's intermediaries.

While currently there are no provisions in place for training users and applicators, as a result of this PERSUAP process, provisions are being put in place to train producers/applicators, applicator service providers (USAID-WN only), agro-chemical dealers, agricultural extension services (i.e., ANDAR and others), and PCE and USAID-WN staff in headquarter offices and in the field. A training of trainers approach will likely be the focus. The SUAP recommends that PCE and USAID-WN develop training plans describing the types of training, training recipients, and schedule for training.

(l) Provisions made for monitoring the use and effectiveness of the pesticide

Producers are trained through the organizations mentioned in (k) above to monitor whether pesticide is needed and whether it is effectively controlling the disease or pest. USAID-WN's approach using SIGESCO *maraichage* may facilitate this because of its general dependence on scheduling and monitoring. But in general, monitoring the need for pesticides and their effectiveness is rarely undertaken on a strategic basis.

PCE and USAID-WN intend to strengthen producer capacity to monitor. By training producers, intermediaries, and PCE and USAID-WN staff (as well as the trainers) in IPM, which will include monitoring the need for and effectiveness of all control measures, it is expected that pesticides will be used as a last resort control, and only when necessary and when indicated by a monitoring program. Monitoring is also expected to alleviate problems with pesticide resistance – when producers are used to using a particular insecticide, and they find it is no longer as efficacious as it once was, there is a tendency to try to use more and more of the insecticide. However, with adequate training, this practice will be strongly discouraged and producers will be given the tools that will help them understand that using more pesticide or more concentrated forms will not solve their pest problems.

PART 3. SAFE USER ACTION PLAN (SUAP)

Two *Safe Use Action Plans* have been prepared, one for PCE and one for USAID-WN. The SUAPs incorporate recommendations and mitigation measures that address concerns identified in Part 2, the Pesticide Evaluation Report. Annexes B-F provide tools that PCE and USAID-WN can use when developing safe use and IPM guidance and trainings.

----------Separate here for USAID-WN only----------

USAID-WULA NAFAA SAFE USE ACTION PLAN

USAID-WN SUAP Mitigation Measures

Below, findings (A through F) are presented. The findings emanate from the analyses in the Pesticide Evaluation Report. Mitigation measures (1 through 13) are recommended that address the findings.

A. Findings: Producers in the USAID-WN rice and market garden VCs may use pesticides that are highly toxic and that are classified as or are similar to USEPA restricted use pesticides. Less toxic alternatives are not widely known or accepted by producers.

Mitigation measures:

1) Use only PERSUAP-approved pesticides: USAID-WN shall not provide assistance for the use or procurement of any pesticide active ingredient or product which is not included in SUAP Table 1 below. The nine approved pesticide active ingredients are shown in the table below for each USAID-WN value chain. If USAID-WN intends to provide assistance for the procurement or use of a pesticide not included in SUAP Table 1, an amendment to the PERSUAP must be submitted to and approved by USAID prior to providing this assistance. Refer to the Pesticide Evaluation Report for the definition of "assistance for the procurement or use."

2) Phase-out highly toxic pesticides: USAID-WN shall phase out the use of dimethoate, product Systoate (concentrated liquid, 40% active/1 liter). The target date for phase-out is December 2010. During the period that assistance for the procurement or use of dimethoate is allowed in the project, USAID-WN shall actively research efficacious and less toxic alternatives to dimethoate, and shall report on findings in WN progress reports to USAID.

3) Identify alternatives to highly toxic pesticides: Because this PERSUAP denies use of furadan and deltamethrin, two highly toxic pesticides, which are commonly used in the market garden VC, USAID-WN shall consult with pesticide experts to help identify and field test alternatives to these pesticides, and shall report on findings in USAID-WN progress reports to USAID. Research and limited field evaluation shall comply with 22 CFR 216.3(b)(2)(iii), which requires that research and limited field testing must be done in accordance with toxicological and environmental safeguards, and that treated crops will not be used for human or animal consumption unless appropriate tolerances have been established by EPA or recommended by FAO/WHO.

SUAP Table 1: Active Ingredients and Pesticide Products Requested for Use in USAID-WN (with registration status and toxicity levels)

ACTIVE INGREDIENT	PRODUCT	EPA registration status: RUP/GUP	EPA & WHO Toxicity Levels	Special concerns
USAID-WN/Market gardens (most common crops are tomato, cabbage, pepper, okra, and lettuce)				
1) Maneb-Mancozeb	Man-cosan (PM) 70% active/1 kg	GUP (product is similar to Dithane M 45)	WHO U EPA 3	Special concerns: toxicity to fish and aquatic invertebrates, and grazing animals; and potential carcinogenic action in humans.
2) Dimethoate	Systoate (Concentrated liquid, 40% active /1 liter)	Similar to GUPs	WHO II EPA 2 (similar to Dimethoate 4ec)	Special concerns: Human health hazard; risk to handlers is high; birds, bees, and beneficial arthropods, fish, aquatic invertebrates, domestic and wild mammals. Considered a pesticide of Special Concern by USEPA (see Annex B)
3) Azadirachtin	Suneem 1% EC	GUP	WHO NL EPA 3	Special concerns: fish and other aquatic resources
USAID- WN Rice				
1) Propanil	Propanil 360 g/l	GUP	WHO III, EPA 3	Special concerns: birds, fish, aquatic invertebrates
2) 2,4 – amine salt or 2,4 D	Herbextra 720 SL Malo Binfaga 720g/l	GUP All similar products are GUPs	WHO II EPA 1-3 (various formulations)	Special concerns: human toxicity; birds, fish, earthworms, and groundwater contaminant
Possible replacements for deltamethrin, dimethoate, and furadan				
1) *Bacillus thuringiensis*	Batik	GUP	WHO NL EPA 3	Normal safety precautions
2) Thiame-thoxam	Actara 25 WG	GUP	WHO NL EPA 3	Special concerns: Aquatic ecosystems, bees, and terrestrial wildlife
3) Indoxacarb	Avaunt 150 EC	GUP	WHO NL EPA 3	Special concerns: risk to humans (eye irritation), birds, bees, fish, aquatic invertebrates, and domestic and wild mammals
4) Chlorpyri-fos-ethyl	Spiphor 5G powder	Depends on formulation; many are RUPs.	WHO II EPA 1, 2, 3: depends on formulation	Special concerns: impacts to humans, birds, bees, and all aquatic organisms, birds, bees.

B. Findings: Producers in USAID-WN VCs rarely take appropriate safety precautions when mixing, applying, storing, transporting, and disposing of pesticides. USAID-WN has an opportunity to raise awareness of the risks and the importance of the use of appropriate safety precautions, including the use of safety gear, as part of USAID-WN's:

- **Radio broadcasts**

- **Agricultural production Best Practice Guidance**
- **VC trainings that include information on pesticides**
- **Direct technical assistance for producers, producer organizations, and nurseries where assistance on pesticide use is provided**
- **Demonstration sites**
- **Pesticide procurement**

Mitigation Measures

4) Promote use of safeguards to mitigate impacts to human health: To minimize impacts of pesticides to human health, USAID-WN shall promote the use of safety precautions. SUAP Table 1 (above) shows special concerns for each approved pesticide; the table should be referred to when identifying specific precautions necessary for that pesticide. In addition to the information in the table, the pesticide label should be used as a guide, and additional recommendations for safe use, including use of safety gear are included in Annex D.

5) Promote use of safeguards to minimize impacts to non-target ecosystems and organisms: To minimize impacts to wildlife, fish and other aquatic resources and to the environment in general, USAID-WN shall promote the use of safety precautions to their beneficiaries. SUAP Table 1 highlights special environmental concerns for each approved pesticide. With this table as a guide, USAID-WN shall use the information on pesticide labels and the information in Annex E to develop training and technical assistance to ensure impacts to the environment are minimized.

C. Findings: IPM is not widely known or implemented by USAID-WN's value chain producers. IPM reference material being used by USAID-WN is out of date in some cases, and could be misleading. USAID-WN has an opportunity to promote IPM in:

- **Radio broadcasts**
- **Best Practice Guidance**
- **Pesticide trainings**
- **Providing technical assistance for the use of pesticides**
- **Demonstration sites**
- **Should be considered when procuring pesticides**

Mitigation Measures

6) Provide pesticide assistance only within an IPM framework: Annex F provides general information on IPM that may be incorporated into USAID-WN's assistance for the use or procurement of pesticides. This information should be incorporated into USAID-WN's technical assistance and training activities.

7) Disseminate IPM information widely: Guidance on IPM for managing specific diseases and pests shall be developed and distributed to producers in USAID-WN's VCs. This guidance may be in the form of posters best practice field guides, manuals, or other tools that would be most appropriate for use

by USAID-WN stakeholders and beneficiaries. By the end of the project, IPM best practices for each VC and pest/disease should be developed. IPM tools in Annex F can be referred to assist in developing IPM guidance for USAID-WN VCs.

D. Findings: Many small producers apply pesticides in a manner that endangers human health and the environment, and safety gear is still not widely used among small producers. In addition, farmers often fail to maintain their safety and application equipment, in part because they are unaware of maintenance requirements, and in part because maintenance services are unavailable in rural areas. Training is one measure (#s 4 and 5 above) that can be taken to encourage safer practices, but more proactive measures are available.

Mitigation Measures

8) Promote the use of trained applicator service providers: USAID-WN will work with partners to develop a pilot program that trains and certifies applicators. Once trained, these applicators will be promoted as service providers in USAID-WN's market gardens and rice VCs, and producers will be encouraged to use applicators rather than apply pesticides on their own. If the pilot program is successful, scaling up should be considered. This would mitigate several concerns, including the limited availability of safety gear; the unwillingness to use safety gear; lack of maintenance of application equipment and safety gear; and would minimize impacts to human health and the environment from mixing, applying, storing, transporting, and disposal.

9) Promote greater availability of safety equipment and encourage its use: USAID/WN shall work with agricultural supply shop owners to develop measures that will allow them to procure more and better safety equipment, and that will strengthen their capacity to advice clients on the need to take safety precautions.

E. Findings: The USAID-WN rice VC includes well-established producer organizations that have bylaws that describe operating procedures and roles and responsibilities; these bylaws can be strengthened to incorporate the use of pesticide safe practices.

Mitigation Measure

10) Where appropriate, use existing organizational frameworks to implement pesticide best practices: Safe practices (to mitigate impacts to human health and the environment), including the use of trained applicators, should be incorporated into rice VC producer organization bylaws, as appropriate.

F. Findings: USAID-WN staff interact directly with producers, yet project staff are not adequately trained in safe use and IPM. In addition, USAID-WN VC producers are targeted by other development projects, and sometimes receive conflicting messages on which pesticides to use, and safe practices to implement. Consistent, ongoing, and relevant training is needed, targeting several levels of USAID-WN staff, who can then provide this information to producers. USAID-WN staff need the tools to ensure that their messages are accurate, and if conflicting with other technical assistance, to address these concerns.

Mitigation Measures

11) Develop and implement a Pesticide Safe Use and IPM Training Plan: USAID-WN shall develop and implement a Training Plan that describes training courses and curricula for project staff, partners, target beneficiaries and stakeholders in safe use and IPM. The plan should include classroom and field training and should target:

USAID-WN staff, including the Water Management and Agriculture Production Specialists, the Local Agricultural Support Fund Manager;

- USAID-WN Assistant Coordinators (four)
- USAID-WN Facilitators (12).

Training of trainers techniques should be used with the intention of training USAID-WN staff who could then conduct regular, ongoing training for the 12 facilitators who are the main points of contact, on a day-to-day basis, with farmers.

Curricula should include information from the USAID-WN SUAP and should be consistent with this document. SUAP Table 1 and appropriate annexes should be referred to in the development of course curricula.

The Training Plan should include a schedule of training for all recipients of USAID-WN training, including continuous field training for USAID-WN's beneficiaries in the rice and market garden VCs (training by the USAID-WN facilitators); training for agricultural supply shop managers; and training for other partners and stakeholders, as appropriate.

USAID-WN's Annual Work Plans should include measures from the Training Plan to be implemented in that Fiscal Year (FY). USAID-WN progress reports should report on the development of the Training Plan (which may be reviewed by USAID COTR and Mission Environmental Officer) and on courses implemented as part of the Training Plan, and their successes and shortcomings.

12) Help ensure that USAID-WN's VC producers receive consistent messages: USAID-WN shall coordinate with other stakeholders (e.g., FAO and bi-lateral development projects) to help ensure that messages given to USAID-WN producers by all parties are focused on safe use of pesticides and IPM, and that the advice is consistent.

