INITIAL ENVIRONMENTAL EXAMINATION: AMENDMENT

Face sheet

PROGRAM/ACTIVITY DATA:

Program/Activity Number: 685-0012
Country/Region: Senegal/West Africa
Program/Activity Title: Strategic Objective 12: Improved Health Status of Families

Sub-Activity Amount: Indoor Residual Spraying (IRS)

Funding Begin: FY07 **Funding End:** FY10 **LOP Amount**: TBD

IEE amendment Prepared By: Aminata N. Badiane M.E.O and Mary Cobb, USAID/Senegal Malaria Advisor

Current Date: 03/08/2007

IEE Amendment (Y/N): __Y__ If "yes", June 7, 2006

Environmental Media and/or Human Health Potentially Impacted:

Air ____ water _X_ land _X_ biodiversity ____ human health _X_ other ____ none____

Environmental Actions Recommended:

_X_ 1. *Categorical Exclusions*

_X_ 2. Initial Environmental Examination:

_X_ *Negative Determination*: no significant adverse effects expected regarding the proposed activities, which are well defined over life of the Improved Health Status of families program.
IEE prepared:

__-__ without conditions (no special mitigation measures needed; normal good practices and engineering will be used);
_X_ with conditions (special mitigation measures specified to prevent unintended adverse impact)

____ *Negative Determination*: no significant adverse effects expected, but multiple sites and sub-activities are involved which are not yet fully defined or designed.
"Umbrella" IEE prepared.
___ Conditions agreed to regarding an appropriate process of environmental capacity building and screening, mitigation and monitoring.

____ *Positive Determination*: IEE confirms potential for significant adverse effect of one or more activities. Appropriate environmental review needed/conducted.
____ EA to be / being / has been (circle which) conducted.

____ *Deferral*: one or more elements not yet defined, will not be implemented until amended IEE is approved.

__X__ Pesticides used; 22 CFR 216.3 (b) (1) applies; Pesticide Evaluation Report and Safe Use Action Plan (PERSUAP) attached.

SUMMARY OF FUNDINGS

The original IEE was approved in June 2006; the IEE is being amended to include the use of pesticides for Indoor Residual Spraying (IRS) in Senegal for malaria vector control. The pesticide that will be used for the first spray rounds is ICON Wettable Powder (WP), composed of the active ingredient lambda-cyhalothrin. As such, a PERSUAP has been added to this amended IEE.
The PERSUAP was prepared in accordance with guidance contained in the USAID Bureau for Global Health "Programmatic Environmental Assessment (PEA) "Integrated Vector Management Programs for Malaria Vector Control (2006). To the extent possible relevant analysis in that PEA is cited herein rather than repeated. This document focuses on elements that are specific to the activities in questions and risk mitigations that can be taken within these activities

All other project activities remain essentially the same.

Based on environmental review procedures, the following environmental determinations are recommended:

1. Pursuant to 22CFR 216.2(c)(2)(i), a **Categorical Exclusion** is recommended for IRs 1 (Improved Quality of Health Services, Products, and information) IR 2 (Increased Use of Appropriate Health Services, Products, and Information) for all training, education capacity building, communication and technical assistance activities implemented under this SO as they have no effect on the environment under 22 CFR 216.2(c)(2)(i).

2. Pursuant to 22 CFR 216.2(c)(2)(v), a **Categorical Exclusion** is recommended for IRs 1 and 2 for all documentation and information transfer activities implemented under this SO as they have no effect on the environment.

3. As per 22 CFR 216.3 (a) (2) (iii), a **Negative Determination with Conditions** is recommended for IRs 1 and 2 for all health care activities under this SO. The conditions are that sound disposal procedures for medical and health care waste established in the www.encapa.africa USAID/AFR/SD publication *Environmental Guidelines for Small-Scale Activities in Africa* will be promoted at all health care institution receiving assistance under this SO. All revised and new agreements with institutions funded under this SO will stipulate agreement to this principle.

4. Pursuant to 22 CFR 216.3 (b) (1) (i) (a-l), a **Negative Determination with Conditions** is recommended for IR 2 for insecticide treated bed nets. The conditions are that the procedures spelled out in a pesticide evaluation report and safer use action plan (PERSUAP) will be followed. The PERSUAP was developed under Program/Activity Number HRN-A-00-99-00016-00, in April 2003, to address all USAID activities in Senegal that directly or indirectly support the distribution of insecticide treated bed nets. This PERSUAP was prepared in accordance with the guidance contained in the USAID Bureau for Africa's "Programmatic Environmental Assessment (PEA) for Insecticide-Treated Materials in USAID Programs in Sub-Saharan Africa 2002".http://www.afr-sd.org/documents/iee/docs/32AFR2_ITM_PEA.doc

5. A **Negative Determination with Conditions** is recommended for support to Indoor Residual Spraying (IRS) for epidemic prevention. This activity will use pesticides (ICON Wettable Powder (WP), composed of the active ingredient lambda-cyhalothrin) for malaria vector control. The condition, therefore, is that a PERSUAP be prepared and approved before this activity is initiated.

This IEE specifies a set of steps to ensure adequate environmental review of USAID-supported activities, including capacity-building elements. These negative determinations are also conditioned on the provision of supplemental project technical assistance and training support to augment existing efforts. These capacities will be developed and implemented in close collaboration with USAID/Senegal.

Monitoring:

As required by ADS 204.5.4, the SO12 team and implementing partners will "actively monitor and evaluate whether the environmental features designed for the activity resulting from the 22 CFR 216 processes are being implemented effectively and whether there are new or unforeseen consequences arising during implementation that were not identified and reviewed in accordance with 22 CFR 216." Zero tolerance for any medical wastes that are not disposed of according to WHO guidelines will be promoted at all institutions receiving assistance under this SO. All revised and new agreements with institutions funded under this SO will stipulate agreement to this principle. WHO literature detailing the importance of safe disposal and safe disposal techniques for medical wastes will be widely disseminated. USAID and its implementation partners will carefully monitor clinical interventions to ensure correct disposal of sharps, bio-hazardous and other potentially hazardous and infectious materials through accepted entombment and incineration methods.
In addition, USAID and its implementation partners will ensure that procedures spelled out in the pesticide evaluation report and safer use action plan (PERSUAP) addressing all health activities in Senegal are followed.

The SO Team shall also monitor the need for additional environmental review based on IEE recommendations. SO12, in collaboration with implementing partners, shall ensure that provisions of the IEE, including the conditions and monitoring set forth herein, are incorporated into all contracts, cooperative agreements, grants and sub-grants, as appropriate.

APPROVAL OF ENVIRONMENTAL ACTION RECOMMENDED:

USAID/Senegal health : IRS for Malaria Control in Senegal

Clearance

Mission Director, USAID/Senegal : _____Date ___3/19/07_____

Lisa Franchett (Acting)

CONCURRENCE:

Bureau Environmental Officer: _____ _____ Date__4/11/07_____

Brian Hirsch

Approved_xx___
Disapproved _____

File No.

FY07 Senegal_ SO12 Health_ PERSUAP. doc

ADDITIONAL CLEARANCES:

Mission Environmental Officer _____Date___3/14/07_____
Aminata Niane Badiane

Malaria Advisor
USAID/Senegal _____Date_3/14/07_____

Mary Cobb

Health Office Director _____Date__3/14/07_____
Etian Sylva

Regional Legal Advisor _____ Date _3/16/07_ see typos_____

Cruz-Hubbard Haven

OPTIONAL CLEARANCE:

Environmental Officer _____ Date_____
Bureau of Global Health Michael Zeilinger

Regional Environmental Officer _/cleared/ _____ Date_March 23, 2007_____
Robert Clausen

INITIAL ENVIRONMENTAL EXAMINATION AMENDMENT

PROGRAM/ACTIVITY DATA
Program/Activity Number: 685-0012
Country/Region: Senegal/Africa
Program/Activity Title: **Strategic Objective 12:** Improved Health Status of Families

1.0 BACKGROUND AND PROJECT DESCRIPTION

Although substantial improvements have been made in the health sector over the previous decade, including reducing maternal mortality from 50 out of 10,000 mothers giving birth, to 43, Senegal's human development indicators remain unacceptably low. (It is ranked 157 out of 177 on the UNDP Human Development Index). Population growth is straining the ability of the government to provide adequate social services for its rapidly growing population. The high maternal mortality rate (43 per 10,000 births) and infant death are attributable to inadequate services and poor nutritional status. Over 40% of the population is urban, with a high rural to urban migration rate. Fertility has slowly decreased, but remains high, at 5.3 children per woman. The contraceptive prevalence rate is low, with only about 10.3% of married women of reproductive age using modern methods of contraception. Given the young age structure of the population, early age of marriage (national average of about 18.5) and widespread polygamy, prospects for a significant reduction in population growth are bleak, unless a major effort is undertaken to improve reproductive health activities as well as women's and girls education.

Senegal's current health policy is outlined in Senegal's Poverty Reduction Strategy Paper (PRSP) as well as in the National Health Development Plan, 1998-2007, which was endorsed by donors and other stakeholders. A recent evaluation of the Health Plan's first phase indicates mixed results. On the positive side, substantial progress was reported in the areas of health services delivery (with the increased availability of cost effective interventions and essential drugs at the health posts) and of health systems administration particularly with respect to hospital management. The government also demonstrated its financial commitment to the health sector by increasing its share of budget to 10% in 2005 and by raising the non-wage portion of the recurrent budget.

In response to these changes currently underway in both the national health system and among international donors, USAID is restructuring its support for health care in Senegal and modifying the focus and the methodology of its interventions. Within this new context, USAID/Senegal will support four essential and mutually dependent program components beginning in FY 2006: (1) Health Care Financing and Policy; (2) Maternal and Child Health, and Family Planning; (3) HIV/AIDS, and TB Prevention and Control; and (4) Community Health.

USAID addresses health issues in Senegal at the national, regional and district levels. Under the SO 12 program, USAID will continue to work in Thies, Louga, Kaolack and Ziguinchor - where support for service delivery at both the clinical and community levels was concentrated in the past. As these Health Districts and Regions are now able to provide relatively adequate routine clinical services to their populations, the focus of the new strategy in these regions will be to concentrate on new interventions to further reduce child and maternal mortality, particularly by offering more services at the community level.

1.1 Purpose and Scope of IEE

This IEE is directed at the entire Strategic Objective No. 12: Improved Health Status of Families. The SO will be achieved through the accomplishment of two Intermediate Results (IRs) outlined in this section. Four general program areas have been identified, each of which will contribute to the achievement of both IRs.
In addition, Indoor Residual Spraying (IRS) is proposed for **negative determination with conditions** since it requires the use of pesticides in Malaria vector control, a Pesticide Use Report and Safe Utilization Action Plan (PERSUAP) is attached.

1.2 Description of Activities

Strategic Objective 12 will be implemented through one or more contracts, cooperative agreements and/or grants under two key intermediate results. SO 12 is comprised of the following two intermediate results:

- Intermediate Result One (IR 1): Improved Quality of Health Services, Products, and information;
- Intermediate Result Two (IR 2): Increased Use of Appropriate Health Services, Products, and Information.

IR 12.1: Improved quality of health services, products, and information

This IR has three sub-IRs which USAID believes will converge to result in better quality of all types of health related services and information offered to the population. Information refers to counseling, IEC/BCC and social marketing information, messages promulgated by community health volunteers regarding health behavior (e.g. when to seek care, using family planning, FGC, stigma reduction for HIV/AIDS, etc).

The GOS already has in place, in part due to USAID's support, many effective technical policies and protocols for quality health services. Building on this, it must be ensured that providers at all levels of the health system are adequately trained to carry out these activities, and that the curricula for nurses and midwives are regularly updated to include new policies and protocols as they are adopted. Examples include the neonatal care package, community treatment of pneumonia, and PMTCT. In addition to training, USAID believes that supervision and management are keys to improving service delivery, and that leadership is needed in the health system to apply best practices and ensure that they are offered correctly and appropriately in health facilities or in the community. Finally, ensuring the offer of quality services requires that the processes of planning, budgeting, and implementing those health plans and services are carried out effectively. USAID views increased accountability and transparency, as well as community organization, as essential achievements leading toward its ultimate health results and objectives.

Achievement of this IR will result in better quality of all types of health-related services and information offered to the population. Illustrative activities under this IR include but are not limited to:

- introducing or institutionalizing (depending on the region) a package of services to prevent adverse pregnancy and childbirth outcomes;
- integrating the newborn care package into all health facilities in the focus regions;
- training health workers at the community level to apply malaria and pneumonia case management protocols;
- providing technical assistance to health staff, community health workers, and health and management committees to improve planning and budgeting processes to ensure that appropriate equipment and drugs are budgeted for and procured;
- implementing systems of incentive for good performance and motivation of health workers;
- training VCT laboratory workers in quality control protocols;
- building capacity at the district level to carry out effective supervision of service delivery points;
- training health workers at all levels in new MOH protocols and procedures as necessary;
- promoting transparency and accountability measures, such as publication or posting of user fee schedules and budgets, in the health system and on health and management committees;
- assisting the GOS to monitor drug resistance, to ensure drug quality testing and to strengthen the regulatory structures of the Ministry of Health;
- introducing improved planning and budgeting tools, such as National Health Accounts, in the Ministry of Health;
- providing technical guidance in updating curricula for nurses and midwives to include new policies and protocols as they are adopted;
- engaging in central level policy dialogue to develop consensus among policymakers and stakeholders around key policies that will facilitate more effective use of financial and human resources for better health outcomes;

- working with the private sector and GOS to introduce micronutrient-fortified foods to the commercial market;
- building leadership capacity at district and regional levels to monitor and adapt interventions and scale them up;
- strengthening the MOH capacity to obtain additional resources and use them effectively;
- engaging Management Committees to begin functioning and providing oversight to the operations of Health Committees, ensuring transparent selection of members, clear definition of roles and responsibilities, and proper use of funds according to plans;
- providing technical and financial assistance to operate a "matching grants" program, particularly in under-served communities and in collaboration with other donors;
- strengthening psychosocial and nutrition components of the care and support package for persons living with HIV/AIDS and orphans and vulnerable children affected by HIV/AIDS;
- strengthening capacity and management in the National TB Program to improve clinical detection and cure rates;
- and building the capacity and infrastructure of the National AIDS Council to more effectively monitor and evaluate the evolution of the epidemic, the implementation of planned activities, and the effectiveness of various interventions.

I.R. 12.2 Increased use of appropriate health services, products, and information

This IR has two sub-IRs aimed at increased use of services, commodities, and information to make better health-related choices. Essential to increasing use are improving demand for, as well as access to, services and information. USAID will support increased demand through working with communities to create health plans with activities specific and appropriate to the community's needs, and through approaches to promote information about the benefits of health services and healthy behaviors. For access, USAID is interested in improving affordability, availability, geographic access, and acceptability of health services and products and health behaviors. USAID also believes that improvements in transparency and accountability in the health system will also lead to increased demand for services.

This IR will increase the use of services, commodities, and information to make better health-related choices. Essential to increasing use are improving demand for, as well as access to, services and information. Illustrative activities include but are not limited to:

- working with communities to create health plans with activities specific and appropriate to the community's needs;
- designing communications strategies and tools to promote information about the benefits of using health services and products and practicing healthy behaviors;
- supporting social financing mechanisms, such as Mutual Health Organizations, to improve financial access to health services;
- expanding the number of services offered at each level of the health system, including the community level;
- training community health workers in distribution of family planning products, including registration and follow-up of users;
- promoting transparency and accountability measures, such as publication or posting of user fee schedules and budgets, in the health system and on health and management committees;
- socially marketing health products and services, including adding new products to the range of currently socially-marketed items;
- working with the private sector and private providers to increase commercial availability of health services and products;
- assisting community health workers to identify and address socio-culturally sensitive practices that affect health outcomes in their communities;
- introducing a voucher system to increase access to insecticide-treated bednets to prevent malaria for the most vulnerable populations;
- exploring the potential for Indoor Residual Spraying (IRS) with insecticide for malaria prevention;
- increasing civil society participation in health planning and monitoring of the health system;
- establishing programs to improve access to services for vulnerable groups;

- designing targeted HIV/AIDS prevention interventions for high-risk populations as well as prevention messages for the general population;
- improving follow-up for clinic-based TB treatment adherence in USAID-supported health facilities to decrease defaulter rates and improve cure rate;
- training community health workers in follow up of TB patients under treatment and in referral of possible TB cases for diagnosis;
- and institutionalizing HIV and TB reciprocal testing.

Key program components:

The IRs will be achieved through 5 key program components and will be managed by component. Key activities for the components include:

Health Care Financing and Policy: USAID intends to increase the efficiency in the use of resources available within the health sector; ensure that communities have access not only to their locally-generated health revenues, but also to an increased share of central government resources; build within the MOH a link for technical support to local communities; and increase involvement of private providers. Much of the work that USAID will undertake in this sector will be coordinated with the public, private and NGO sectors to promote transparency, increase civic participation, improve governance and ensure a more integrated approach. This component addresses IRs 1 and 2.

USAID will engage in central level policy dialogue to develop consensus among policymakers and stakeholders around key policies that will facilitate more effective use of financial and human resources

Maternal and Child Health and Family Planning: Maternal and child health and family planning activities will be undertaken by two different components in this program: the MCH/FP component and the Community Health component described below. These two components will undertake some similar activities, but in different settings, i.e., clinical and community. The Maternal and Child Health and Family Planning component will focus on facility-based interventions (i.e. within the MOH structures) and social marketing of appropriate products and services to promote family planning and maternal and child health. The maternal health improvement objective will be achieved through a combination of preventive measures, particularly family planning and quality antenatal care services, as well as improved birthing practices and management of obstetric emergencies. This component will contribute to improvements in child survival primarily through assisting the MOH with its implementation of a neonatal care package and through malaria prevention and treatment activities.

Malaria is the largest cause of both morbidity and mortality in Senegal, particularly affecting pregnant women and children under five. USAID will continue to support subsidization of insecticide treated nets (ITNs) and to strengthen clinical management of malaria progressively through the use of artemisinin-based combination therapy (ACT) and through the intermittent preventive treatment (IPT) of malaria in pregnancy. Community management of malaria will also be supported through the Community Health component described below.

A special emphasis will be placed on meeting the unmet demand for family planning through modern contraceptive methods. USAID will seek to improve the quality and availability of services and methods via improved supervision and training of providers, increased involvement of the private sector and an expanding program of social marketing. The Community Health component will also support community-based distribution of contraceptives.

Strengthening of the health system will also be a key part of the MCH/FP component's activity. Issues to be addressed will include improvements in supervision, motivation of health workers, accountability and transparency in the health system, and leadership capacity of health personnel.

This component focuses on family planning, maternal and neonatal health, social marketing, and health systems strengthening under IRs 1 and 2.

HIV/AIDS and TB Prevention and Control: The focus will be on facility-based and MOH interventions, while the Community Health component will undertake activities at the community level, outside the official structures of the MOH. USAID will support activities to expand and improve preventive services to Senegal's four main high-risk or bridge populations, namely commercial sex workers, transportation workers, fishing industry workers and men who have sex with men. Also key in prevention efforts will be the implementation of the Prevention of Mother to Child Transmission (PMTCT) program (with the MCH/FP component) and the expansion of Voluntary Counseling and Testing (VCT) services in Senegal. This component will also focus on strengthening the psycho-social and nutritional components of care and support for Persons Living with HIV/AIDS (PLWHA) and explore ways of easing the financial burden of treatment-associated costs.

USAID, along with the Centers for Disease Control and Prevention (CDC) and other partners, has supported and will continue to support the development of a well-functioning disease and behavioral surveillance system for Senegal. As program needs change and new partners and new techniques come on board, the structure of the surveillance system will change.

USAID is particularly interested in legal issues related to HIV/AIDS stigma and discrimination, and in advancing legislation currently pending related to discrimination against PLWHA.

In the area of Tuberculosis, this component will support the National Tuberculosis Program (NTP) and target clinical and laboratory services, including in Dakar, where about 50% of Senegal's TB burden is concentrated. Activities will be conducted at the facility level in order to achieve TB indicators that meet WHO standards and ensure an effective integration of HIV and TB activities, where appropriate.