13) Train VC producers to monitor pesticide use: The Training Plan (see #11) should ensure that USAID-WN staff have the tools they need to train producers to implement IPM, to use safe practices, and to monitor the effectiveness of pesticides so that pesticide misuse is less likely and so resistance is avoided (See Annex F for information on surveillance and monitoring).

Environmental Mitigation and Monitoring Plan

Responsible for implementing the EMMP: Agriculture Sector Team Leader with support from other Kaolack-based staff

Findings	Mitigation measure	Indicators	Monitoring/ Reporting frequency
a) Pesticides that are highly toxic and that are classified as or are similar to USEPA RUPs may be used by USAID-WN beneficiaries.	1) Use only PERSUAP-approved pesticides (SUAP Table 1).	Monitor pesticides used by USAID-WN beneficiaries.	Annual Report
a) Less toxic alternatives are not widely known or accepted by producers.	2) Phase out the highly toxic pesticide, dimethoate, product Systoate, by December 2010.	Monitor results of research into less toxic alternatives to dimethoate.	Quarterly Reports; Report on successful phase-out of dimethoate by Dec 2010; Amended PERSUAP for approval to use/procure alternatives
	3) Identify alternatives to highly toxic pesticides in common use in the market garden VC: furadan and deltamethrin.	Monitor results of consultations with experts; identification of alternatives to these active ingredients.	Quarterly Reports; Amended PERSUAP for approval to use/procure alternatives

b) Producers rarely take appropriate safety precautions when mixing, applying, storing, transporting, and disposing of pesticides.	4) Promote the use of safety precautions to protect human health by referring to SUAP Table 1 "special concerns" for each approved pesticide; the pesticide label; and additional Annex D.	Monitor inclusion of safety precaution measures in: -Radio broadcasts -Agricultural production - Best Practice Guidance -VC trainings that include information on pesticides -Direct technical assistance -Demonstration sites -When procuring pesticides for beneficiaries	Quarterly Reports
	5) Promote the use of safeguards to minimize impacts to non-target ecosystems and organisms by referring to SUAP Table 1's special environmental concerns for each approved pesticide; the pesticide label; and Annex E.	Monitor inclusion of safety precaution measures in: -Radio broadcasts -Agricultural production - Best Practice Guidance -VC trainings that include information on pesticides -Direct technical assistance -Demonstration sites -When procuring pesticides for beneficiaries	Quarterly Reports
c) IPM is not widely known or implemented.	6) Provide pesticide assistance only within an IPM framework: Incorporate information in Annex F in all USAID-WN's assistance for the use or procurement of pesticides.	Monitor inclusion of safety precaution measures in: -Radio broadcasts -Agricultural production - Best Practice Guidance -VC trainings that include information on pesticides -Direct technical assistance -Demonstration sites -When procuring pesticides for beneficiaries	Quarterly Reports
c) IPM reference material being used by USAID-WN is out of date in some cases, and could be misleading.	7) Develop and distribute guidance on IPM for managing specific diseases and pests of USAID-WN's VCs (IPM tools in Annex F can be referred to assist).	Monitor guidance developed (posters, best practice field guides, manuals, or other tools that would be most appropriate for use by USAID-WN stakeholders and beneficiaries). Goal: By the end of the project, IPM best practices for each VC and major pest/disease should be developed.	Quarterly Reports Report on status of overall goad in Annual Reports
d) Many small producers apply pesticides in a manner that endangers human health and the environment, and safety gear is still not widely used or maintained by small producers. More proactive measures (than training)	8) Promote the use of trained applicator service providers: develop a pilot program, and scale up, as appropriate.	Monitor development and success of pilot program; and scaling up.	Quarterly Reports
	9) Work with agricultural supply shop owners to develop measures that will allow them to procure more and better safety equipment,	Monitor collaboration with agricultural supply shop owners; their procurement of more and better safety equipment; and their capacity	Quarterly Reports

are available and needed.	and that will strengthen their capacity to advice clients on the need to take safety precautions.	to advise on safe use of pesticides.	
e) The USAID-WN rice VC includes well-established producer organizations (PO) that have bylaws that describe operating procedures and roles and responsibilities; these bylaws can be strengthened to incorporate pesticide safe practices.	10) Use existing rice VC POs' bylaws, as appropriate, to include pesticide safe practices (to mitigate impacts to human health and the environment), including the use of trained applicators.	Monitor # of bylaws strengthened to include pesticide safe practices.	Quarterly Reports
f) USAID-WN project staff are not adequately trained in safe use and IPM. VC producers sometimes receive conflicting messages on which pesticides to use, and safe practices to implement.	11) Develop and implement a Pesticide Safe Use and IPM Training Plan identifying type of training (ToT, field/classroom); recipients of training; curricula; and training schedule.	Monitor development of Training Plan; implementation of Training Plan	Quarterly Reports
	12) USAID-WN shall coordinate with other stakeholders (e.g., FAO and bi-lateral development projects) to help ensure that messages given to USAID-WN producers by all parties are focused on safe use of pesticides and IPM, and that the advice is consistent.	Monitor coordination with other stakeholders to clarify pesticide safe use messages.	Quarterly Reports
	13) Train VC producers to monitor pesticide use: The Training Plan should include classes to train on monitoring the effectiveness of pesticides so that pesticide misuse is less likely and so resistance is avoided (See Annex F for information on surveillance and monitoring).	Ensure curricula include this topic.	Report in Progress Report during quarter that curricula are finalized.

----------Separate here for USAID-PCE only----------

PCE SAFE USE ACTION PLAN

PCE SUAP Mitigation Measures

Below, findings (A through C) are presented. The findings emanate from analyses in the Pesticide Evaluation Report. Mitigation measures (1 through 10) are recommended that address the findings.

A. Findings: Producers in the PCE value chains (VC) of mango, banana, millet and sorghum, rice, and irrigated and rain-fed maize may use pesticides that are highly toxic and that are classified as or are similar to USEPA restricted use pesticides (RUP). Less toxic alternatives are not widely known or accepted by producers; one less toxic alternative (Biotrap) proposed for use in the mango VC, is not yet registered for use in Senegal.

Mitigation Measures

1) Use only PERSUAP-approved pesticides: PCE shall not provide assistance for the use or procurement of any pesticide active ingredient or product which is not included in SUAP Table 1 below. The 15 approved pesticide active ingredients are approved for each VC, as shown in the table. If PCE intends to provide assistance for the procurement or use of a pesticide not included in SUAP Table 1, an amendment to the PERSUAP must be submitted to and approved by USAID prior to providing this assistance. The Pesticide Evaluation Report defines "assistance for the procurement or use."

2) Use only pesticides approved for use in Senegal: PCE shall not provide assistance for the use or procurement of Biotrap with rotenone until rotenone is registered by the CSP and approved for use in Senegal, or until other arrangements are made that would allow for the legal use of Biotrap in PCE's mango VC.

3) Coordinate with the Integrated Management of Mango Pests' project: PCE's mango VC shall coordinate with this USAID/Senegal project to ensure that research findings and mitigation measures developed as part of the *Integrated Management of Mango Pest* project are also implemented by PCE's mango VC. PCE should also coordinate with this project regarding the use of Biotrap with rotenone. [The Integrated Pests' project received approval to use rotenone – an unregistered chemical – because the project is implemented in collaboration with DPV.]

4) **Identify alternatives to highly toxic pesticides**: Because this PERSUAP denies use of cypermethrin and other highly toxic pesticides, which may typically be used in PCE's VCs, PCE shall consult with pesticide experts to help identify and field test alternatives to the more highly toxic pesticides in common use, and shall report on findings in PCE progress reports to USAID. Research and limited field evaluation shall comply with 22 CFR 216.3(b)(2)(iii), which requires that research and limited field testing must be done in accordance with toxicological and environmental safeguards, and that treated crops will not be used for human or animal consumption unless appropriate tolerances have been established by EPA or recommended by FAO/WHO.

SUAP Table 1: Active Ingredients and Pesticide Products Requested for Use in PCE (with registration status, toxicity levels, and special concerns noted)

ACTIVE INGREDIENT	PRODUCT	EPA registration status: RUP/GUP	EPA & WHO Toxicity Levels	Special concerns
PCE/Mango				
1) Spinosad 2,4 g/l	SUC-CSESS APPAT 0.24 CB GF 120	GUP	WHO U EPA 3 & 0 (Success) EPA 3 (GF)	Special concerns: bees, aquatic invertebrates.
2) Malathion + Parapheromone methyl eugenol	Malatrap	GUP: all products with malathion GUP: methyl eugenol	WHO III, EPA 1-3 (malathion: most are 3, many are 2, few are 1) WHO NL EPA 3 (methyl eugenol)	Special concerns: Pesticide handlers, aquatic invertebrates, tadpoles, earthworms, honeybees, beneficial arthropods. Safe disposal must be addressed.
3) Rotenone + Parapheromone methyl eugenol	Biotrap	Most rotenone products are GUPs, few are RUPs (use of this product in a trap will be less toxic than if sprayed or broadcast. GUP: methyl eugenol	WHO II EPA 1- 3 (rotenone) WHO NL EPA 3 (methyl eugenol)	Special concerns: risk to humans; high toxicity to fish. Rotenone is not registered by CSP, 2010; it shall not be used by PCE until registered. Safe disposal must be addressed.
4) Azadirachtin, 10 g/l (Neem)	Suneem 1% EC	GUP	EPA 3 WHO NL	Special concerns: fish and other aquatic resources
PCE/Banana				
1) Metarhizium flavoviride anisoplae	Green muscle	GUP (similar product)	WHO NL EPA 3	Normal safety precautions
2) Sulfur	Atenea DF	All products are GUPs	EPA 1-3 (almost all products are EPA 3) WHO U	Normal safety precautions
3) Eucalyptus	Euca-lyptus oil	All products are GUPs	WHO NL EPA 2, 3	Special concerns: Highly flammable—issue for transport, storage, application, disposal
PCE/Millet and Sorghum				
1) Glyphosate	GLYPHADER 75	GUP (product similar to Departure, registered by EPA)	WHO U EPA 3	Special concerns: amphibians, aquatic invertebrates, beneficial arthropods, earthworms
2) Propanil (480 g/l)	TOPRANIL 480 EC	GUP (product similar to Propanil 48, reg'd by EPA)	WHO III EPA 3	Special concerns: birds, fish, aquatic invertebrates
3) Thiamethoxam 20g/kg+ difenoconazol	A-PRON STAR 42 WS Seed treatment	GUP (similar to Meridien); difenocononazole similar to other GUP	WHO NL, EPA 3 (thia) WHO III, EPA2, 3 (difen)	Special concerns: fish and other aquatic organisms, bees, wildlife

ACTIVE INGREDIENT	PRODUCT	EPA registration status: RUP/GUP	EPA & WHO Toxicity Levels	Special concerns
e 2g/kg		products		
4) Imidacloprid 350 g/kg + Thiram 100 g/kg	IMIDALM T 450 WS MOMTAZ 45 WS	Similar to Atera, GUP All thiram products are GUPs	WHO II, EPA 3 (Imid) WHO III(Thi), all are EPA 2, 3	Special concerns: human by ingestion, inhalation, and eye irritation; bees and other non-target insects, birds, fish and aquatic ecosystems
5) Spinosad	SPINTOR POUDRE	Similar products are GUPs	WHO U	Special concerns: bees, aquatic invertebrates.
PCE/Rice				
1) Propanil 360	Propanil	GUP	WHO III, EPA 3	Special concerns: birds, fish, aquatic invertebrates
2) 2,4 – amine salt or 2,4 D	Herbextra 720 SL Malo Binfaga 720g/l	GUP All similar products are GUPs	WHO II EPA 1-3 (various formulations)	Special concerns: human toxicity; birds, fish, earthworms, and groundwater contaminant
PCE/Maize (irrigated)				
None				
PCE/Maize (rainfed)				
1) Glyphosate 360 g/l	Dango-roba, Gly-phalm 360 SL, Domin-ator 360 SL	GUP (for products similar to this that are EPA registered)	WHO U EPA 3	Special concerns: amphibians, aquatic invertebrates, beneficial arthropods, earthworms
Pendimethalin	Activus 500 EC	GUP (for products similar to this that are EPA registered)	WHO III EPA 3	Special concerns: fish and aquatic invertebrates

B. Findings: PCE uses a "cascade system" where capacities of service providers are strengthened so that they are well-equipped to assist producers in PCE's target VCs. Instead of working directly with producers, PCE relies on these intermediaries to provide services to farmers. Yet, some service providers may not have adequate capacity in certain fields, especially pesticide safe use, IPM, and maintenance of safety and application equipment. Others may be technically capable, but may need training in adult education methods (i.e., they may need to be trained in how to train others). This will require PCE staff to become familiar with capacities of the service providers, and PCE staff will need to closely monitor the training to ensure it is adequate and that beneficiaries are receiving consistent messages from trainers.