Through activities to promote HIV prevention, AIDS care and support, systems strengthening for HIV and TB, and TB treatment, this component will contribute to the achievement of SO #12: ***Improved Health Status of Families***, via IRs 1 and 2.

Community Health: The community health component of the USAID/Senegal health portfolio reflects the recognition that providing communities themselves with the tools (including information, training, access to services and commodities) to prevent and treat their most pressing health threats has the potential to immensely increase access to quality care and life-saving interventions. Community providers already exist throughout Senegal, and pilot activities have shown that providing training and supervision to these providers greatly improves treatment outcomes.

Activities to be supported under this component will align with - and be similar to - the activities mentioned above to be carried out by the MCH/FP and the HIV/AIDS and TB components. The difference will be that the two aforementioned components will work within the MOH structures and be more clinical in nature. This Community Health component will work directly in communities, often at the level of the health hut. The only medical service currently authorized for all health huts in Senegal is combination therapy for malaria. Many health huts should soon be authorized to provide cotrimoxazole for pneumonia cases, following a very successful pilot activity in 2004.

Along with community management of malaria, diarrhea, and pneumonia, other activities will include health communications at the community level, community-based DOTS (Directly Observed Treatment, Short-course) for TB and support for a neonatal care package (to complement the package to be introduced in clinical settings). USAID is particularly interested in reviving and expanding community-based distribution of contraceptives.

Another aspect of improving health at the community level is providing information and encouraging discussion around healthy behaviors and practices. Correct information about practices or services that may be culturally sensitive but which affect health outcomes will be appropriately raised and discussed by community health workers.

Pharmaceutical Logistics and Quality: To address the issues of pharmaceutical logistics and quality in Senegal, USAID will procure technical assistance to assist the Government of Senegal to monitor drug resistance, particularly related to drugs for the treatment of malaria, pneumonia and tuberculosis, to ensure

drug quality testing and to strengthen the regulatory structures of the Ministry of Health.

2.0. COUNTRY AND ENVIRONMENTAL INFORMATION (BASELINE INFORMATION)

The program will be implemented in all or part of seven Regions of Senegal including: Kaolack, Louga, Ziguinchor, Kolda, Thies, Saint Louis, and Dakar (city only). The following provides a brief description of the biophysical and socio-economic aspects of Senegal.

2.1. Country Climatic, Physical and Ecological Background

Senegal is the most western country in the Sahel. It is bounded in the West by the Atlantic Ocean, in the North by Mauritania, in the East by Mali, in the South-East by Guinea, in the South-West by Guinea-Bissau, and it completely enclaves The Gambia. It comprises an area of 196,722 km2 which is mostly flat, without any pronounced relief.

2.1.1. Climate: Senegal has a harsh climate with generally high temperatures, and low to moderate rainfall. Rainfall is irregular both in distribution and frequency. The rainy season is limited to a seasonal monsoon, wetter in the South than in the North. Average annual rainfall varies between 200mm and 400mm from July to September in the North, 400-700mm in the center, and 700-1,000mm from May to October in the South.

2.1.2. Surface Water: Senegal is cut by four major rivers: Senegal, Sine-Saloum, Gambia and Casamance. Because of the seasonality of the rains and the high evaporation rate, there are practically no permanent surface bodies of significance except for the Lac de Guiers which is replenished yearly by the floods of the Senegal River. The decrease in rainfall over the last 40 years has also affected flood volumes of the main rivers. For example, volumes in the Senegal River have decreased from more than 30 billion m3 to less than 20 billion m3, the lowest being in 1984 with less than 10 billion m3.

2.1.3. Ground Water: Groundwater reserves are relatively abundant in Senegal. These include numerous shallow aquifers replenished by rain waters, and a deeper Maestrichian formation that underlies most of the country.

2.1.4. Soil Fertility: Except along the Senegal River Basin where the soil texture tends to be higher in clay content, the soils of Senegal range from dry sandy soils in the north through the tropical ferruginous soils of the central Sahelo-Sudanian region to the ferralitic soils of the Sudanian region in the South. Overall, soil fertility is low and soils are also generally fragile, making them highly susceptible to water and wind erosion when disturbed.

2.2. Population

The population of Senegal is growing at the relatively high rate of 2.64 percent per year, having increased from approximately 3.2 million at independence in 1960 to 6.9 million and 9.96 million respectively in 1988 and 2002. As a result of this rate of increase, nearly 45% of the population is under the age of 15. The average population density was 16/km2 in 1960 compared to 57/km2 in 2006; outside of urban areas, population density is very uneven.

The second major feature of population is a sustained migration from rural to urban areas. Whereas 73% of the population lived in rural areas in 1960, and 27% in urban areas, only 59.3% live in rural areas in 2006 and 40.7% in urban areas. The population growth rate from 1988 to 2006 averaged 2.98% per year in cities and only 2.44% per year in the rural areas.

Senegal has been modestly successful in improving the physical quality of life since independence. Life expectancy increased from 42 to 52.3; crude death rate decreased from 23 to 9.6 per 1,000 persons; and crude birth rate fell from 47 to 36.0 per 1,000 persons. Child mortality (age 0 to 5) decreased from 287 per 1,000 in 1971-75 to 121 per 1,000 in 2005. In addition, the 2005 Demographic and Health Survey (DHS) indicates that only 10.3% of women use modern contraceptives. HIV sero-prevalence among the general population is estimated at 0.7% in 2005. The health care system in Senegal has also been plagued with the

inconsistent quality of preventive and curative care and frequent unavailability of trained staff and essential products at health centers. Supervision of health services has been poor or non-existent, and the lack of local government support and involvement in health services remains a serious obstacle to improved quality.

3.0 EVALUATION OF ISSUES WITH RESPECT TO ENVIRONMENTAL IMPACT POTENTIAL

The goal of this five-year initiative is to improve the health status of families in targeted areas of Senegal and will be achieved through the following IRs: **(1) Improved Quality of Health Services, Products, and Information** and **(2) Increased Use of Appropriate Health Services, Products and Information**.

The following provides an evaluation of potential environmental impact of key activities planned under the program.

Health Care Financing and Policy: USAID will provide technical assistance and training, and support policy dialogue activities to increase the efficiency in the use of resources available within the health sector; ensure that communities have access not only to their locally-generated health revenues, but also to an increased share of central government resources; build within the MOH a link for technical support to local communities; and increase involvement of private providers. These activities are not expected to affect the physical environment in any way and, therefore, meet the criteria for **Categorical Exclusion** pursuant to 22CFR 216.2 (c) (2) (i).

Maternal and Child Health and Family Planning: This technical program focuses on family planning, maternal and neonatal health, social marketing of contraceptives and insecticide-treated bed nets, and health systems strengthening. Activities also include health care, education and communication, and technical assistance.

Health care activities envisioned will generate a minimal amount of hazardous (sharps) materials from vaccination and other injection procedures from community level health services. The majority of these materials are routinely burned at each facility. Needles and other clinical sharps are normally disposed of in pit latrines or other burial sites to prevent injury to other persons after use.

Of all activities, only malaria-related activities are considered to have a potential environmental effect. USAID/Senegal will likely provide financial, material and technical support to apply a to-be-determined insecticide within homes. The type of insecticide and the strategy for spraying residences have not yet been decided. These activities will not begin until further guidance is issued from Washington and decisions are made regarding the type of insecticide to be used and the approach for spraying (unlikely to begin before May 2007). The program will also assist in the distribution of insecticide treated bed nets.

These activities are not expected to have an overall negative effect on the environment because they are accompanied by efforts to control the distribution and destruction of used bed nets. These conditions are spelled out in a pesticide evaluation report and safer use action plan (PERSUAP) that will be followed. The PERSUAP is included in this IEE by reference. The PERSUAP was developed to address all USAID activities in Senegal that directly or indirectly support the distribution of insecticide treated bed nets. This PERSUAP was prepared in accordance with the guidance contained in the USAID Bureau for Africa's "Programmatic Environmental Assessment (PEA) for Insecticide-Treated Materials in USAID Programs in Sub-Saharan Africa' 2002" http://www.afr-sd.org/documents/iee/docs/32AFR2_ITM_PEA.doc.

HIV/AIDS and TB Prevention and Control: USAID will provide technical assistance, training, education, information to promote HIV prevention, AIDS care and support, systems strengthening for HIV and TB, and TB treatment.

These activities will have no effect on the environment, and therefore meet the criteria for **Categorical Exclusion** pursuant to 22CFR 216.2 (c) (2) (i).

Pharmaceutical Logistics and Quality: USAID will procure technical assistance to assist the Government of Senegal to monitor drug resistance, particularly related to drugs for the treatment of malaria, pneumonia and

tuberculosis, to ensure drug quality testing and to strengthen the regulatory structures of the Ministry of Health.

These activities will have no effect on the environment, and therefore meet the criteria for **Categorical Exclusion** pursuant to 22CFR 216.2 (c) (2) (i).

4.0 RECOMMENDED MITIGATION ACTIONS (INCLUDING MONITORING AND EVALUATION)

Based on the environmental review procedures and the discussion included within this amended IEE, This section focuses upon recommendations to reduce possible negative impacts of program activities.

Under **IR 1: Improved quality of health services, products, and information** a **categorical exclusion** is recommended for all activities under all 5 program components involving education, technical assistance, training [per 22CFR216.2(c)(2)(i)]; for activities involving analyses, studies, academic or research workshops and meetings [per 22 CFR 216.2(c)(2)(iii)]; and for document and information transfer activities [per 22CFR216.2(c)(2)(v)].

Under **I.R. 12.2 Increased use of appropriate health services, products, and information** a **categorical exclusion** is recommended for all activities under all 5 program components involving education, technical assistance, training [per 22CFR216.2(c)(2)(i)]; for activities involving analyses, studies, academic or research workshops and meetings [per 22 CFR 216.2(c)(2)(iii)]; and for document and information transfer activities [per 22CFR216.2(c)(2)(v)].

A **Negative Determination with Conditions** is recommended for health care activities involving disposal for medical and health care wastes, as per 22 CFR 216.3 (a) (2) (iii).