5) Develop and implement a PCE Training Plan for Pesticide Safe Practices and IPM: PCE shall develop a plan to use intermediaries/service providers, such as Ceres Locustrus, CropLife, and others, who can train other PCE service providers (ANCAR, ISRA, etc.) who ultimately will train PCE's VC producers. If necessary, PCE shall work with partners to develop or revise curricula so that they apply to PCE's specific needs. SUAP Table 1 and SUAP Annexes should be used in the development or refinement of curricula. PCE should ensure their service providers (trainers) are familiar with the PERSUAP; the trainers should ensure messages given to recipients of training are consistent with this PERSUAP.

The Training Plan should identify:

- The service provider(s) to be used for training
- Any training that the provider will need (in some cases, the service provider may need training in adult education methods rather than more technical areas)
- In view of the "cascade system," recipients of training down the cascade

The Training Plan curricula should include aspects of safe use of pesticides, including reducing impacts on human health and proper use and maintenance of application and protective gear (refer to Annex D); reducing impacts on the environment (refer to Annex E); and IPM, including methods of training producers to monitor pesticide use to mitigate pest resistance and over-use, and other misuse of pesticides (refer to Annex F).

C. Findings: Besides working through service providers who are in direct contact with producers, PCE may provide assistance for the use or procurement of pesticides by other means, such as in:

- **Radio broadcasts;**
- **Agricultural production Best Practice Guidance;**
- **Demonstration sites;**
- **Pesticide procurement; and**
- **Other technical assistance**

PCE has the opportunity to promote safe practices and IPM through these means.

Mitigation Measures

6) Promote use of safeguards to mitigate impacts to human health: To minimize impacts of pesticides to human health, PCE shall promote the use of safety precautions, including use of protective gear when transporting, storing, mixing, applying, and disposing of pesticides. SUAP Table 1 shows special concerns for each requested pesticide; the table should be referred to when identifying specific precautions necessary for that pesticide, and training and technical assistance should include these safety precautions. In addition to the information in the table, the pesticide label should be used as a guide, and additional recommendations for safe use, including use of safety gear, included in Annex D, should also be incorporated into training and technical assistance.

7) Promote use of safeguards to minimize impacts to non-target ecosystems and organisms: To minimize impacts to wildlife, fish and other aquatic resources and to the environment in general, PCE shall promote the use of safety precautions. SUAP Table 1 highlights special environmental concerns for each requested pesticide. With this table as a guide, PCE shall use the information on pesticide labels and the information in Annex E in radio broadcasts, at demo sites, in Best Practice Guides, and in other technical assistance to ensure partners are trained to minimize impacts to the environment.

8) Provide pesticide assistance only within an IPM framework: Annex F provides general information on IPM that may be incorporated into PCE's assistance for the use or procurement of pesticides. IPM measures shall be incorporated into PCE's capacity strengthening activities (radio broadcasts, demo sites, etc.).

9) Assist service providers to disseminate IPM information widely: PCE shall work with intermediary service providers to determine best methods for disseminating IPM information about specific diseases and pests. Service providers may need posters, best practice field guides, updated manuals, or other tools to help them get the IPM message out to PCE beneficiaries. By the end of the PCE project, IPM best practices for each PCE VC and pest/disease should be developed. IPM tools in Annex F can be referred to in developing IPM guidance.

10) Promote greater availability of safety equipment and encourage its use and maintenance: PCE shall work with agricultural input service providers to develop measures that will allow them to procure more and better safety equipment, and that will strengthen their capacity to advice clients on the need to take safety precautions when using pesticides and on maintenance of safety and application equipment.

Environmental Mitigation and Monitoring Plan

Responsible for implementing the EMMP: VC managers reporting to M & E staff person

Findings	Mitigation measure	Monitoring indicators	Monitoring/ Reporting frequency
a) Producers in the PCE VCs may use pesticides that are highly toxic and that are classified as or are similar to USEPA restricted use pesticides.	Use only the 15 PERSUAP-approved pesticides in SUAP Table 1.	Monitor pesticides used by PCE beneficiaries.	Annual Report
a) One less toxic alternative (Biotrap) proposed for use in the mango VC, is not yet registered for use in Senegal.	2) Use only pesticides approved for use in Senegal: PCE shall not provide assistance for the use or procurement of Biotrap with rotenone until rotenone is registered by the CSP and approved for use in Senegal.	Monitor progress toward approval of Biotrap.	Report in Quarterly Report of quarter when Biotrap approval is obtained.
	3) Coordinate with the Integrated Management of Mango Pests' project: PCE's mango value chain shall coordinate with this USAID/Senegal project to ensure that research findings and mitigation measures developed as part of the Integrated Management of Mango Pest project are also implemented by PCE's mango VC.	Monitor collaboration with the Mango Pests' project and development of mitigation measures.	Quarterly Reports
a) Less toxic alternatives are not widely known or accepted by producers.	4) Identify alternatives to highly toxic pesticides: Because this PERSUAP denies use of cypermethrin and other highly toxic pesticides, which may typically be used in PCE's VCs, PCE shall consult with pesticide experts to help identify and field test alternatives to the more highly toxic pesticides in common use.	Monitor results of consultations with experts; and identification of alternatives to cypermethrin.	Quarterly Reports; Amended PERSUAP for approval to use/procure alternatives
b) Some service providers may not have adequate capacity in certain fields, especially pesticide safe use, IPM, and	5) Develop and implement a PCE Training Plan for Pesticide Safe Practices and IPM: PCE shall develop a plan to use intermediaries/service providers, who can train other PCE service providers (ANCAR, ISRA, etc.) who ultimately will train PCE's VC producers.	Monitor development of Training Plan; development/ refinement of curricula; implementation of Training Plan; PCE staff monitoring of training.	Quarterly Reports

maintenance of safety and application equipment and/or need training in educational methods.	The Training Plan should identify: the service provider to be used for training; any training that the provider will need (in some cases, the service provider may need training in educational methods rather than more technical areas); and in view of the "cascade system," recipients of training down the cascade. The Training Plan shall include a schedule for training, and any refinements needed to existing curricula (in line with the PERSUAP).		
c) PCE has the opportunity to promote safe practices and IPM through means other than service providers.	6) Promote use of safeguards to mitigate impacts to human health: To minimize impacts of pesticides to human health, PCE shall promote the use of safety precautions, including use of protective gear, when transporting, storing, mixing, applying, and disposing of pesticides. Refer to SUAP Table 1 "special concerns," pesticide labels, and additional recommendations for safe use, including use of safety gear, included in Annex D.	Monitor inclusion of pesticide safety precaution messages in: -Radio broadcasts -Agricultural production Best Practice Guidance -Demonstration sites -Pesticide procurement -Other technical assistance	
	7) Promote the use of safeguards to minimize impacts to non-target ecosystems and organisms by referring to SUAP Table 1's special environmental concerns for each approved pesticide; the pesticide label; and Annex E.	Monitor inclusion of pesticide safety precaution messages in: -Radio broadcasts -Agricultural production Best Practice Guidance -Demonstration sites -Pesticide procurement -Other technical assistance	Quarterly Reports
	8) Provide pesticide assistance only within an IPM framework: Incorporate information in Annex F in all USAID-WN's assistance for the use or procurement of pesticides.	Monitor inclusion of safety precaution measures in: -Radio broadcasts -Agricultural production - Best Practice Guidance -VC trainings that include information on pesticides -Direct technical assistance -Demonstration sites -When procuring pesticides for beneficiaries	Quarterly Reports
	9) Assist service providers to disseminate IPM information widely.	Monitor development of: posters, best practice field guides, updated manuals, or other tools to help service providers get the IPM message out to PCE beneficiaries. Goal: By the end of the PCE project, IPM best practices for each PCE VC and pest/disease should be	Quarterly Reports Report on status of overall goad in Annual Reports

		developed. IPM tools in Annex F can be referred to in developing IPM guidance.	
	10) Promote greater availability of safety equipment and encourage its use and maintenance: PCE shall work with agricultural input providers to develop measures that will allow them to procure more and better safety equipment, and that will strengthen their capacity to advice clients on the need to take safety precautions when using pesticides and on maintenance of safety and application equipment.	Monitor collaboration with agri-input providers, and outcome of collaboration in regard to availability of safety equipment and technical capacity to advise beneficiaries.	Quarterly Reports

ANNEX A. SCOPE OF WORK FOR THE PERSUAP

Preparation of a Pesticide Evaluation Report and Safer Use Action Plan (PERSUAP) for the USAID/Wula Nafaa Project

Scope of Work

PART I - GENERAL BACKGROUND:

Introduction

Risks and the reduction or mitigation of risks are the drivers for USAID's environmental procedures. Many types of development projects can increase risks of harm to human health, environment and natural resources, but pesticides pose some of the most significant of these risks. USAID environmental procedures are codified into Part (Regulation) 216 of Title 22 (Foreign Assistance Act) of the Code of Federal Regulations (CFRs). All USAID activities are subject to evaluation via, at minimum, an Initial Environmental Examination (IEE) and at maximum, an Environmental Assessment (EA).

Pesticides require special attention due to the risks inherent with their use. A large part of Regulation 216 – part 216.3(b) – is devoted to pesticide use and safety. Part 216.3(b) requires that 12 pesticide factors be analyzed and that, following pesticide sector Best Management Practices (BMPs), recommendations are written to mitigate or reduce risks, to be followed up with appropriate training and risk reduction monitoring.

Integrated Pest Management (IPM)

In the early 1990s, USAID adopted the philosophy and practice of IPM as official Agency policy. IPM is strongly promoted and required as part of Regulation 216.3. A good definition of IPM is as follows (from UC Davis[1]):

> "Integrated pest management (IPM) is an ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties. Pesticides are used only after monitoring indicates they are needed according to established guidelines, and treatments are made with the goal of removing only the target organism. Pest control materials [pesticides] are selected and applied in a manner that minimizes risks to human health, beneficial and nontarget organisms, and the environment."

It is important to note that IPM *includes* the use of pesticides, be they from synthetic or natural sources, but requires that their use be justified (by threshold pest levels or crop damage), and not taken for granted.

[1] http://www.ipm.ucdavis.edu/IPMPROJECT/about.html

Pesticide Evaluation Report and Safer Use Action Plan (PERSUAP)

In the late 1990s, USAID's Bureau for Africa developed a tool, called a PERSUAP, to analyze the pesticide system(s) in any given country, territory or region for risk and risk mitigation opportunities. This "systems approach" analyzes, for risks, the pesticide system from registrations and regulations-enforcement to import and formulation, distribution, sales, transport, farm storage, training, safe use, clean up, natural resource conservation, human health and environmental impacts, first aid, and monitoring and disposal of leftover pesticides and containers.

The PERSUAP examines the particular circumstances of a USAID Strategic Objective, Program or Project, including the pesticide system(s) within which it operates to determine the risks inherent in that system, the risk management choices available, and how risk mitigation recommendations and a SUAP would be put into force.

A PERSUAP consists of two parts, a "PER" and a "SUAP." First, a background section performs the systems analysis of risks and opportunities for risk mitigation in the country's agriculture production and pesticide systems, with special emphasis on S&C systems and natural resources conservation. Next, the Pesticide Evaluation Report (PER) section addresses the 12 pesticide factors required in the Agency's Pesticide Procedures. The Safer Use Action Plan (SUAP) puts the conclusions and recommendations reached in the PER into a plan of action, including a timeline and assignment of responsibility to appropriate parties connected with the program. Annexes to the PERSUAP will contain international BMPs on pesticide use, exposure mitigation, personal protection equipment (PPE), first aid, disposal and record-keeping to be used for training purposes for implementing partner staff, farm managers and farmers to attain a better understanding of pesticide safety.

This Action Plan will be implemented by the Prime and Subcontract companies through their local Associations or NGO Implementing Partners (IPs). The conditions and recommendations in the SUAP would be written by the Prime or Sub-contractor into grants or agreements with local IPs, and IPs would be responsible for implementing them. Monitoring and reporting of the implementation and impact of the recommendations would rest with the Prime Contractor, or delegated to the Subcontractor.