Conditions:

1. Sound disposal procedures for medical and health care waste will be promoted at all health care institution receiving assistance under this SO. These procedures will be done in done in accordance with criteria and best practices established in chapter 8: Healthcare Waste in the www.encapa.africa USAID/AFR/SD publication *Environmental Guidelines for Small-Scale Activities in Africa.* Minimum procedures include, among others, the establishment of written plans and procedures, staff training, promotion of protective clothing and good hygiene practices, designated storage locations , waste minimization, waste segregations an treatment and the identification of an appropriate final disposal site;

2. All funding provided to institutions under this SO will stipulate agreement to this principle.

A **Negative Determination with Conditions** is recommended for insecticide treated bed nets. The conditions are that the procedures spelled out in a pesticide evaluation report and safer use action plan (PERSUAP) will be followed. The PERSUAP was developed under Program/Activity Number HRN-A-00-99-00016-00, in April 2003, to address all USAID activities in Senegal that directly or indirectly support the distribution of insecticide treated bed nets. This PERSUAP was prepared in accordance with the guidance contained in the USAID Bureau for Africa's "Programmatic Environmental Assessment (PEA) for Insecticide-Treated Materials in USAID Programs in Sub-Saharan Africa 2002 ".http://www.afr-sd.org/documents/iee/docs/32AFR2_ITM_PEA.doc.

A **Negative Determination with Conditions** is recommended for support to Indoor Residual Spraying (IRS) for epidemic prevention. This activity will use pesticides for Malaria vector control. The condition, therefore, is that a PERSUAP be prepared and approved before this activity is initiated

Monitoring:

As required by ADS 204.5.4, the SO12 team and implementing partners will "actively monitor and evaluate whether the environmental features designed for the activity resulting from the 22 CFR 216 processes are being implemented effectively and whether there are new or unforeseen consequences arising during

implementation that were not identified and reviewed in accordance with 22 CFR 216." Zero tolerance for any medical wastes that are not disposed of according to WHO guidelines will be promoted at all institutions receiving assistance under this SO. All revised and new agreements with institutions funded under this SO will stipulate agreement to this principle. WHO literature detailing the importance of safe disposal and safe disposal techniques for medical wastes will be widely disseminated. USAID and its implementation partners will carefully monitor clinical interventions to ensure correct disposal of sharps, bio-hazardous and other potentially hazardous and infectious materials through accepted entombment and incineration methods. In addition, USAID and its implementation partners will ensure that procedures spelled out in the pesticide evaluation report and safer use action plan (PERSUAP) addressing all health activities in Senegal are followed.

The SO Team shall also monitor the need for additional environmental review based on IEE recommendations. SO12, in collaboration with implementing partners, shall ensure that provisions of the IEE, including the conditions and monitoring set forth herein, are incorporated into all contracts, cooperative agreements, grants and sub-grants, as appropriate.

5.0 SUMMARY OF FINDINGS

The original IEE was approved in June 2006; the IEE is being amended to include the use of pesticides for Indoor Residual Spraying (IRS) in Senegal for malaria vector control. The pesticide that will be used for the first spray rounds is ICON Wettable Powder (WP), composed of the active ingredient lambda-cyhalothrin. As such, a PERSUAP has been added to this amended IEE.
The PERSUAP was prepared in accordance with guidance contained in the USAID Bureau for Global Health "Programmatic Environmental Assessment (PEA) "Integrated Vector Management Programs for Malaria Vector Control (2006). To the extent possible relevant analysis in that PEA is cited herein rather than repeated. This document focuses on elements that are specific to the activities in questions and risk mitigations that can be taken within these activities.

All other project activities remain essentially the same.

1. Pursuant to 22CFR 216.2(c)(2)(i), a **Categorical Exclusion** is recommended for IRs 1 and 2 for all training, education capacity building, communication and technical assistance activities implemented under this SO as they have no effect on the environment.

2. Pursuant to 22 CFR 216.2(c)(2)(v), a **Categorical Exclusion** is recommended for IRs 1 and 2 for all documentation and information transfer activities implemented under this SO as they have no effect on the environment.

3. As per 22 CFR 216.3 (a) (2) (iii), a **Negative Determination with Conditions** is recommended for IRs 1 and 2 for all health care activities under this SO. The conditions are that sound disposal procedures for medical and health care waste established in the www.encapa.africa USAID/AFR/SD publication *Environmental Guidelines for Small-Scale Activities in Africa* will be promoted at all health care institution receiving assistance under this SO. All revised and new agreements with institutions funded under this SO will stipulate agreement to this principle.

4. Pursuant to 22 CFR 216.3 (b) (1) (i) (a-l), a **Negative Determination with Conditions** is recommended for IR 2 for insecticide treated bed nets. The conditions are that the procedures spelled out in a pesticide evaluation report and safer use action plan (PERSUAP) will be followed. The PERSUAP was developed under Program/Activity Number HRN-A-00-99-00016-00, in April 2003, to address all USAID activities in Senegal that directly or indirectly support the distribution of insecticide treated bed nets. This PERSUAP was prepared in accordance with the guidance contained in the USAID Bureau for Africa's "Programmatic Environmental Assessment (PEA) for Insecticide-Treated Materials in USAID Programs in Sub-Saharan Africa, 2002" http://www.afr-sd.org/documents/iee/docs/32AFR2_ITM_PEA.doc.

5. A **Negative Determination with Conditions** is recommended for support to Indoor Residual Spraying (IRS) for epidemic prevention. This activity will use pesticides for Malaria vector control. The condition,

therefore, is that a PERSUAP be prepared and approved before this activity is initiated.

Monitoring:

As required by ADS 204.5.4, the SO12 team and implementing partners will "actively monitor and evaluate whether the environmental features designed for the activity resulting from the 22 CFR 216 processes are being implemented effectively and whether there are new or unforeseen consequences arising during implementation that were not identified and reviewed in accordance with 22 CFR 216." Zero tolerance for any medical wastes that are not disposed of according to WHO guidelines will be promoted at all institutions receiving assistance under this SO. All revised and new agreements with institutions funded under this SO will stipulate agreement to this principle. WHO literature detailing the importance of safe disposal and safe disposal techniques for medical wastes will be widely disseminated. USAID and its implementation partners will carefully monitor clinical interventions to ensure correct disposal of sharps, bio-hazardous and other potentially hazardous and infectious materials through accepted entombment and incineration methods. In addition, USAID and its implementation partners will ensure that procedures spelled out in the pesticide evaluation report and safer use action plan (PERSUAP) addressing all health activities in Senegal are followed.

The SO Team shall also monitor the need for additional environmental review based on IEE recommendations. SO12, in collaboration with implementing partners, shall ensure that provisions of the IEE, including the conditions and monitoring set forth herein, are incorporated into all contracts, cooperative agreements, grants and sub-grants, as appropriate.

PESTICIDE EVALUATION REPORT AND SAFER USE ACTION PLAN (PERSUAP)

FOR

INDOOR RESIDUAL SPRAYING (IRS) USING LAMBDA-CYHALOTHRIN FOR MALARIA CONTROL IN SENEGAL

ACRONYMS

ADS	Automated Directives System
ASP	Africa Stockpiles Program
CDC	Centers for Disease Control
CNGP (in French)	National Commission on Pesticides management
DEEC (in French)	Direction of Environment and Classified Establishments
DDT	Dichloro-diphenyl-trichloroethane
DPV (in French)	Direction of Crop Protection
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
GFATM	The Global Fund to Fight AIDS, Tuberculosis, and Malaria (referenced as “Global Fund”)
IEC	Information, Education and Communication
IEE	Initial Environmental Examination
IPCS	International Program on Chemical Safety
IRS	Indoor Residual Spraying
ITNs	Insecticide Treated Nets
LLINs	Long-Lasting Insecticidal Nets
IDSR	Infectious Disease Surveillance and Response
IVM	Integrated Vector Management
LATH	Liverpool Associates in Tropical Health
MEPN (in French)	Ministry of Environment and Protection of Nature
MOA	Ministry of Agriculture
MOHMP	Ministry of Health and Medical Prevention
MOU	Memorandum of Understanding
NGOs	Non-Governmental Organization
NMCP/PNLP	National Malaria Control Program
PEA for IVM	Programmatic Environmental Assessment for Integrated Vector Management
PERSUAP	Pesticide Evaluation Report and Safer Use Action Plan
PMI	President’s Initiative on Malaria in Africa (U.S.)
PPE	Personal Protective Equipment
RBM	Roll Back Malaria
RTI	Research Triangle Institute
TOR	Terms of Reference
TPRI	Tropical Pesticides Research Institute
USAID	United States Agency for International Development
USEPA	United States Environmental Protection Agency
WP	Wettable Powder
WHO	World Health Organization
WHOPES	World Health Organization Pesticide Evaluation Scheme

INTRODUCTION

This program is associated with the U.S. President's Initiative on Malaria (PMI) in Africa, launched in 2005, which seeks to reduce malaria mortality by 50% in up to 15 countries. The Initiative supports and complements efforts of the Global Fund, the World Bank, and other members of the Roll Back Malaria Partnership. The Initiative will include detailed reporting on inputs, outputs, and results. Angola, Tanzania, Uganda, Mozambique, Rwanda, Malawi and Senegal were the first seven selected for this Initiative; eight additional countries were selected and announced in December 2006.

As part of a new malaria control program, USAID proposes to implement Indoor Residual Spraying (IRS) in Richard Toll, Velingara and Nioro Districts in three different regions (south east and central parts) in Senegal. These three districts are located in three different areas that are representative of the different ecological conditions of the country. Like the rest of the country, these three districts are characterized by seasonal transmission. An efficient control of the transmission through this pilot project would justify the scaling up of the method as capacity is built.

Another aspect of malaria vector control supported by the Ministry of Health and Medical Prevention includes Insecticide Treated Nets (ITN)s and Long Lasting Insecticidal Nets (LLINs). Larviciding and environmental management and sanitation are also among the vector control methods set forth in the PNLP's preventive strategies.

USAID's support would include an IRS Program for malaria prevention in Richard Toll, Velingara and Nioro Districts. The activities within the program are intended to facilitate access to spraying products and equipments and the mitigation of any harmful human health and environmental effects that could occur as a result of spraying with lambda-cyhalothrin. The program includes raising awareness and knowledge on best professional practices.