Under this SOW, it is important to note that assistance for the procurement or use of pesticides is defined broadly and includes recommending the conduct of training programs in pesticide handling/use or field agriculture production demonstrations.

Farmer, Environment and Consumer Protections

When the USEPA registers pesticide products 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, and best practices for storage, transport, and disposal. In many countries, a local-level analysis and evaluation such as a PERSUAP is needed for pesticide use because farmers and other field workers are unlikely to have had sufficient training or literacy levels to effectively reduce the risks associated with using pesticides.

Thus, 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 better assure appropriate use of the pesticide products. The preparation of a PERSUAP gives a USAID program manager, Prime contractor, Subcontractors and Field Implementers the opportunity to consider practical actions to reduce the risks of using pesticide products, taking into consideration the context, or system, in which the products will be used, the particular elements of the program, and the different capacities of the partners and stakeholders involved. Further, the application of PERSUAP recommendations helps prepare project participants to be able to more rapidly adopt voluntary standards requirements of market-driven Standards and Certification (S&C) Systems like GlobalGAP, Organic and others developed to ensure

food safety, along with worker and environmental protections. It is important to note that at present, these market-driven S&C Systems are pushing the adoption of BMPs, by small and medium farmers, much faster than are government regulations.

Who prepares a PERSUAP?

Program managers are generally responsible for assuring that environmental review requirements for their programs are met, including the drafting of PERSUAPs and EMMPs (Environmental Mitigation and Monitoring Plans). To source technical expertise to perform the PERSUAP, degrees and expertise in entomology and plant pathology are most useful, as is coursework in weed and soil science, agronomy, IPM, pesticide toxicology, and, in particular, chemistry in order to fully understand pesticides. To understand the special constraints inherent in agribusiness sectors, markets and linkages, an MBA or other business degree is highly desirable.

Several years of experience understanding and working with Regulation 216, Agency BEOs, training on Regulation 216, and actual experience performing PERSUAPs, EAs, and other Best Practices studies should also be required. An understanding of market-driven S&C systems such as GlobalGAP, Organic, BRC, and others which drive use of best and safest management practices in agriculture would be considered highly beneficial.

PART II – PROJECT BACKGROUND AND SCOPE OF WORK

Background

USAID/Senegal has asked the International Resources Group (IRG), as the prime contractor for Wula Nafaa and the Economic Growth Project (PCE), to update the status of these projects under USAID Regulation 216—Environmental Procedures. These activities were previously reviewed and approved from the environmental perspective under the aegis of the Mission's SO-11 IEE dated June 2006. As a continuation of the recent IEE Amendment (Sept. 09), the next priority step is to update the environmental compliance status of pesticide use for USAID/Senegal for both the Wula Nafaa Project and PCE.

The Natural Resources Management (Wula Nafaa) Project and its objectives

The purpose of Wula Nafaa is to increase the sustainable, profitable and decentralized use and management of Senegal's agricultural, marine and natural resources base. The achievement of that purpose is based on four components:

- The Creation of Wealth through an increase in the number of businesses based on sustainable resource use and a corresponding increase in those businesses' profitability;
- Improving Local Governance by improving the performance of local governments in monitoring, regulating, and managing the use of their natural resources;
- Improving Biodiversity Conservation by promoting the sustained use, conservation and management of natural resources and biodiverse areas by local populations; and,
- A Policy and Communications component that improves the enabling environment in which citizen and professional groups can successfully lobby for policy changes that serve their economic, governance or environmental interests.

Purpose of this Scope of Work

This SOW describes the services requested for one Environmental & Social Assessment (ESA) Professional who will perform services for the USAID Wula Nafaa and PCE Projects in Senegal.

The services described herein will enable the above-mentioned Projects to respond to and comply with the requirements of USAID Regulation 22CFR 216.3(b), USAID's pesticide procedures, as well as USAID's *policy* on the use of Integrated Pest Management (IPM). These services will make it possible for the project to comprehensively contribute to environmental and human health safety on this project, while conserving natural resources and achieving project goals.

Responsibilities of ESA Professional: PERSUAP Production

The ESA Professional will be responsible for: Contacting mission MEO, CTO, appropriate ministries, private sector representatives and beneficiary farmers; conducting a PERSUAP, as follows.

The PERSUAP will:

- Ensure compliance with the Agency's pesticide procedures (Regulation 216);
- Promote and facilitate use of Integrated Pest Management (IPM) with a view of avoiding or reducing unnecessary pesticide risk;
- Ensure compliance with the Government of Senegal's pesticide regulations, laws, policies or procedures on importation, testing, storage, use and disposal;
- Ensure compliance with the Government of Senegal's list of registered pesticides, permitted uses and availability;
- Analyze the Active Ingredients (AIs) in all registered pesticides for chemical class, EPA registration for same or similar purposes, Restricted Use Pesticide (RUP) status, WHO and EPA acute human toxicity classifications, chronic human health issues, groundwater pollution potential, and ecotoxicity to birds, honeybees, earthworms, fish, amphibians, mollusks, crustaceans, aquatic insects and plankton;
- Identify IPM technologies currently in use in Senegal for each target crop as well as additional IPM technologies used in more developed market countries that may be adopted and used in Senegal for the same crops/cropping systems;
- Create a risk profile for Senegal by identifying and analyzing the agrochemical system for risk, using indicators that both increase and decrease chances for risks;
- Identify and recommend appropriate pesticide sector BMPs and mitigative actions for incorporation into the projects' activities;
- Identify and recommend alternative actions and/or pesticides, as appropriate; and
- Identify and address key pesticide use issues, particularly those that impact on pesticide utilization by small-scale farm laborers and farmers;
- Make recommendations for training of project field staff and beneficiary farmers, and for the provision of Personal Protection Equipment (PPE) for pesticide users;
- Draft the PERSUAP; respond to comments from IP contact persons, CTO, MEO and/or REA, BEO and, if food security, the DCHA BEO.

Collaboration with the Economic Growth Project (PCE)

This assignment will be carried out in parallel with a similar effort to develop a PERSUAP for the USAID/Senegal Economic Growth Project also implemented by IRG. The PCE and Wula Nafaa

projects both work on certain crops and so elements of the PERSUAP for each project are expected to be the same or very similar.

Period of performance / Level of Effort

The ESA Professional is expected to begin work at home in late February with field work beginning in mid-March. The Level of Effort for work associated with the needs of Wula Nafaa is not to exceed 25 days, including, two trips to Senegal. The travel to Senegal would coincide with the travel required to prepare the PERSUAP for the PCE project.

The LOE specific to the PERSUAP for the Wula Nafaa project will be roughly divided into the following four phases:

- Preliminary analysis regarding pesticide choices and their use, begun at home by the Consultant based on the information provided in Annex 1 and in consultation with PCE staff by email (4 days).
- An initial trip to Senegal to gather the base data, discuss activities and practices with concerned project staff (12 days)
- Off-site preparation of the PERSUAP with remote discussions with Wula Nafaa staff as needed (5 days)
- Second trip to Senegal to discuss PERSUAP with Wula Nafaa staff and USAID and to do some basic training with the concerned agronomist staff and others about the report and how to use it (2-3 days).

Deliverables

1. Brief mission report for first trip (submitted prior to departure)
2. A final report that includes:
    a. A brief mission report on the consultant's activities
    b. The PERSUAP, including any relevant EMMP information

The consultant will work directly under the direction of the Chief of Party, and with the Agriculture Component team members and the Project M&E manager.

ANNEX B. PESTICIDES OF GLOBAL CONCERN

This annex contains the following:

(1) Chemicals banned in accordance with the Rotterdam Convention, PIC Procedure

(2) The Pesticide Action Network "Dirty Dozen"

(3) The "Dirty Dozen" POPs

(4) Organophosphate products of concern

While PCE and USAID-WN may only provide assistance for the use or procurement of pesticides in SUAP Table 1, the pesticides in this annex should be strongly discouraged.

(1) Rotterdam Convention, PIC Procedure

The following is from the *Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade.* The chemicals listed in Annex III of the convention include pesticides and industrial chemicals (not included herein) that have been banned or severely restricted for health or environmental reasons by Parties. There are a total of 40 chemicals listed in Annex III, 29 are pesticides (including four severely hazardous pesticide formulations) and 11 industrial chemicals. This information, as well as additional information on the Rotterdam Convention and Prior Informed Consent Procedure can be found at http://www.pic.int/home.php?type=t&id=29&sid=30

Annex III (**)

Chemical *(CAS number(s))*
2,4,5-T and its salts and esters *(93-76-5)* *
Aldrin *(309-00-2)*
Binapacryl *(485-31-4)*
Captafol *(2425-06-1)*
Chlordane *(57-74-9)*
Chlordimeform *(6164-98-3)*
Chlorobenzilate *(510-15-6)*
DDT *(50-29-3)*

Dieldrin *(60-57-1)*
Dinitro-ortho-cresol (DNOC) and its salts(such as ammonium salt, potassium salt and sodium salt) *(534-52-1; 2980-64-5; 5787-96-2; 2312-76-7)*
Dinoseb and its salts and esters *(88-85-7)*
1,2-dibromoethane (EDB) *(106-93-4)*
Ethylene dichloride *(107-06-2)*
Ethylene oxide *(75-21-8)*
Fluoroacetamide *(640-19-7)*
HCH (mixed isomers) *(608-73-1)*
Heptachlor *(76-44-8)*
Hexachlorobenzene *(118-74-1)*
Lindane *(58-89-9)*
Mercury compounds including inorganic mercury compounds, alkyl mercury compounds and alkyloxyalkyl and aryl mercury compounds (CAS numbers)
Monocrotophos (6923-22-4)
Parathion
Pentachlorophenol and its salts and esters *(87-86-5)* *
Toxaphene *(8001-35-2)*
Tributyltin compounds
Dustable powder formulations containing a combination of : benomyl at or above 7 per cent, carbofuran at above 10 per cent, thiram at or above 15 per cent *(17804-35-2; 1563-66-2; 137-26-8)*
Methamidophos (Soluble liquid formulations of the substance that exceed 600 g active ingredient/l) *(10265-92-6)*
Phosphamidon (Soluble liquid formulations of the substance that exceed 1000 g active ingredient/l) *13171-21-6* (mixture, (E)&(Z) isomers) *23783-98-4* ((Z)-isomer) *297-99-4* ((E)-isomer))
Methyl-parathion (emulsifiable concentrates (EC) at or above 19.5% active ingredient and dusts at or above 1.5% active ingredient) *(298-00-0)*

* Only the CAS numbers of parent compounds are listed. For a list of other relevant CAS numbers, reference may be made to the relevant decision guidance document.

** As amended by the First Meeting of the Conference of the Parties by its decision RC 1/3 of 24 September 2004

(2) Pesticide Action Network (PAN) Dirty Dozen Pesticides

PAN International launched its Dirty Dozen Campaign in 1985 to target a list of extremely hazardous pesticides for bans or strict controls on production and use worldwide, and to advocate their replacement with safe and sustainable pest control methods. Collectively, Dirty Dozen pesticides cause many deaths and widespread environmental damage every year. Most have been banned or restricted in the industrialized countries because of their known hazards. Yet the Dirty Dozen are still heavily promoted and widely used in many developing nations, where the lack of protective equipment, safety training, and medical services makes their impact even more devastating.

The Dirty Dozen are:

aldicarb
toxaphene
chlordane and heptachlor
chlordimeform
chlorobenzilate
DBCP
DDT
the "drins" (aldrin, dieldrin, and endrin)
EDB
HCH
lindane
paraquat, parathion and methyl parathion, pentachlorophenol, and 2,4,5-T

Most of these pesticides qualify as persistent organic pollutants (POPs), which are notable for their longevity, toxicity to humans and animals, and their ability to be transported around the globe through the atmosphere.

The United Nations Environment Programme (UNEP) has identified a number of the Dirty Dozen chemicals as the initial targets for global elimination under an international treaty.

Nine of the UNEP targeted chemicals are organochlorine pesticides (aldrin, endrin, dieldrin, DDT, chlordane, heptachlor, hexachlorobenzene, toxaphene and mirex). The industrial chemicals dioxin, furans and PCBs are also on the POPs treaty list (see below). The treaty, which will come into force when ratified by 50 countries, will have provisions to add additional chemicals which meet the agreed-upon criteria for persistence in the environment, bioaccumulation, and transportability.

There is widespread agreement that some of the remaining PAN Dirty Dozen pesticides which are still in use in the United States and other industrialized countries (e.g., lindane and endosulfan) meet these criteria. Other, less persistent but still highly toxic PAN Dirty Dozen chemicals like methyl parathion, pentachlorophenol, paraquat, and 2,4,5-T remain in use in the U.S. or other countries.

(3) The "Dirty Dozen" POPs

POP chemicals are targeted because they exhibit a combination of particularly dangerous properties: they are toxic; they are persistent in the environment, resisting normal processes that break down contaminants; they accumulate in the body fat of people, marine mammals and other animals, and are passed from mother to

fetus; and they can travel great distances, typically from temperate and tropical regions to the poles, on wind and water currents. Because of this last trait, even though most of these named POPs have been banned or severely restricted in many countries, the only way to provide adequate protection is assuring global elimination. In addition, because they are widely recognized as being impossible to keep from escaping to the environment and causing harm once they are manufactured, the only way to prevent their effects is to not create them in the first place and eliminate those already there. Even very small quantities of POPs can be harmful, causing cancer and developmental disorders, as well as damage to the reproductive, nervous and immune systems.

POP - Date of Definition and Primary Use

- Aldrin - 1949 - Insecticide used against soil pests (primarily termites) on corn, cotton and potatoes.
- Chlordane - 1945 - Insecticide now used primarily for termite control.
- DDT - 1942 - Insecticide now used mainly against mosquitoes for malaria control.
- Dieldrin - 1948 - Insecticide used on fruit, soil and seed crops, including corn, cotton and potatoes.
- Endrin - 1951 - Rodenticide and insecticide used on cotton, rice and corn.
- Heptachlor - 1948 - Insecticide used against soil insects, especially termites. Also used against fire ants and mosquitoes.
- Hexachlorobenzene - 1945 - Fungicide. Also a by-product of pesticide manufacturing and a contaminant of other pesticide products.
- Mirex - 1959 - Insecticide used on ants and termites. One of the most stable and persistent pesticides. Also a fire retardant.
- Toxaphene - 1948 - Insecticide used especially against ticks and mites. A mixture of up to 670 chemicals.
- PCBs - 1929 - Used primarily in capacitors and transformers, and in hydraulic and heat transfer systems. Also used in weatherproofing, carbonless copy paper, paint, adhesives and plasticizers in synthetic resins.
- Dioxins - 1920s - By-products of combustion (especially of plastics) and of chlorine product manufacturing and chlorine bleaching of paper.
- Furans - 1920s - By-products, especially of PCB manufacturing, often with dioxins

(4) Organophosphate pesticides (OPs) are among the most acutely toxic pesticides, with most of these chemicals classified by the USEPA as toxicity class I (highly toxic) or toxicity class II (moderately toxic). In addition, some OP pesticides cause developmental or reproductive harm, some are carcinogenic, and some are known or suspected endocrine disruptors. From the PAN site, the following are **organophosphates of primary concern:**

azinphos-methyl
chlorpyrifos
diazinon
dichlorvos
dimethoate
ethephon
malathion
methamidophos
naled
oxydemeton-methyl

ANNEX C. TOXICITY CLASSIFICATION OF PESTICIDES

a) WHO classification

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	-	-

b) USEPA classification

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[3]	Skin		
1	Extremely toxic	≤50	≤200	≤0.2	Corrosive	Corrosive	< 0.1	
2	Highly toxic	50-500	200-2000	0.2-2.0	Severe	Severe	0.11-1.0	< 2 µg/bee
3	Moderately toxic	500-5000	2000-20000	2.0-20	No corneal opacity	Moderate	1.1-10.0	2.1-11 µg/bee
4	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	

[2] Expressed in ppm or mg/l of water

[3] 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

According to common usage in the US, there are two broad categories of pesticides, restricted-use (RUPs) and general use (GUPs). Field application and use of RUPs can only be carried out by licensed operators. Use of GUPs does not require licensing. These are pesticides mostly in Class III or Class IV. The criteria for restricted-use classification are usually based on human hazard; additional considerations include effects on aquatic organisms, effects of residues on birds, hazard to other non-target organisms, and accident history.

ANNEX D. MITIGATION OF HUMAN TOXICOLOGICAL EXPOSURES

This Annex contains:

(1) General guidance on mitigating potential pesticide dangers

(2) Mitigation of human toxicological exposures

(3) Protective clothing guide

Assistance for the use or procurement of pesticides must be provided concurrent with guidance on mitigating the potential dangers of pesticides on human health.

(1) General Guidance on Mitigating Potential Pesticide Dangers

Measures to ensure safe transport, mixing, use, storage, and disposal

If there are no feasible alternatives to pesticides, take the following measures to mitigate and reduce the 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. The key is to ***reduce exposure time or the degree of exposure.***

Before use

Transport

- Separate pesticides from other materials being transported
- Ensure no spillage during transport

Packaging

- Follow international and national norms and guidelines
- Use packaging (small containers) adapted to local needs, and always retain the label
- 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
- Keep all pesticide containers, mixed pesticide, sprayed pesticide, pesticide sprayers, and empty pesticide containers away from children. Ensure safe storage – in a clean dry location *away from children*. Use a well-recognized "danger" symbol to warn people away from areas where pesticides are stored.

  Formulating

- Use appropriate type and concentration
- Only re-use containers to mix pesticides, and do not re-use without first cleaning in accordance with safe practices

During use

Training

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

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

After use

- Know, enforce, respect, and provide training on exclusion or re-entry periods after application
- Assure proper cleaning and rinsing off of:
  - applicators' preparation and application equipment
  - applicators' clothing
  - storage containers

  Train on safe practices in washing and storing pesticide application equipment, containers, and leftover pesticides

- Assure proper disposal of pesticide 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

Focus on providing protective "buffer zones" around the following:

- Housing
- Environment: water, sensitive areas

(2) Mitigation of Human Toxicological Exposures (as revised from the AgVANTAGE PERSUAP, USAID/Georgia)

Most pesticide poisonings result from careless handling practices or from a lack of knowledge regarding the safe handling of pesticides. The checklist below can help avoid the 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 exposure

- Check the label for special instructions or warnings regarding oral exposure
- Never eat, drink, or smoke or 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 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

(3) Protective Clothing Guide

In addition to the measures above, use of the prescribed protective gear will also help ensure against exposure to pesticides. If a pesticide product is USEPA-registered, specific protective gear will be described on the label for each pesticide by EPA toxicity class I, II, III, or IV, with signal word DANGER, WARNING, CAUTION. If the pesticide product is not USEPA-registered – as is usually the case in Senegal – the label may still carry instructions, as required by the regulating authority, regarding safety gear requirements. If the label is missing or the pesticide product was repackaged and no accurate label or no label at all was provided, a similar product may be identified and the protective gear information for that applied to the pesticide with no label. Purchase of pesticide product that is re-packaged and unlabelled should, of course, be strongly discouraged.

The following guide for protective clothing is helpful, but keep in mind that if a product is unlabelled or if it is not USEPA-registered, it will not have EPA toxicity classes, and a proxy is needed. It is better to be on the safe side and encourage the use of available protective gear.

Protective Clothing and Equipment Guide

	Label Signal Words		
Formulations	Caution	Warning	Danger
Dry	Long-legged trousers and long -sleeved shirt; shoes and socks.	Long-legged trousers and long-sleeved shirt; shoes and socks; wide-brimmed hat; gloves.	Long-legged trousers and long-sleeved shirt; shoes and socks; wide-brimmed hat; gloves; cartridge or canister respirator if dusts in air or if label precautionary statement says: Poisonous or fatal if inhaled.
Liquid	Long-legged trousers and long-sleeved shirt; shoes and socks; wide-brimmed hat.	Long-legged trousers and long-sleeved shirt; shoes and socks; wide-brimmed hat; rubber gloves. Goggles if required by label precautionary statement. Cartridge or canister respirator if label precautionary statement says: Do not breathe vapors or spray mists. or Poisonous if inhaled.	Long-legged trousers and long-sleeved shirt; rubber boots, wide-brimmed hat; rubber gloves, goggles or face shield. Canister respirator if label precautionary statement says: Do not breathe vapors or spray mists, or Poisonous if inhaled.
Liquid (when mixing)	Long-legged trousers; long-sleeved shirt; shoes and socks; wide-brimmed hat; gloves; rubber apron.	Long-legged trousers and long-sleeved shirt; shoes and socks; wide-brimmed hat; rubber gloves; goggles; or face shield; rubber apron. Respirator if label precautionary statement says: Do not breathe vapors or spray mist, or Poisonous (or fatal or harmful) if inhaled.	Long-legged trousers and long-sleeved shirt, rubber boots, wide-brimmed hat, rubber gloves, goggles or face shield. Canister respirator if label precautionary statement says: Do not breathe vapors or spray mists, or Poisonous if inhaled.
Liquid (when mixing the most toxic concentrates)	Long-legged trousers; long-sleeved shirt; boots, rubber gloves, water proof wide-brimmed hat.	Water repellant, long-legged trousers and long-sleeved shirt, rubber boots; rubber gloves; rubber apron; water-proof wide-brimmed hat, face shield, cartridge or canister respirator	Water-proof suit, rubber gloves, water-proof hood or wide-brimmed hat.

ANNEX E. POTENTIAL IMPACTS ON WILDLIFE, BEES, AND AQUATIC SYSTEMS AND RECOMMENDED MITIGATION MEASURES

This annex contains:

(1) Mitigation measures to minimize impacts on protected areas

(2) Mitigation measures to minimize impacts on non-target ecosystems and organisms

(3) General information and recommendations to mitigate impacts on wildlife

(3) Safety precautions to protect bees and other pollinators

(4) Safety precautions to mitigate impacts on groundwater resources

(1) Mitigation Measures to Minimize Impacts on Protected Areas (national parks, forests, wildlife reserves, etc.):

The following information may be included in USAID-WN and PCE training programs, and is also provided to help USAID-WN and PCE mitigate any potential impacts to protected areas (PAs):

- Identify national parks, forests, other protected areas, important waterways, including drinking and washing water sources, and habitat of threatened and endangered species in PCE and USAID-WN intervention zones.
- Link with local environmental authorities and environmental NGOs, who may be aware of important ecological features and safeguards that should be taken to minimize environmental impacts of pesticide use.
- Solicit the assistance of an environmental NGO to partner with on field visits.
- A minimum distance of a 100 meter buffer area [or typical buffer recommended in Senegal situation] should be allowed between agricultural fields that are sprayed and any protected areas to minimize impact from pesticide spray drift.
- Pesticides should not be used in areas where the water table is in within three meters of the surface.

- Crops that require pesticide treatment should not be planted within 100 meters of bodies of water or wetland areas.
- Pesticides should not be applied in areas adjacent to protected areas unless precautions are taken to ensure that habitat and wildlife (including birds, fish, and other organisms) will not be affected.
- Construct erosion barriers to prevent runoff of soil from agricultural fields into waterways and wetland areas.
- When washing sprayers and disposing of pesticides, measures must be taken to protect waterways, wetlands, and drinking water sources for humans and wildlife. Safe areas for washing and disposing of remaining pesticides should be delineated or created.

(2) Mitigation Measures to Minimize Impacts on Non-target Ecosystems and Organisms

Safety precautions to minimize effects of pesticides on non-target ecosystems and organisms should be integrated into the provision of assistance for the use or procurement of pesticides. The information in this section can be used in training and technical assistance, as appropriate. It has been adapted from http://edis.ifas.ufl.edu/PI122 (University of Florida Extension), and focuses on the effects of pesticides on non-target ecosystems and organisms and measures to mitigate impacts.

Soil Microorganisms

Soil organisms are responsible for contributing to the decomposition of dead animal and plant material into organic matter, an important component of our soil fraction. Others are involved in the natural control of soil pests. Aside from their direct effects on pest organisms, soil microbes are a major agent in degrading pesticides. The breakdown of pesticides is beneficial for crop rotation and food residue concerns, and provides herbicide selectivity in some instances. The value of certain soil bacteria that have a symbiotic relationship with leguminous plants in fixing nitrogen translates into reduced synthetic nitrogen fertilizer inputs and increased crop yields. Fortunately, the effect of soil-applied pesticides is short-lived; in fact, in some instances they may enhance the population of certain soil microorganisms.