BACKGROUND AND PURPOSE

Under PMI, IRS will be undertaken as one component of comprehensive malaria prevention and control program in Senegal. In addition to IRS, activities will include strengthening the capacities of the public health sector and community health workers to effectively diagnose and treat malaria and to provide at least two doses of intermittent preventive treatment (with SP) to pregnant women attending prenatal care; promotion, education, distribution, and subsidization of ITNs and LLINs and periodic re-treatment of older ITNs. Other activities to strengthen these primary efforts will include reinforcement of laboratory equipment and training, drug quality management, and intense monitoring and evaluation of all aspects of the program and its impact.

Although this PERSUAP focuses on IRS, USAID has conducted a PERSUAP for ITN's in Senegal as a separate activity.

USAID's support for the IRS Program includes the following:

- Purchase of insecticide, spraying equipment, and adequate amounts of personal protective clothing and equipment for spray operators and supervisors;
- Financial support for trainers and spray teams;
- Technical advisors to plan the program, train field staff, and supervise field operations;
- Entomological training and monitoring;
- Wall bioassays to determine the residual effect of pesticides;
- IEC to inform beneficiaries, raise public awareness, promote behavior change and promote cooperation;
- Financial support for renting storage facility; and
- Additional human health and environmental safety components.

AFFECTED ENVIRONMENT

The three targeted districts in Senegal are located in the north (Richard Toll), in the South east (Velingara) and in the Centre (Nioro) of Senegal. The districts are predominately rural, agrarian and comprise of an estimated total population of 630,264 inhabitants.

Table 1: Areas and Population of targeted districts

Districts	Surface (km²)	Population
Richard Toll	2,912	144,803
Velingara	5,435	221,068
Nioro	2,279	264,393
TOTAL	**10,626**	**630,264**

Sources: Health Districts data bases

Richard Toll is characterized by irrigation networks sourced by the Senegal river and Lac de Guiers; the largest lake in Senegal and a major source of portable water in the Dakar region. The agrarian society mainly produces rice tomatoes and potatoes. The existence of huge irrigated surfaces and the numerous natural humid zones favor a second malaria transmission peak in that area in comparison to the rest of the country where the usual peak occurs between August, September and October.

Velingara is located in one of the rainiest areas of the country with annual rainfall ranging between 800 to 1200 mm. The area is humid with tributaries and mosquito breeding sites.

In Nioro, permanent surface waters exist in large depressions filled with sea water called *Bolongs* (a local terminology). The area hosts many valleys and ponds that are filled by rain and stagnant water.

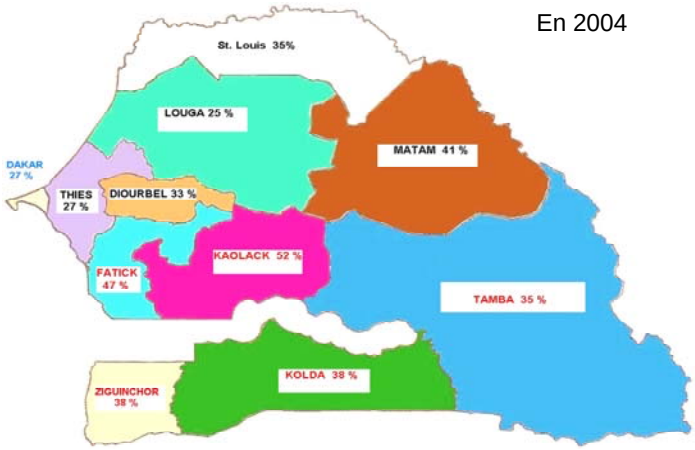
The various water bodies can be polluted rinse water techniques are not enforced and spray cans discharged in or beside those surface waters. Consequently, spray operator will receive training and intensive supervision in waste management and disposal to minimize the potential risks.

Malaria Burden in Senegal

Malaria is one of the leading causes of mortality and morbidity death in Senegal. Outpatient morbidity rates in health facilities average 32% whilst hospital death due to malaria is estimated at 3.22%. Malaria cases are estimated at approximately 600,000 per year, leading to 5,000 deaths (WHO). In addition to the death rates, poor health has a negative impact on productivity among adults and school attendance. MOHMP web site) In the context of Senegal where poverty affects 48.5 % of households on average (DSRP II), malaria is considered a disease of poor people as well as a cause of poverty.

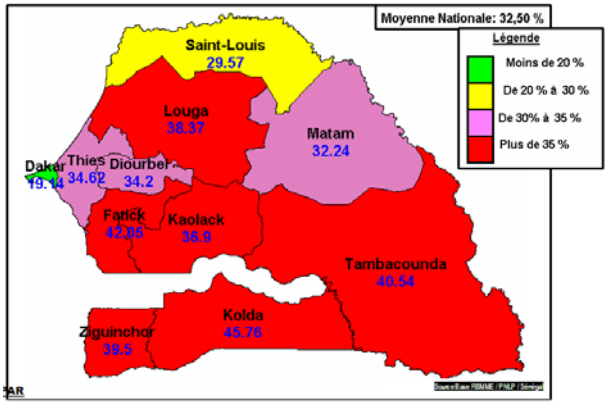
Figure 1: Distribution of malaria morbidity rate throughout Senegal; 20041 et 2005

1 This administrative map indicates the 11 regions of Senegal. The districts of Richard Toll, Velingara and Nioro are located in the regions of Saint Louis, Kolda and Kaolack respectively.



En 2004

Source: PNLP, 2005



Source: Thior M., 2006

Plasmodium falciparum is the main plasmodium species encountered in Senegal with 90% of malaria cases, followed by *Plasmodium malariae* and *Plasmodium ovale*.

Table 2: Main vector species encountered in the three targeted districts

Richard Toll area	Velingara area	Nioro area
An. arabiensis *An. gambiae forme M* *An. pharoensis* *An. funestus*	*An. gambiae forme M et S* *An. arabiensis* *An. funestus* *An. nili*	*An. gambiae forme M et S* *An. arabiensis* *An. funestus*

Source: Dia I, 2006.

Scaling up of the use of ITN as preventive measures is one of the key strategies of the PNLP. Preliminary results of the 2006 National Malaria Indicator Survey show that 16% of children under five and 17% of pregnant women slept under an ITN the night preceding the survey.

Complementary and Conflicting Policies, Plans or Controls for the Areas under Consideration

The Senegalese Environmental Code is the main regulatory framework dealing with the environmental aspects of the IRS Program. According to the code (articles L44 – L47) an Environmental Assessment is required prior to the implementation of any project that is likely to have negative environmental effects. The procedure of the Assessment as well as the format and the content of the assessment report are well defined in a set of regulatory documents related to the enforcement of the Code. The Environment and Classified Establishments (DEEC in French) is responsible for the enforcement of the Code.

The IRS Program is required to seek:

a. Approval by National Commission on Pesticides management (CNGP in French). The IRS Program is inspected to provide the commission with information (chemical, toxicological, ecotoxicological) on the compound and an Environmental and Health Action Plan dealing with mitigation activities;
b. Approval by the DEEC: the IRS project must prepare a Strategic Environmental Assessment (SEA) report according to the national regulations required by the Senegalese Environment Code. This will include the preparation and submission of the report for approval by a committee established by the DEEC

The manufacturer's information on the composition, active ingredients and safety date will be submitted to CNGP through Senegal's National Malaria Control Program.

The Senegalese Ministry of Environment and Protection of Nature (MEPN) requires compliance with the

Basel, Rotterdam and Stockholm conventions' implementation plans and strategies.

The Direction of Crop Protection (DPV in French) has set forth a regulation on agricultural pesticides, including a list of registered pesticides; such regulation is not applied to public health pesticides.

I. PESTICIDE PROCEDURES

The Senegal National Malaria Control Program has selected ICON Wettable Powder (WP) composed of active ingredient lambda-cyhalothrin for the first round of spraying operations in Nioro, Velingara and Richard Toll.

A. The USEPA registration status of the requested pesticide

The registration status of lambda-cyhalothrin is summarized in Table 3.

Table 3. Registration Status of Suggested Pesticide

Is the pesticide…	Lambda-cyhalothrin
Registered by the host country (for public health use)?	YES
Registered by EPA for "same or similar use"?	YES
WHO-recommended?	YES

Lambda-cyhalothrin is recommended by WHO and registered for indoor use in the United States and for public health use in Senegal. According to the US Environmental Protection Agency, lambda-cyhalothrin is low to moderately toxic, not carcinogenic, readily breaks down in the environment, and does not bio-accumulate. It is highly toxic to many fish and aquatic invertebrate species (Extoxnet). It is registered for use on the following residential non-food sites: general indoor/outdoor pest control (crack/crevice/spot), as termiticide, on ornamental plants and lawns around homes, parks, recreation areas and athletic fields, and on golf course turf (USEPA 1997). WHO classifies lambda-cyhalothrin as a moderately hazardous (class II) insecticide (WHO 2005b).

Lambda-cyhalothrin WP at the concentration of 0.02-0.03 g/m² is among the 12 pesticides WHO has registered for IRS (WHO, 2004).

B. The basis for selection of the requested pesticide

The following threshold criteria were met in making decisions on the pesticide used in malaria vector control for Senegal:

- Pesticide registration in the host country

In Senegal one refers to the WHO regulations on public health pesticides. The agriculture sector refers to a regional registration procedure defined by the Sahelian Pesticides Committee (CSP) but it deals only with agricultural pesticides. The list of pesticides that are registered includes two products containing lambda-Cyhalothrine

- Acceptability of the pesticide to the National Malaria Control Program

The NMCP took the lead in choosing this chemical, in consultation with a technical committee from other cooperating partners and agencies, including WHO and the Cheikh Anta Diop University.

- Risk to human health—pesticides must be approved by the WHO and will be preferred based on their safety as described in USAID's *Programmatic Environmental Assessment for Integrated Vector Management*.

Lambda-cyhalothrin is approved by WHO for use in IRS and, according to the PEA for IVM, poses a low health risk to both spray operators and resident beneficiaries of the IRS program.

- Risk to environment, livestock and/or agricultural trade

The risk to the environment and livestock is acceptable (see Pesticide Procedures). The risk to agricultural trade is acceptable in the context of the targeted districts areas where pesticides are largely used and there is no existing organic agriculture.