Fish and Wildlife

The most obvious effects of pesticides on fish and other wildlife are direct effects of acute poisoning. At times, pesticides are solely blamed for fish kills; however, in many cases, indirect effects of pesticides that cause dissolved oxygen depletion are the reason for the kill. Pesticides can enter water sources through drift, runoff, soil erosion, leaching, and occasionally, accidental or deliberate release. The table below lists pesticides which are classified as very highly- or highly-toxic to fish. These pesticides, ranging in concentrations of less than 0.1 to 1.0 ppm, can kill fish.

Pesticides can kill birds in several ways: direct ingestion of granules, baits, or treated seeds and direct exposure from sprays; and indirect bird kills may result from consumption of treated crops, contaminated water, or feeding on contaminated prey. Birds and other wildlife can be poisoned when baits, such as those targeting rodents, are improperly placed or not recovered in a timely fashion. Pellet and granular-formulated pesticides may be mistaken for food and consumed by birds and other wildlife. The table below lists pesticides that are classified as very highly- to highly-toxic to birds. These pesticides have bird acute oral LD_{50} values ranging from less than 10 to 50 mg/kg of body weight. Some pesticides have been implicated in negatively affecting the reproductive potential of certain birds and wildlife.

Certain practices can minimize harmful effects of pesticides on fish and wildlife:

- When given a choice of pesticides to control a certain pest, choose one that is relatively non-toxic towards fish and wildlife.
- Pesticide products, with intact labels, should have an "Environmental Hazards" section. In this section are listed special precautions and measures that should be taken to minimize harmful effects.
- Treat only the areas needing treatment.
- Leave a buffer zone between bodies of water and treated areas.
- If wildlife is present in a certain area, use precaution with placement of baits.

Plants and Phytotoxicity

Phytotoxicity refers to plant injury. Of all pesticide types as a group, herbicides are considered to have the greatest potential for causing phytotoxicity, since they are designed to control unwanted vegetation. Inert ingredients in pesticide formulations may also be capable of causing phytotoxicity.

There are many species of plants in natural and undeveloped areas that are desirable because they protect the watershed by reducing erosion and runoff; they provide food and cover for wildlife, and are part of an ecosystem's balance. A disruption of this balance may increase the likelihood of undesirable vegetation becoming more prevalent. There are situations where desirable plants are injured because of one or more of the following reasons:

- Excessive application rate
- Inadequate mixing and agitation
- Environmental conditions, such as extremely hot temperatures and high humidity at the time of application
- Plants which are under stress from lack of water and/or nutrients

Positive confirmation of phytotoxicity caused by pesticides can be difficult. Keeping accurate application records can assist in trying to determine if a pesticide is responsible for the suspected injury. Even with accurate records, pesticide injury can easily be confused with environmental disorders.

USAID-WN and PCE should use the following tables to help ensure that assistance for the procurement or use of pesticides will not have an effect on birds or fish. Pesticides listed below that are not approved for use by this PERSUAP should never be included in PCE or USAID-WN projects.

Pesticides that are classified as very highly- to highly-toxic to fish.

Pesticide	Type*	Toxicity**	Pesticide	Type*	Toxicity**
Alachlor	H	HT	Maneb	F	HT
Aldicarb	I	HT	Maneb + streptomycin	F	HT
Amitraz	I	HT	Metam-sodium	F	HT
Azinphos-ethyl	I	VHT	Methyl parathion	I	HT
Beta-cypermethrin	I	HT	Methyl-isothiocyanate	FM	HT
Beta-cypermethrin	I	HT	Naled	I	HT

Bifenazate	A	HT	Niclosamide	I	HT
Bifenthrin	I	HT	Oxadiazon	H	HT
Bromadiolone	R	HT	Oxyfluorfen	H	HT
Bromoxynil	H	HT	Pendimethalin	H	HT
Butylate	H	HT	Permethrin	I	HT
Captan	F	HT	Petroleum distillate	I	HT
Carbaryl	I	HT	Pirimiphos-methyl	I	HT
Chloropicrin	FM	HT	Prometryn	H	HT
Chlorothalonil	F	HT	Propargite	I	HT
Chlorpyrifos	I	HT	Pyraclostrobin	F	HT
Dazomet	F	HT	Pyraclostrobin	F	HT
Deltamethrin	I	HT	Pyrazophos	F	HT
Diazinon	I	HT	Quizalofop-ethyl	H	HT
Dichlorvos	I	HT	Resmethrin	I	HT
Diclofop-methyl	H	HT	Rotenone	I	HT
Dicofol	I	HT	***Tau*-fluvalinate**	I	HT
***d-trans*-allethrin**	I	HT	Tefluthrin	I	HT
Endothall	H	HT	Tetramethrin	I	HT
Esfenvalerate	I	HT	Thiodicarb	I	HT
Ethion	I	HT	Thiophanate-methyl	F	HT
Ethoprop	I	HT	Thiram	F	HT
Fenbutatin-oxide	I	VHT	Tralomethrin	I	HT
Fenvalerate	I	HT	Tribufos	D	HT
Fludioxonil	F	HT	Triflumizole	F	HT
Folpet	F	HT	***Zeta*-cypermethrin**	I	HT
Malathion	I	HT			
*Type: A = acaricide; D = defoliant; F = fungicide; FM = fumigant; H = herbicide; I = insecticide; R = rodenticide.					
**Toxicity: VHT = <0.1 ppm; HT = 0.1 – 1.0 ppm.					

Pesticides that are classified as very highly- to highly-toxic to birds.

Pesticide	**Type***	**Toxicity****
Pirimiphos-methyl	I	HT
Aldicarb	I	HT
Dicamba	H	HT
Carbofuran	I	HT
Chlorpyrifos	I	HT
Diazinon	I	HT
Dimethoate	I	HT
Ethoprop	I	HT
Dichlorvos	I	HT
Thiodicarb	I	HT

Metaldehyde	M	HT
Methamidophos	A/I	HT
Methyl parathion	I	HT
Phorate	I	VHT
*Type: A = acaricide; H = herbicide; I = insecticide; M = molluscicide.		
**Toxicity (Bird LD_{50}): VHT = <10 mg/kg; HT = 10 – 50 mg/kg.		

Footnotes

1. This document is PI-85, one of a series of the Pesticide Information Office, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Original publication date November, 2005. Reviewed December 2008. Visit the EDIS Web Site at http://edis.ifas.ufl.edu.

2. Frederick M. Fishel, Associate Professor, Agronomy Department, and Director, Pesticide Information Office; Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL 32611.

Additional information on effects of pesticides on non-target ecosystems and organisms can be found in:

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Short, D.E., F.A. Johnson and J.L. Castner. 2005. Beneficial insects sheet 3. UF/IFAS EDIS Document SP-05. http://edis.ifas.ufl.edu/IN012.

(3) General Information and Recommendations to Mitigate Impacts to Wildlife

The following information is adapted from:

Wildlife and Pesticides - Corn

Authors: William E. Palmer, Peter T. Bromley, and John R. Anderson, Jr.

North Carolina Cooperative Extension Service AG-463-2; and

Reducing Pesticide Risks To Wildlife
Authors: Dale Rollins, Thomas W. Fuchs, C. Wayne Hanselka and Judy Winn

How Do Pesticides Harm Wildlife?

Most insecticides kill insects by damaging their central nervous systems and can harm wildlife in the same way. Wildlife may be exposed to insecticides by breathing the chemical, swallowing contaminated food or water, absorbing the chemical through the skin or feathers, or by swallowing the chemical when grooming. Some birds may eat granular insecticides, mistaking them for seeds or grit.

Some animals may become sick or die when exposed to pesticides. This is a lethal effect and it is measured as the particular chemical's toxicity. The toxicity of a pesticide to animals is commonly expressed as either its LD_{50} (lethal dose) or LC_{50} (lethal concentration). The LD_{50} of a particular chemical is the dose that kills 50 percent of the animals exposed to it. The LC_{50} is the concentration of the chemical in the diet, air or water required to kill 50 percent of the animals exposed. LD_{50}s and LC_{50}s are different for every animal species and are determined by laboratory research. For any species, the lower the LD_{50} or LC_{50} the higher the toxicity.

Wildlife also may suffer sublethal effects from pesticides. In such cases they do not die, but their behavior may be altered or their survival or reproductive abilities affected. For example, in one study, bobwhites that received sublethal doses of the insecticide terbufos (Counter) suffered higher mortality from predators. This kind of sublethal effect of pesticides is difficult to measure and may be underestimated.

Pesticides and Endangered Species

Exposure to pesticides may pose particular problems for certain endangered species. In fact, the presence of threatened or endangered plants or animals may restrict the use of pesticides in certain areas.

Application Hazards

One of the greatest risks associated with pesticides is the movement of the chemical, through drift or runoff, from the target crop to adjacent wetlands or other sensitive habitats. Most pesticides are applied either as liquids (sprays) or granules. Spray should be applied under conditions that will minimize drift into sensitive habitats.

Drift can be minimized by:

- Making ground rather than aerial applications, especially near sensitive habitats
- Using nozzles and spray pressures that produce large spray droplets
- Spraying when the wind will carry the chemical droplets away from sensitive habitats
- Not spraying when wind speed is more than 8 mph
- Using a drift control agent

Granular pesticides are much less susceptible to drift, but they pose a special threat to some species of wildlife, especially seed-eating birds. Birds may mistake pesticide granules for grit or seed. It takes only a few granules of some insecticides to kill a sparrow-sized bird. When granules are applied, take special care to cover them with soil and completely disk under any spills.

Herbicides and Wildlife

Most herbicides are only slightly toxic to wildlife. (A notable exception is paraquat.) While herbicides rarely have lethal effects, they can affect wildlife populations indirectly by altering the structure of the habitat. Many

species of weeds and brush provide important food or shelter for wildlife. Care should be taken to protect wildlife habitats when applying herbicides.

How Risks Can Be Minimized

- Use Integrated Pest Management practices to decrease pesticide use.
- Use the pesticide least toxic to fish and wildlife.
- Completely cover pesticide granules with soil, especially spilled granules at the ends of rows.
- Minimize drift when applying chemicals near fish and wildlife habitats.
- Avoid spraying over ponds, drainage ditches or other wetlands.
- Use filter strips along drainages to decrease pesticide runoff into streams.
- Never wash spray equipment or containers where rinse water could enter ponds or streams.
- Read and follow the instructions on pesticide labels.

Table 1. The Effects of Commonly Used Insecticides on Wildlife.

Chemical Name	Trade name(s)	Chemical Group	Effect on Wildlife
Aldicarb	Temik®	Carbamate	Highly toxic to birds, mammals and fish
Carbaryl	Sevin®	Carbamate	Low toxicity for birds, mammals and fish
Carbofuran	Furadan®	Carbamate	Highly toxic to birds, mammals, and fish
Chlorpyrifos	Lorsban®, Dursban®	Organophosphate	Moderately to highly toxic to birds and fish; low toxicity to mammals
Diazinon	Diazinon®, Spectracide®	Organophosphate	Highly toxic to birds; moderately toxic to mammals
Dicrotophos	Bidrin®	Organophosphate	Highly toxic to birds and mammals; moderately toxic to fish
Dimethoate	Cygon®, Dimate®, Dimethoate®	Organophosphate	Highly toxic to birds; moderately toxic to mammals and fish
Disulfoton	Di-Syston®	Organophosphate	Highly toxic to birds, mammals and fish
Malathion	Cythion®	Organophosphate	Low toxicity to birds and mammals; highly toxic to fish
Methomyl	Lannate®	Carbamate	Highly toxic to birds, mammals and fish
Parathion	several	Organophosphate	Highly toxic to birds, mammals and fish; methyl form slightly less toxic than ethyl form
Permethrin	Ambush®, Pounce®	Synthetic pyrethroid	Low toxicity to birds and mammals; extremely toxic to fish
Phorate	Rampart®, Thimet®	Organophosphate	Highly toxic to birds, mammals and fish
Terbufos	Counter®	Organophosphate	Highly toxic to birds, mammals and fish

Ways to Reduce Pesticide Use

Reducing pesticide use is one of the best ways to protect fish and wildlife resources. Using sound cultural practices reduces pest problems and, therefore, results in lower pesticide use. Cultural practices that decrease the need for, pesticides include rotating crops, selecting resistant varieties (when possible), planting and harvesting at the proper time, and using integrated pest management techniques. IPM is a farming approach that employs alternative methods of pest control, rather than relying solely on agrichemicals. With IPM, pesticides are used *only* when the cost of applying a pesticide is outweighed by the cost of pest damage to the crop. This "threshold" must be reached before chemical pest control is economically justified. In this way, IPM practices help to reduce pesticide use and protect wildlife and the environment.

Insecticides

Species that live in and around corn fields are exposed to insecticides when they eat granules and chemical residues on plants or in insects. Wildlife that enter crop fields soon after an insecticide has been sprayed are exposed when they inhale its vapor or when the insecticide contacts their skin or eyes.

The effects of insecticides on wildlife and fish can be minimized by using the least toxic alternative. The hazard of an insecticide is based on its toxicity to wildlife, the way it is used, and other characteristics, such as its persistence in the environment. For example, methomyl (Lannate) is acutely toxic to birds and mammals. However, because methomyl does not persist in the field, careful use of this chemical presents only a moderate hazard to wildlife. Wildlife exposed to insecticides rated high may die or become sick. Insecticides rated moderate may also cause death or sickness, although death is unlikely. Insecticides rated low are unlikely to harm wildlife directly.

Granular Insecticides

Granular insecticides present a serious hazard to birds. Many highly toxic insecticides are formulated as granules, such as fonofos (Dyfonate) and terbufos (Counter). Birds eat granules exposed on the soft surface, mistaking them for food and grit. Ingesting only a few granules of a toxic insecticide can kill a small bird.

To reduce the hazard to wildlife from granular formulations:

- Use the least toxic insecticide that will control the insect pest
- Fully incorporate granules into the soil.

Incorporation is especially important near field edges where many birds search for food and grit. *Disking spilled granules under the soil at row ends* significantly reduces wildlife exposure to the granules. If soil incorporation is not possible, consider using a liquid formulation following the guidelines in the next section.

Liquid Insecticides

Several insecticides that are sprayed on corn foliage are toxic to wildlife; these include carbofuran (Furadan), methyl parathion, and methomyl (Lannate). Other foliar insecticides are only slightly toxic to most birds and mammals; for example, malathion, carbaryl (Sevin), esfenvalerate (Asana XL), and permethrin (Pounce or Ambush). However, many of these insecticides are toxic to fish and other aquatic animals.

To reduce danger to wildlife from foliar applications:

- Spray only when IPM thresholds are met
- Use the least toxic insecticide that will control the insect pest
- Minimize drift of insecticides into wildlife habitats

Several studies of aerial applications of pesticides have reported significant drift of material into nearby wildlife habitats. If it is necessary to use highly toxic insecticides, apply them with ground equipment; this will help to minimize drift and reduce the hazard to wildlife. Ground application may also allow wildlife more time to leave the area during the spraying operation.

Spray drift can be minimized by using application equipment with low drift characteristics, replacing inappropriate or worn nozzles, using appropriate pressure and volume for the chosen nozzle, and adding a drift control agent. Ultra-low-volume sprays are more likely to cause drift than low pressure sprays. Avoid spraying when the wind is blowing faster than 8 mph.

Nematicides

Nematicides commonly used on corn include carbofuran (Furadan), ethoprop (Mocap), and terbufos (Counter). All three are highly toxic and therefore potentially hazardous to wildlife. If granular formulations are used, full incorporation is required on the label. Incorporating spilled granules at row ends greatly reduces the danger to wildlife that feed along the edges of treated fields.

Herbicides

Most herbicides used during corn production are only slightly toxic to birds and mammals. One exception is paraquat (Gramoxone), which is moderately toxic to birds. When paraquat is sprayed directly on bird eggs it can cause abnormal growth of embryos and has been shown to reduce the hatching success of waterfowl eggs. Some herbicides are very toxic to fish, such as pendimethalin (Prowl) and bromoxynil (Buctril). Care should be taken to ensure ponds and streams are not contaminated with herbicides.

Herbicides can harm or destroy wildlife habitats. Herbicide use can often be reduced by employing IPM practices. Keep records of weed problems and use postemergent herbicides only when needed. New postemergent herbicides (such as Accent or Dimension) may help to reduce costs and the total amount of herbicide needed. When applying herbicides, avoid spraying past the outer row of corn because it wastes chemical and can destroy wildlife habitats.

Also, protecting noncrop areas from herbicides is important. Wildlife, especially small game and song birds, benefit from the cover provided by strip habitats. These strips are linear noncrop areas, such as hedgerows, ditch banks, filter strips, field borders, and fencerows. The vegetation in strip habitats provides wildlife valuable cover for nesting, brood rearing, and escaping from predators. These habitats also allow wildlife safe access to corn fields during winter months when these fields provide a good source of food.

Mowing strip habitats also reduces their value for wildlife. When field borders, filter strips, ditch banks, and other fallow areas are mowed during spring and summer, wildlife cover is reduced. Consider maintaining strip habitats by mowing only once per year or less frequently if possible. Mow during early spring only. Mowing alternate sides of strip habitats every other year will ensure that cover will be available to wildlife year-round.

(4) Safety Precautions to Protect Bees and Other Pollinators

In conjunction with assistance for the use or procurement of pesticides, USAID-WN and PCE should provide information on mitigating the impacts of pesticides to bees and other pollinators. Pesticides vary in their effect on bees and other pollinators. The following information is provided to assist in this effort.

Most research on the effect of pesticides on beneficial insects has focused on bees. Contact insecticides kill by contact with the organism, and will affect insects that are sprayed. Systemic insecticides that are incorporated by treated plants can contaminate nectar or pollen and kill bees in their hive.

Active ingredients can be ranked for toxicity to bees, but the actual formulation and mode of application provide the ultimate indication for degree of toxicity to bees. A stronger formulation of a pesticide that might be considered highly toxic might be less toxic if applied only to the soil rather than as spray. Dusts and wettable powders are usually more hazardous to bees than solutions or emulsifiable concentrates.

The following is adapted from "Protecting Honey Bees from Pesticides" by Dr. James E. Tew:

Protecting pollinators, especially honey bees, from pesticide poisoning should be part of any pesticide program. The following recommendations can help minimize bee kills.

Pesticides on Blossoms. The blossom is usually the only part of a plant that bees visit. To avoid killing bees, do not apply pesticides hazardous to bees during the blooming period. When the treated area contains the only attractive plants, in bloom within flight range, injury may occur to colonies several miles away. Treating non-blooming crops with a hazardous pesticide when cover crops, weeds, or wild flowers are in bloom within (or near) the treated field may also cause heavy bee losses.

Drift of Pesticides. Drift occurs from nearly all spray or dust applications of pesticides from a short distance to miles downwind. Pesticide dusts drift farther than sprays. Pesticides applied by plane usually drift farther than those applied by ground equipment. Generally, it is less hazardous to apply pesticides near apiaries with ground equipment than by plane. Drift can be reduced by applying pesticides in the evening or early morning when the air is calm.

Time of Application. Ideally, pesticides should be applied when there is no wind and when bees are not visiting plants in the area. The time and intensity of bee visitation to a given crop depends on the abundance and attractiveness of the bloom. For example, apple trees or clover in bloom may be attractive to bees all day while cucumbers and corn are usually attractive in the morning and early afternoon hours. In general, evening or early night applications are the least harmful to bees.

Formulation of Pesticides. Dusts are usually more hazardous to bees than sprays. Wettable powders often have a longer residual effect than emulsifiable concentrates. Granular pesticides seem to present very little hazard. Ultra-low volume (ULV) formulations of some pesticides are much more toxic than regular sprays. No effective repellent has been developed that can be added to pesticides to keep bees from treated areas.

Toxicity of Pesticides. Most agricultural pesticides have been tested for their toxicity to honey bees. However, laboratory and field results do not always coincide, due to peculiarities of bee behavior, length of residual life of the pesticide, or the effects of different formulations.

Insecticides affect bees in one or more ways: as stomach poisons, as contact poisons, and as fumigants. Pyrethroids, organophosphates, and carbamates vary in their toxicity to bees from relatively nonhazardous to very hazardous, depending upon the individual material or combination of materials.

Some bacteria, protozoans, and viruses that are currently recommended for biological control pose a serious hazard to bees.

Herbicides, defoliants, and desiccants such as paraquat, MAA, and MSMA reportedly were extremely toxic when fed to newly emerged worker honey bees or when sprayed onto older bees in field tests. Most tests have shown other materials in this class to be nonhazardous to bees, except that they kill or damage nectar- or pollen-producing plants.

Fungicides seem to cause little trouble for bees. Captan at field dosages has caused brood damage.

Sex lures, attractants, and other hormones usually cause no problem for bees. Occasionally, a few honey bees and bumblebees have been found in traps containing Japanese beetle lures.

Precautions for Farmers and Applicators

1. Apply pesticides only when needed.
2. Use the recommended pesticide at the lowest effective rate.
3. Use the pesticide least hazardous to bees that will control the pest involved. If all recommended pesticides are equally hazardous to bees, use the one that has the shortest residual effect.
4. Use sprays or granules instead of dusts.
5. Use ground equipment instead of aerial application to apply pesticides near bee hives.
6. Apply pesticides in late afternoon or at night when bees are not working the blooms.
7. Avoid drift of pesticides onto plants that are attractive to bees.
8. Notify beekeepers several days before applying any pesticide that is hazardous to honey bees. This will give them a chance to protect their colonies. However, notifications are not a release of responsibility.

Precautions for Beekeepers

1. Place colonies where they will be away from fields that are routinely treated with hazardous pesticides and will not be subjected to pesticide drifts.
2. Identify your apiary. Post your name, address, and phone number in a conspicuous place near your apiary. Let farmers and custom applicators in your area know where your apiaries are located so they will not unknowingly poison them.
3. Be familiar with pesticides commonly used in your area and what their application dates are.
4. Relocate colonies that are exposed repeatedly to hazardous pesticides. Also, remember that soon after colonies are moved to a new location, foraging bees search for water. They may collect water that has been contaminated with pesticides. To reduce the chance of bee losses, provide clean water near the hives.

Bee Kill Estimations	
0 - 100 dead bees per day	Normal Die-off
200 - 400 dead bees per day	Low Kill
500 - 900 dead bees per day	Moderate Kill
1000 or more dead bees per day	High Kill

Pesticides Toxic to Bees

Pesticide labels provide important information about toxicity to honey bees and other non-target organisms.

USAID-WN and PCE staff and partners can provide recommendations to farmers on using best practices—described above—to minimize impacts to pollinators, and should use the below information as a guide for recommending specific pesticides and discouraging the use of more toxic pesticides with the aim of minimizing effects on honey bees. USAID-WN and PCE are limited to only recommending pesticide active ingredients and products approved by this PERSUAP. USAID-WN and PCE should *discourage* the use of any of the active ingredients below that are highly toxic to honey bees.

The following partial list of pesticides represents groups of materials ranked by toxicity to honey bees. Toxicity ranking may vary depending on the formulation of a pesticide.

Group 1. Hazardous: Generally, these materials kill bees on contact during application and for one or more days after application.

Highly toxic

- 2,4-D
- abamectin
- acephate
- azinphos-methyl
- bifenthrin
- carbaryl
- carbosulfan
- chlormephos
- chlorpyrifos
- cyfluthrin
- d-phenothrin
- demeton-s-methyl
- diazinon
- dichlorvos
- dicrotophos
- dimethoate
- esfenvalerate
- ethion
- etrimfos
- fenitrothion
- fenpropathrin
- fensulfothion
- fenthion
- fenvalerate
- flucythrinate
- fonofos
- heptachlor
- lindane
- malathion
- methamidophos
- methidathion
- methiocarb
- mevinphos
- monocrotophos
- naled
- omethoate
- oxydemethon-methyl
- oxydisulfoton
- parathion
- permethrin
- phosmet
- phosphamidon
- propoxur
- pyrazophos
- resmethrin
- tetrachlorvinphos
- tralomethrin

Group II. Moderately Hazardous: These materials can be used with limited damage to bees if not applied on bees in the field or on hives near the field. Correct application rate, timing, and method of application, are factors that can reduce pesticide kills.

Moderately Toxic

- Acetochlor
- Aclonifen
- allethrin
- alphacypermethrin
- ametryn
- bromopropylate
- cinmethylin
- crotoxyphos
- DCPA
- diphenamid
- disulfoton
- endosulfan
- endrin
- ethoprop
- flufenoxuron
- fluvalinate
- formetanate hydrochloride
- mancozeb
- methanearsonic acid
- neburon
- pebulate
- phorate
- pirimiphos-methyl
- sethoxydim
- sulfosate
- terbufos
- thiocyclam hydrogen oxalate
- thiodicarb
- triforine

Group III. Relatively Nonhazardous: These materials can be applied with little harm to bees. Regardless, follow label instructions.