Beyond these four threshold considerations, technical and logistical factors must be addressed in comparing and selecting insecticides for malaria vector control. The primary factor to be addressed is:

- Vector resistance

This will be monitored closely by PMI and national partners.

Secondary factors include:

- Appropriateness of surface for spraying

House types in the target communities have both plastered cement and traditional huts (mud and thatch) construction. Both types of construction may be appropriate for use of ICON WP and subsequent efficacy for a period of up to five months, based on data from Sharp et al. (1993); however, bioassays will be conducted with PMI support during the malaria transmission season to determine whether this supposition is appropriate for the targeted areas. In some places the interior of the thatch is covered by plastic materials; such surfaces will not be sprayed.

- Duration of effectiveness (and implications for cost)

The malaria transmission season lasts for four to six months between May-June and October with one peak occurring in August to October in the three districts and a second and lower peak in Richard Toll area in February – April (due to surface waters as rivers, lake, irrigation schemes).

- Cost of insecticide

The cost of ICON WP is approximately 5.85 USD per sachet (covering 250 square meters of wall).

Tertiary factors include:

- The need for an insecticide of a different class to prevent resistance

Resistance management is critical for all IRS programs. In the context of the three targeted districts, a resistance management plan must be developed to ensure that IRS remains effective. Along that line, USAID and CDC will continue collaboration among the PNLP, the University, and the Institute Pasteur.

- Major classes of insecticides used in other vector control interventions that could promote resistance

Currently ITN distribution is the only other significant vector control intervention used in the targeted areas. According to preliminary results of the 2006 Malaria Indicator Survey, 36% of households in Senegal own at least one ITN (Delthamethrin-treated). USAID and the NMCP aim to increase ITN ownership and use; in combination with IRS this may promote vector resistance to pyrethroids.

- Major classes of insecticides used in the agricultural sector that could promote resistance

Major classes of insecticides used in the agricultural sector that could promote resistance include pyrethroids and organophosphates that are largely used in the targeted area, increasing the risk that agricultural use of pesticides will promote vector resistance to public health pesticides.

- Host-country capacity to prevent pilferage

Almost all the farmers in project areas use pesticides on their crops; pilferage may be a serious problem for the IRS campaign. Pilferage reduction will be achieved through community education measures, IEC campaign, securing and guarding of pesticide storage facilities, supervision, and tracking of pesticide usage by spray operators.

C. The extent to which the proposed pesticide use is part of an integrated vector management program

The National Malaria Control Strategy highlights the importance of vector control and the need to create an integrated intervention package. The current strategic plan (PNLP, 2006) is intended to further develop IRS (and larviciding) in Senegal in addition to the reinforcement of use of ITNs. The PNLP intended to include other mechanisms such as environmental management and sanitation for controlling mosquito population and elimination of breeding sites.

Until recently, the promotion of ITN remains the main vector control method. The Government is focused on facilitating the access to ITNs, supporting large scale distribution and involving the private sector on the supply side. Demand is greatly influenced by community-based promotion and IEC. Donor agencies and international organizations such as USAID, UNICEF, WHO, the Global Fund, ADB, Word Bank, UNDP, French Cooperation Agency and the JICA are supportive of the PNLP in the promotion of ITNs.

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

The proposed method of application is Indoor Residual Spraying, or IRS. IRS is a commonly-used malaria vector control method that is particularly effective in preventing malaria. It is implemented by the application of residual insecticides, to which *Anopheles* female mosquitoes have been demonstrated to be susceptible, to the interior walls of houses and other structures. The insecticide remains on the treated surfaces upon which the mosquitoes will rest before or after taking a blood meal. Several formulations of insecticides are available for this purpose. The residual effect of the insecticide is sufficient to kill resting mosquitoes for a period ranging from three to twelve months depending on the insecticide, the surface on which it is applied, and local conditions. The objective of IRS programs is to reduce the mean life-span of the female mosquito population below the duration required for development of the parasite life phases that occur in the mosquito and, thereby, to substantially reduce the population's ability to sustain malaria transmission. IRS is most effective in areas with seasonal malaria transmission and is typically implemented by teams of spray operators who spray houses in at-risk localities prior to the rainy season, as heavy rains prompt increases in the *Anopheles* vector population. To be effective, IRS must attain coverage rates of at least 85% of the houses in a target area.

The spray operators who implement IRS use compression sprayers to apply a measured amount of insecticide on the interior walls of houses and structures. A water-soluble insecticide is added to the sprayer containing a pre-measured amount of water, the prayer is pressurized, and the material is then carefully applied to the interior walls of targeted homes and structures. After the day's spraying is complete, spray operators must clean the sprayer following the manufacturer's recommendations to ensure their proper operation and calibration.

The spray equipment used for IRS will be manufactured according to WHO specifications for compression sprayers for IRS operations. District Health Officers (including Public Hygiene staff) will determine mechanisms by which potential spray operators will be chosen. Spray operators will initially be chosen based on their completion of primary school and their ability to read, write and make calculations. Pregnancy tests will be conducted to ensure pregnant women are not included on the spray teams.

These individuals recruited for IRS campaigns will receive intensive training on the use, operation, calibration and repair of the sprayer and practical exercises during a 14 day period prior to the beginning of the spraying campaign. They will also receive training to understand proper hygiene, to recognize the signs and symptoms of poisoning, and to understand the referral procedure for any incidents involving poisoning. This training will be conducted in accordance with WHO's "Manual for Indoor Residual Spraying" (WHO 2002). Potential spray operators must also pass written and practical tests at the end of training. In this way, spray operators will be prepared to conduct appropriate application of the insecticide.

Each spray team will consist of six or seven spray operators. Each spray operator will be provided with the following safety equipment, in accordance with WHO specifications:

- Overalls
- Broad-rimmed hat
- Face shield
- Dust mask
- Rubber gloves
- Rubber boots

Supervisors will observe two spray teams to ensure spraying occurs according to best practices. Supervisors will travel between spray teams and will observe spray operators and team leaders in the preparation, spray technique, and sprayer and PPE cleanup during the IRS campaign, as well as compile all data collected by their respective teams. Supervisors will receive training according to WHO best professional practices, and will also receive additional training on personnel management, environmental aspects, entomological monitoring, geographical reconnaissance, and data recording and analysis. After each day's spray activities, supervisors will collect sachet packing material to track the amount of insecticide used, and ensure that spray operators practice proper personal hygiene to avoid prolonged insecticide exposure. The insecticide is packaged in water-soluble sachets, minimizing pesticide exposure to spray operators during sprayer preparation.

Scrupulous attention to personal hygiene is an essential component of the safe use of pesticides. For spray operators, safety precautions will depend largely on personal hygiene, including washing and changing clothes. A drill for carrying out and supervising personal hygiene, regular washing of protective clothes and cleaning of equipment will be organized along the following lines (WHO 2006):

- Spraying staff will be provided with at least two uniforms to allow for frequent changes.
- Washing facilities with sufficient water and soap will be made available in the field at appropriate locations.
- All working clothes must be removed at the end of each day's operations and a shower or bath taken.
- Working clothes must be washed regularly, the frequency depending on the toxicity of the formulation used.
- Particular attention will be given to washing gloves, as wearing contaminated gloves can be more dangerous than not wearing gloves at all.
- Spray operators must wash before eating.
- Eating, drinking and smoking during work must be strictly forbidden.
- When work involves insecticides or relatively high toxicity, the hours of work must be arranged so that exposure to the material is not excessive; transport will be arranged so that there is not a long delay between the end of the day's operations and return to base for washing.

An overalls wash-person will be hired and provided with his/her own protective gear (e.g. apron and gloves). However, if hiring of such a person is not feasible, spray operators will wash their own overalls at a central location in tubs used exclusively for overall washing. Spray operators must also wash themselves after each day's operations. Spray operators should never wash themselves, their overalls, or their PPE in water bodies, and all wash-water will be disposed of in a concrete evaporation tank covered with a locked grate and/or latrine pits.

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

For acute and long-term toxicological hazards, see the PEA for IVM toxicological profile for lambda-cyhalothrin, located in Annex 2.

Residential Exposure. The steps to mitigate, to the fullest extent possible, occupational exposure to pyrethroids are mentioned in the preceding section and described fully in the WHO's "Manual for Indoor Residual Spraying" (WHO 2002). However, as in all IRS operations, the risk of residential exposure is also present. District authorities and program staff will work with relevant boards, committees, and non-

governmental organizations to carry out an IEC campaign to sensitize residents to IRS activities, in accordance with WHO guidelines. The IEC campaign (as well as IRS Program team leaders and supervisors will also instruct residents on best practices prior to spraying) should focus on the following elements of residential safety during an IRS program:

- clear homes of mats or rugs, furniture, cooking implements and foodstuffs prior to spraying
- if furniture cannot be moved out of the home, then move it to the center of the room if possible
- stay outside the home during spraying and for one hour after spraying
- move and keep all animals outside the home during spraying, and for one hour after spraying
- sweep floors free of any residual insecticide that may remain from the spraying
- do not replaster or paint over the sprayed walls after spraying
- keep using bednets for protection against malaria

The IEC component for IRS will ensure that the populations targeted for spraying are aware of these steps.

Pesticide Poisoning. Although doctors and nurses are generally aware of poisoning treatment, refresher training of clinicians in pesticide poisoning in the three districts is currently being planned by Ministry of Health officials in preparation for this IRS activity. Training in poison treatment is necessary for appropriate treatment and care. It is recommended that the MOHMP make available medicine for diagnosing/treating symptoms of lambda-cyhalothrin in health facilities, hospitals and health centers (table 4).

Table 4: Pesticides exposure treatments

Name of drug	Active ingredients
Promethazine	Promethazine Hydrocloride
Panadol	Paracetamol
Diazepam	Benzodiazapine/Diazapam
Lorazepam	Lorazepam
Calamine cream	Calamine, zinc oxide, glycerol, phenol, purified water, sodium citrate, betonite,
Vit E	Tocopherol, fragrance, mineral oil, deionized water, sodium hydroxide, stearic acid
Hydrocortisone cream	1% hydrocortisone
Salbutamol	Salbutamol 100 mcg, suspended inert aerosol
Salbutamol tablets	Salbutamol sulphate 4 mg
Activated Charcoal	Activated Charcoal

Safe Pesticide Transport. Prior to long-distance transport of the insecticide from the customs warehouse/central storage facility to the District, drivers must be informed about general issues surrounding the insecticide and how to handle emergency situations (e.g. road accidents). Training for long-distance transport will include the following information:

- For what use the insecticide is intended
- Toxicity of the insecticide
- Understanding security issues, implications of the insecticide getting into the public
- Handling an accident or emergency (according to FAO standards)
- Combustibility and combustion byproducts of insecticide

Drivers hired specifically for the two-month spray campaign period will receive

- Training provided to spray operators (with the exception of sprayer operation and spray practice)
- Handling an accident or emergency (according to FAO standards)
- Handling vehicle contamination (see below)

Because vehicles will be rented for the program, it is important to ensure that pesticide contamination in the vehicle does not have negative impacts when the vehicle is subsequently used for another purpose (e.g. food transport). Drivers will be responsible for taking care that any cloth vehicle seats are covered to

prevent contamination from transportation of spray operators. To prevent pesticide runoff from vehicle washing, drivers will also be responsible for wiping the vehicle bed with a damp cloth prior to washing the exterior of the vehicle. Finally, drivers will be responsible for cleaning and decontaminating the interior of the vehicle and exterior bed at the end of the spray campaign. Drivers will be provided with gloves to wear for cleaning the vehicle. All cloths used in wiping down the interior and bed of the vehicle will be washed with spray operator overalls.

F. The effectiveness of the requested pesticide for the proposed use

Lambda-cyhalothrin is an appropriate insecticide when considering the long-lastingness of the insecticide. Based on field trials conducted by Brian Sharp in South Africa and the Institut Pasteur in Madagascar, it is effective on mud walls for at least five months.

Recently the PNLP tested the effectiveness of Perméthrine 1%, Deltaméthrine 0,05% and DDT 4% on anopheline mosquitoes. In 2000 the results of the tests showed high mortality rates (98 to 100%) with the two first pesticides and lower rate (13 – 85%) with DDT. The 2005 test showed that deltamethrin remained as effective as in 2000 while permethrin was less effective. The pesticides that are used by the Public Hygiene Department in its IRS activities under the conditions mentioned above include Amethion, Deltamethrin, Permethrin and Chlorpyriphos.

Mosquito Resistance: In the context of the three Districts, resistance management seems to be a key issue. Indeed, in the medium or long term, if the ongoing trend in the use of agricultural pesticides is maintained resistance to lambda-cyhalothrin may occur through cross-resistance because pyrethroid class pesticides are largely used in crop protection (Annex 3). Furthermore, fields are often located not far from the dwellings; in such conditions crop sprayings may favor conditions leading to mosquito resistance. In Velingara Lambda-cyhalothrin is among the compounds that are used to protect the 14,800 ha of cotton distributed throughout the district area. Another important source of risk of resistance is the use of deltamethrin in ITNs since both insecticides belong to the same chemical category. It is essential to monitor the simultaneous use of both pesticides with regards to mosquito resistance during the first and the second spray rounds.

Quality control: The manufacturer is responsible for ensuring the quality of the product through independent testing.

Community Acceptance: The efficacy of the IRS campaign is highly dependent on community acceptance. Through extensive stakeholder consultation, adaptation of the program according to agricultural trade needs, and consequent IEC campaigns, it is expected that the campaign can proceed safely, and achieve the high percentage of household coverage that is needed for transmission reduction. The coordinator of IEC campaigns (the chief of party of the Mission's bilateral community health program) will cooperate closely with the spraying and environmental managers of the IRS contractor so that the IEC integrates the environmental issues properly.

G. Compatibility of the proposed pesticide with target and nontarget ecosystems

Outside Environment. Since Lambda-cyhalothrin is toxic to bees, and fish and other aquatic organisms; the following measures are recommended:

- ***Release of sprayer rinse-water into water bodies.*** Sprayer rinse-water will be re-used for the next day's operations. If this is not logistically possible, supervisors and spray operators must be trained to dispose of sprayer rinse-water in pit latrines.
- ***Spray operators washing themselves, overalls and PPE in water bodies.*** Spray operators should wash themselves, and wash persons should wash overalls and PPE at the local or central meeting point for IRS operations. If this is not feasible, spray operators will be instructed to do the following:
    - Never wash yourself, overalls or PPE in natural water bodies

- Instead, collect water from the water source and wash yourself, overalls and PPE in an area far away from the water body
- Dump excess water in a cement evaporation tank covered with a locked gate and/or latrine pit
- Thoroughly wash any washtubs that may be used with soap/detergent

- ***Accidental spraying of apiaries (beehives).*** Accidental spraying of apiaries would kill bees residing therein.

According to United States Code of Federal Regulations Title 22 Section 216, "to the extent feasible and relevant, projects and programs for which Environmental Impact Statements or Environmental Assessments have been prepared will be designed to include measurement of any changes in environmental quality, positive or negative, during their implementation." Monitoring of changes in environmental quality as a result of this IRS activity is not relevant for the following reasons:

- Lambda-cyhalothrin does not bioaccumulate or persist in the environment.
- Lambda-cyhalothrin will not be sprayed on agricultural fields or in the environment, and substantial releases of the pesticide into the environment as a result of project activities are improbable.
- Impacts of lambda-cyhalothrin on non-target organisms are acute and transitory.
- The Djoudj park is the main protected natural resource in the project area.

Monitoring will be considered, however, for pesticide residues in organic crops (see paragraph below). This type of monitoring will be discussed among stakeholders and can be carried out by the Tropical Pesticides Research Institute (TPRI).

Organic Crop Exports. Lambda-cyhalothrin is expected to be compatible with households in the target districts.

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

Richard Toll District is located in the Senegal River Delta area with a surface area of 2919 Km². The climate is sahelian with alternate wet and dry seasons and hot and dry winds. Annual precipitation ranges between 300 and 500 mm with mean annual temperature is around 27°C;

The soil is muddy around water courses in comparison to sandy soils in the other parts of the country. The district's vegetation is sahelian type savanna dominated by spiny bushes, acacias, *Tamarix senegalensis*, and *Balanites aegyptiaca*. During the rains dense populations of aquatic vegetation appear in the flooded zones. The area hosts the Djoudj National Bird Sanctuary (the third most important bird park in the world) which is particularly noted as a stopover for a large number of bird species;

The IUCN list of threatened species (IUCN,2006) includes several species encountered in the Djoudj park or in the Senegal river delta in general : *Trichechus senegalensis* , *Batis senegalensis* present in the Djoudj park year round, *Burhinus senegalensis* present in the Djoudj park year round and in other parts of the delta area, *Centropus senegalensis* , *Cyclanorbis senegalensis,Eremomela pusilla ;* rare ; present in January, *Galago senegalensis, Lemniscomys limulus, Poicephalus senegalus, Taterillus pygargus, Vanellus lugubris.*
Most of these species are classified as "least concern / lower risk"; some of them have not been observed for decades.

The park is crossed by several water courses which host or constitute habitat or breeding sites for several species of water birds. Water pollution by the IRS pesticides

(via rinse water for example) and it subsequent impact on water birds must be avoided. Washing stations will be kept far away from these water courses.

Velingara climate is Soudano-Guinean or sub-guinean type with annual precipitation ranging between 800 to 1200 mm. The district is 5435 km² and located near (but not included in) the Niokolo koba park. The district is humid with soils are predominately ferralitic

Nioro is 2279 km² with an annual precipitation of 200 to 250 mm, mean annual temperature of 28°C and relative humidity is 59% . The soils are predominately tropical ferruginous.

Contamination or pollution of surface waters and ground waters need to be monitored and mitigated. It is recommended that the IRS Program:

- Secure storage areas to prevent pilferage.
- Manage the handling of pesticides to avoid accidental spillage, during transport mainly.
- Supervise the spray teams to ensure proper insecticide handling and prevent pilferage.
- Count used insecticide sachets to account for proper use of the insecticide.
- Re-use sprayer rinse-water throughout the Program (if feasible).
- Implement triple-rinsing of any contaminated packaging prior to disposal.

I. The availability and effectiveness of other pesticides or non-chemical control methods

Other Pesticides. Alternative WHO-recommended chemicals include:

- Alpha-cypermethrin
- Bendiocarb
- Bifenthrin
- Cyfluthrin
- DDT
- Deltamethrin
- Etofenprox
- Fenitrothion
- Malathion
- Pirimiphos-methyl
- Propoxur

Non-Chemical Control Methods. Environmental management and sanitation are considered among vector control methods in the current strategic plan of the PNLP (PNLP, 2006). The aim is to suppress all man-made mosquito breeding sites in targeted areas. The strategies are community-based and include awareness-raising among individuals and communities, the multi-sectarian approach, identification and destruction of breeding sites and capacity building.

J. The requesting country's ability to regulate or control the distribution, storage, use and disposal of the requested pesticide

With regards to storage, the Direction of Crop Protection (DPV in French) and the Direction of Public Hygiene hold several warehouses in Dakar and in the three districts. These facilities can be used by the IRS Program as primary and secondary storage facilities for pesticides and protective equipments. Most of those facilities are adequate for pesticide storage but will require improvements for ventilation; minor repairs and hiring of a warehouse keeper. Prior to commencement of spray operations these facilities will be visited for detailed planning and repairs.

The assessment team found no formal guideline on the safe handling of chemicals although the DPV is

actively involved in the management of health and safety issues of pesticides use. Thus, there is a real need for training of the different stakeholders involved in the handling of pesticides at the beginning of the implementation of the IRS project.

To that end, efforts (in terms of environmental and/or health impacts management) will be focused on:

- Introduction of guidelines on safe handling of pesticides: transportation, storage, distribution, use (spraying), cleaning of spray cans and pesticide management. WHO, FAO and US EPA have produced guidelines which can be referred to.
- Training of people who involved in the handling of pesticides on the risks associated with the pesticides and the measure to be taken to lower those risks to an acceptable level.

K The provisions made for training of users and applicators

Provisions made for training of users and applicators are described under *Pesticide Procedures D*. Training for spray operators and supervisors will be conducted over a 7 to 14 day period. Training will be conducted according to the WHO's "Manual for Indoor Residual Spraying" (WHO 2002).