Relatively Non-Toxic

- 2,4-D butoxyethyl ester
- 2,4,5-T
- alachlor
- aldicarb
- aldoxycarb
- alloxydim sodium
- amitraz
- amitrole
- ammoniacal copper sulfate
- anilazine
- anthraquinone
- atrazine
- azadirachtin
- azamethiphos
- azocyclotin
- Bacillus thuringiensis
- benomyl
- bentazon
- bitertanol
- Bordeaux mixture
- bromacil
- bromadiolone
- bromofenoxim
- bromoxynil
- buminafos
- bupirimate
- butylate
- butylate
- captan
- captfol
- carbendazim
- carbetamide
- carboxin
- chinosol
- chloramben
- chloranil
- chlorbromuron
- chlordimeform
- chlorflurenol
- chloridazon
- chlormequat chloride
- chlorobenzilate
- chlorophacinone
- chloropicrin
- chlorothalonil
- chlorotoluron
- chloroxuron
- chlorpropham
- clofentezine
- copper oxide
- copper oxychloride
- cyanazine
- cycloate
- cycloxydim

- cyhexatin
- cyproconazole
- dalapon
- daminozide
- dazomet
- DCNA
- desmetryn
- dibromochloropropane
- dicamba
- dichlobenil
- dichlofenthion
- dichloroprop-P
- dichlorprop
- diclofop-methyl
- dicofol
- dienochlor
- diflubenzuron
- dikegulac sodium
- dimethirimol
- diniconazole-M
- dinocap
- diquat dibromide
- dithianon
- dithiocarbamates
- diuron
- dodemorph acetate
- dodine
- endothall
- epoxiconazole
- ethephon
- ethidimuron
- ethion
- ethirimol
- ethofumesate
- ethylfluralin
- fenaminosulf
- fenamiphos
- fenarimol
- fenfuram
- fenpropimorph
- fentin hydroxide
- fenuron
- ferbam
- fluometuron
- fluorodifen
- fluoroglycofen
- folpet
- fosamine ammonium
- fuberidazole
- furalaxyl
- gibberellic acid
- glyodin
- glyphosate
- glyphosate
- guazatine
- indole-3-butyric acid
- iprodione
- Isopropalin
- isoproturon
- lenacil
- linuron
- maneb
- MCPA
- MCPB
- mecoprop
- mecoprop-p
- MEMC
- mepiquat chloride
- metalaxyl
- metalaxyl
- metaldehyde
- methamitron
- methazole
- methoxychlor
- methyl bromide
- Metiram
- metobromuron
- metolachlor
- metoxuron
- metribuzin
- monalide
- monolinuron
- monuron
- MSMA
- nabam
- napropamide
- naptalam acid
- naptalam
- nicotine
- nitralin
- nitrapyrin
- nitrofen
- norflurazon
- nuarimol
- oryzalin
- ovex
- oxycarboxin
- oxyfluorfen

- oxythioquinox
- paraquat
- PCNB
- pendimethalin
- phenmedipham
- phosalone
- picloram
- pirimicarb
- PMA
- prochloraz
- procymidone
- profluralin
- prometon
- prometryn
- pronamide
- propachlor
- propam
- propamocarb hydrochloride
- propargite
- propazine
- propineb
- prothiocarb
- pyrethrins
- pyridate
- pyroquilon
- quinclorac
- quizalofop-ethyl
- rotenone
- ryania
- sabdilla
- sethoxydim
- simazine
- sulfur
- TCA
- terbacil
- terbumeton
- terbutryn
- tetradifon
- thiabendazole
- thiophanate-methyl
- thiram
- triadimefon
- triadimenol
- tribufos
- trichlamide
- trichlorfon
- triclopyr
- trietrazine
- trifluralin
- triphenyltin hydroxide
- validamycin A
- vernolate
- vinclozolin
- warfarin
- WSSA
- zineb
- ziram

Above information from:

Farm Chemicals Handbook, '95, Meister Publishing Company.

Pollinator Protection, Johansen & Mayer, Wicwas Press, 1990.

The New Pesticide User's Guide, Bert L. Bohmont, Reston Publishing Company.

(5) Safety Precautions to Mitigate Impacts on Groundwater Resources

Each pesticide has physical characteristics, such as solubility in water and ability to bind to soil particles and be held (adsorbed) by soil so they do not enter the soil water layers and the groundwater table. This data can be found 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 nine days have the *potential* to contaminate groundwater. Pesticides with a hydrolysis half-life greater than 14 days have *potential* to contaminate groundwater. All of these statements are generalizations, but good rough guides to anticipated pesticide behavior in soil and water. However, each pesticide requires individual investigation or research.

As noted in the SUAP-Table 1, some of the proposed pesticides are potential ground water contaminants. These pesticides in particular, but in general no pesticides, should be mixed, applied, stored, or disposed of adjacent to or upslope from waterways, wetlands or drinking water sources without appropriate safeguards.

ANNEX F. INTEGRATED PEST MANAGEMENT TOOLS

This Annex contains two tools: (1) a general IPM protocol and (2) a scouting and decision-making protocol for a specific greenhouse situation. While both these tools would need to be adapted to conditions in Senegal, they provide detailed information on IPM in a general sense, and help to illustrate the strategic use of IPM in a value chain.

(1) A General IPM Planning and Design Protocol

The following has been adapted from the AgVantage PERSUAP (USAID/Georgia).

The vital parts of an IPM plan include a definition of the targeted primary (small or large-holders) and secondary (markets, processors, transporters, and consumers) beneficiaries, implementation partners (farmers, laborers, extension personnel, national, regional and international organizations), production constraints, and IPM strategies for dealing with them.

Elements of IPM Program

The basic steps needed in an IPM program are 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 using 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 parasite s/parasitoids
- Release or augment microbial pesticides

Step 2: Assess IPM Needs and Establish Priorities. In planning IPM, 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 may 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 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 farmers may not be 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 often do not understand the role of some insects as vectors of plant diseases.

Step 5: Use 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 agro-ecosystem. 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. The underlying idea is to

guide 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).

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
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 the rapidly growing organic food market can be a strong incentive to adopt IPM.

Step 6: Partner successfully with other IPM implementers. Many IPM efforts 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 may 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, and the rates at which pesticides were applied.

(2) Scouting and Decision Making

A regular monitoring program is the basis of integrated crop management (ICM) decision making, regardless of the control strategies used. By regular monitoring, a scout is able to gather current information on the identity and location of problems and to evaluate treatment effectiveness. The following are the basics for an effective greenhouse scouting program.

Tools

Essential monitoring tools include:

- Trained personnel
- Handlens with 10X power and/or optivisor (headset with magnifying glass)
- Yellow sticky cards, clothes pins, bamboo stakes
- Flagging tape or colored flags
- Record keeping system, ie. clipboard and pen or small notebook
- Individual maps of all greenhouses
- Support labs and on-site diagnostic kits for disease diagnosis
- Support labs and solubridge for soil tests
- Resource information such as pesticide labels, pictures and life cycles of key pests

Optional tools include:

- Soil thermometer
- Field microscope (30X)
- Potato chunks (to monitor fungus gnat larvae)
- Waterproof magic marker to label sticky cards

Pre-Crop site evaluation

Prior to the introduction of a crop, evaluate the entire greenhouse, inside and out. Note the presence of weeds in and around the greenhouse, drainage problems, algae build-up, pet plants, stock plants and debris under benches. Crops growing in adjacent greenhouses, or outdoors should be recorded. Previous pest problems in the greenhouse and current pesticide application methods should be reviewed. A plan

of action may then be developed to eliminate these problems prior to the arrival of the crop. Prevention of key pest problems may be more easily accomplished if the grower and scout take the time to identify, analyze and correct problems before crops are introduced. Also, consider how the variety of plants to be grown in the same area may influence ease of pesticide applications and spread of disease. For example, keep seedling and cutting geraniums separate to help minimize spreading bacterial blight. Keep propagation houses separate from other growing areas, and vegetable transplants separate from ornamentals to help reduce the incidence of impatiens necrotic spot virus when western flower thrips are present. Note that most pesticides labeled for ornamentals are not labeled for vegetable and herb plants.

Inspection of incoming plants

At the time of arrival or soon after, the scout should inspect one-third or more of the plants. Thoroughly examine the plants for signs of insects and diseases. (See chart.) Early detection and prompt action can minimize the spread of insects and diseases and save pesticide applications.

Using sticky cards

Sticky cards are used to detect infestations of adult flying insects. Yellow colored cards will attract fungus gnats, shore flies, whiteflies, thrips, leafminer flies and winged aphids. Blue colored traps are more attractive to thrips, although it is more difficult to see the thrips against the blue background. Attach each card to a wire or wood stake using a clothespin. Using two clothespins glued back-to-back will allow you to move the card upwards as the plant matures. Attach one end of the clothespin to a stake and clip the card to the other clothespin.

Each yellow sticky card should be numbered and placed in the greenhouse at the minimum rate of one card per 1,000 sq.ft.. Space the cards equally throughout the entire range in a grid pattern. Place cards near all entryways and vents. Small greenhouses (<4,000 sq.ft.) can be scouted as one unit. Larger greenhouses should be divided into 2,000 to 3,000 sq.ft. sections for ease of scouting.

Change the cards weekly, and place new cards in the same areas of the greenhouse to track pest trends. Brief, concise and accurate information is one of the best tools available to make a pest management decision. Identify and record pest numbers in a notebook or clipboard. Over time, population trends will emerge and provide direction for your pest management program.

Scouting and Monitoring

Scouting and monitoring should be performed weekly or, preferable, twice weekly during the entire production season. Scouting procedures should be performed as routinely as any other crop management task. Maps should be made of the greenhouse and scouting should follow the same pattern every time. Scouting must be intensive; the more plants monitored the better. Scouting should always start at the major doorway, which is usually an entry point of pests. Special attention should be paid to plants around any openings in the greenhouse.

Scouts should walk every aisle and move from bench to bench in a snake-like manner. At least 10 minutes should be spent inspecting 20 or more plants for every 1,000 square feet of production area. Three or more randomly chosen plants on every bench should be inspected. Inspection starts at the bottom of the plant by checking the soil for insect, mite or disease pests and proceeds upwards, looking at older leaves, young leaves and new growth. Pots should be tipped sideways for inspection of the underside of the leaves. Hanging pots and baskets should also be inspected. The first plant showing symptoms on a bench becomes an indicator plant. This plant is tagged to allow the scout to easily recognize it from a distance.

Indicator plants

Indicator plants can be used in three ways:

1. to examine the pest's development cycle
2. to monitor the effectiveness of a treatment
3. to detect the early presence of disease

Indicator plants should be marked and numbered with a colored flag or flagging tape so the scout can identify them quickly each week.

Making pest management decisions

Each week, the grower and scout should review the scouting information. Pest numbers recorded from sticky card counts and foliar inspections, the use of indicator plants, and located reservoirs of pests and diseases will help to prioritize a pest management strategy. Once this information is analyzed, a decision must be made that will include; the choice of pesticide or biological control, the rate, method and site of application; and any other management techniques that may help solve the problem. Every pest management action should be recorded. Monitoring is an ongoing part of the management strategy.

Early detection will result in better pest management than a pest population that is "out of control." If problems are detected early, better pesticide coverage may be achieved due to a smaller canopy, and problem areas can be identified and treated reducing the need for blanket pesticide applications. In addition, "green pesticides" and biological controls may be more successfully incorporated into the pest management program. Over time, growers will determine their individual threshold for a given pest. One grower may accept 10-15 thrips per sticky card per week, while another grower with a history of Impatiens Necrotic Spot Virus will not accept 5 thrips per card per week.

Another important aspect of integrated crop management is crop culture. Crop culture involves plant nutrition, crop scheduling, height management, watering practices, temperature and light management.

At the end of each season, the grower and scout should examine their records to identify trends in pest populations and to review their management strategies. The weekly scouting reports and action taken is the basis for decisions about current and future pest management strategies and for judging the efficacy and cost of any management action.

ANNEX G. KEY WEBSITES FOR PESTICIDE SEARCHES

Ones with asterisks are the most useful for PERSUAP preparation)

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://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)

www.who.int/ipcs/publications/pesticides (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****

CABI Site for Crop Protection Compendium (CPC)

http://www.cabi.org/compendia/cpc/index.htm to enter CABI CPC for crop/pest reccs.

Obsolete Pesticides

http://www.fao.org/ag/AGP/AGPP/Pesticid/Disposal/en/103401/index.html

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)

PERSUAP Sites

http://www.encapafrica.org/sectors/pestmgmt.htm (PERSUAP guidance)

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)

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