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

Monitoring Use.
Supervisors of the IRS campaign will use the IRS Campaign Oversight Checklist (Annex 1) to record spray operator compliance with best practices. This will allow for easy analysis of data on mitigation practices, which will then be used to address any divergence (e.g., individual and program-wide) from best practices.

In addition to internal program monitoring, external program monitoring will be conducted by the DEEC; which is responsible for monitoring the implementation the Environmental Management Plan for IRS contained in the Strategic Environmental Assessment. Coordination between the DEEC and the MOHMP/PNLP should ensure that a DEEC agent is involved in the monitoring of the IRS Program. It is recommended that DEEC staff participate in training activities for spray operators.

Environmental compliance monitoring will also be provided by the USAID IRS Program contractor, who will conduct a site visit during IRS operations and report to USAID on the implementation of compliance activities.

Finally, as required by Automated Directives System (ADS) 204.5.4, the Strategic Objective (SO) team will actively monitor ongoing activities for compliance with the requirements and recommendations in this assessment, and modify or end activities that are not in compliance.

Monitoring Effectiveness (from USAID's PEA for IVM). The primary function of entomological monitoring associated with vector management is to assure that interventions are effective. Such monitoring is essential for IRS and larval control and, though not as critical, should also be implemented in areas where only ITNs have been deployed. The monitoring program must include at least the first three types of tests described below; the fourth category should also be included when possible.

Determine vector susceptibility to available insecticides. Susceptibility studies detect the presence of individuals in the vector population that are physiologically resistant to the insecticide being tested. For IRS, susceptibility studies can be conducted by using WHO test strips or CDC bottle assays on adults caught in the wild or adults reared from immature larvae. Although the CDC bottle assays have the advantage of testing a sample of the same chemical batch being applied, the WHO test strips enable more comparability across countries and time. Where possible, both will be done. In addition to the above "in vivo" resistance information, it is also possible to collect large numbers of the vector species for analysis by polymerase chain reaction (PCR) to determine the frequency of genetic markers that code for pesticide resistance in the local vector population. Nevertheless, PCR analysis should not be used as a substitute for "in vivo" resistance analysis.

Verify that the insecticide was applied properly and had an immediate effect. This involves routine follow-up observations. For IRS, wall bioassays are used to verify there is sufficient residual pesticide on the walls of sampled structures to kill vector mosquitoes, and to monitor the loss of residual efficacy over time.

Determine the geographic and temporal distribution of vector populations. To target areas where vector control for malaria is needed, it is necessary to determine where malaria transmission occurs and the length of the transmission season by establishing when populations of adult vectors are present. This can be done by using a variety of collection techniques, including human landing catches, CDC light traps, cattle-baited hut or net collections, nonbaited hut or net collections, pyrethrum spray catches (PSCs), and window exit traps.

Measure the impact of the intervention on the vector population and/or malaria transmission intensity. Several different techniques are used to monitor the vector population and/or the frequency and infectivity of vector biting. In general, the intention is to determine whether the vector management program has substantially reduced the vector population or survivorship, as indicated either by a reduction in the number of mosquitoes that can be collected, a reduction in mosquito biting, or, as detected through mosquito dissections, the proportion parous (the proportion that have laid at least one batch of eggs). Methods are available for human landing catches, CDC light traps, cattlebaited hut or net collections, nonbaited hut or net collections, PSCs, and window exit traps.

II. The Safer Use Action Plan

Human Health and Environmental Effects of the IRS campaign

Few to no adverse human health or environmental effects are anticipated as result of occupational, residential, and/or environmental exposure to lambda-cyhalothrin due to mitigation efforts. Lambda-cyhalothrin belongs to one of the least harmful classes of pesticide (pyrethroids), however attention needs to be paid to the negative environmental and health impacts these products may have when they are used under unsafe conditions. Indeed, from storage to spraying, these chemicals may cause harm through accidental spills and acute poisonings among spraying teams, mostly when protective measures are not taken properly.

Pesticides are widely used in the three areas and particularly in Richard Toll which is situated in the Delta of Senegal River Basin- one of the largest agricultural zones in the country. Rice, tomato and potato are among the major crops cultivated where large amounts of diverse pesticides (insecticides, fungicides, herbicides, etc.) are used in crop protection. Velingara is also known for cotton production and use of a variety of pesticide. The campaign will not cover communities that rely heavily on organic agricultural trade goods unless agricultural stakeholders can agree on an appropriate strategy to mitigate contamination of organic crop commodities.

The primary environmental risks include negative impacts on bee hives and contamination of aquatic ecosystems, which could have a transitory adverse effect on freshwater fish and invertebrate species. Training and supervision of spray personnel according to best practices should adequately address this risk.

Pesticide poisonings are frequents in those areas; some of them are intentional (suicides) while others are accidental following reuse of pesticide containers and confusion or contamination because pesticides are stored with foodstuffs.

Effects from occupational exposure to lambda-cyhalothrin could include temporary skin and eye irritation, although personal protective equipment should minimize such irritation. Wearing protective equipment is a key issue the IRS project will focus on so as to lower such occupational risk to acceptable levels. It is possible that the impacts of residential exposure could include effects on the neurodevelopment of unborn fetuses, but further research is necessary to test this hypothesis (Berkowitz, et al. 2003). Further information on the impacts of lambda-cyhalothrin and proposed mitigation for those impacts is discussed in the *Pesticide Procedures* section.

The storage facilities will also contain barrels or tubs used for rinsing sprayers and cleaning overalls, face shields, gloves, and boots. If not secured, these barrels or tubs may be pilfered and used for drinking water or food storage.

Table 5 summarizes the required mitigation actions activities for the IRS Program. USAID/Senegal Health SO team and the MOHMP will conclude a Memorandum of Understanding (MOU), defining roles and responsibilities for the required mitigation measures outlined in this table. Table 6 summarizes the monitoring responsibilities for this project.

Table 5. Required Mitigation Activities for IRS Program.

Pre-Campaign
Prepare and submit a Strategic Environmental Assessment report to the Environment and Classified Establishments; implement the appropriate parts (relevant to the pre-campaign) of the environmental management framework derived from the assessment.
Development of protocol for decision-making when environmental monitoring indicates environmental contamination as a result of IRS
Pregnancy tests for spray team operators
Training of spray operators, team leaders and supervisors according to WHO and PERSUAP guidelines; training of storekeepers, drivers and health workers.
Registration and procurement of sprayers manufactured according to WHO specifications; procurement and proper use of PPE by spray operators, team leaders and supervisors (cotton overalls, face shield, dust mask, broad-rimmed hat, rubber gloves, gum boots)
Procurement and distribution of treatment medicines for insecticide exposure
Organization of a drill for carrying out and supervising personal hygiene, regular washing of protective clothes and cleaning of equipment according to WHO guidelines
Procurement and distribution of barrels for progressive rinse, and wash-tubs for personal hygiene (if appropriate); inscription of program barrels and tubs as District Health Office property to deter sale and domestic use in event of pilferage
Renovation of DPV/DHP storage facilities in Dakar and in the District areas; Procurement and distribution of emergency equipment to permanent insecticide storage facilities;
IEC Campaign, citing importance of removing all food, utensils and straw flooring from house prior to spraying, moving furniture to the center of the room or outside, staying out of the house during and 1 hour after spraying, not allowing children or animals in the house until floor residue is swept outside; also needs to cite importance of not plastering or painting walls after the home has been sprayed.
Lab-testing of insecticide to ensure quality control
Entomological monitoring
During Campaign
Prohibition of spraying in homes where sick persons or pregnant women are living and cannot move outside the home *and* stay outside the home during and 1 hour after spraying.
Prohibition of spraying in homes where food, utensils and straw flooring have not been removed from the house, and where furniture has not been removed outside *or* moved to the middle of the room and covered with a cloth by the spray operator.
Prohibition of eating, drinking and smoking during work; prohibition of eating before washing
Prior to spraying, covering furniture that cannot be moved with cloths provided by the MOHMP, District Health Office, or Program

Reprimanding of spray operators that do not follow proper procedure in all aspects of operations (handling, spraying, hygiene, cleanup)
Supervisors will use the IRS Campaign Oversight Checklist (Annex 1) to record spray operator compliance with best practices.
Supervisors will collect sachet packing material, among other methods, to track the amount of insecticide used
Daily sprayer maintenance, sprayer progressive rinse, spray operator bathing, washing of overalls, PPE and cloths used to cover furniture, latrine disposal of laundry wash-water
Triple-rinsing (and, if necessary, shredding) of contaminated packaging; local disposal
Double-padlocking and guarding of storage facilities; Storage of all insecticides, empty packaging, barrels and tubs in storage facilities, reducing use of contaminated goods domestically
Entomological monitoring
Environmental compliance monitoring by Direction of Environment and Classified Establishments and USAID
Post-Campaign
Development of protocol/implementation of measures to mitigate mosquito resistance to insecticides-- pesticide rotation or mosaicing.
Submission of environmental compliance reporting to USAID
Entomological monitoring

Table 6: Monitoring of Mitigation Measures

Activities	Frequency/Number	Targets	Indicators	Sources of Information	Responsible for Monitoring
Drafting of PERSUAP and SEA report	Prior spraying campaign	Adherence to US (22 CFR 216) and Senegalese regulation	PERSUAP approved and Certificate of compliance delivered by Environment Department.	MOH/PNLP/RTI project files	- RTI - USAID/Senegal Health SO team - DEEC
Drafting protocol for decision-making for the management of environmental contamination	Prior to spraying campaign	Biophysical Environment	A protocol accepted by interested actors	MOH/PNLP/RTI project files	- RTI - USAID/Senegal Health SO team - DEEC
Pregnancy Tests for female spray operators	Once a month before, during spray operations and a month after spray operations	Female spray operators	Percentage of female spray operators who took pregnancy tests	Health records	- RTI - Health Districts - USAID/Senegal Health SO team
Promote safe handling of pesticides through training	Prior to spraying campaign	- Spray operators - Team leaders - Supervisors - Storekeepers - Drivers - Health workers	- The number of training sessions - Topics covered - Attendance rate - Number of poisoning cases	Training reports	- RTI/ Service d'Hygiene - USAID/Senegal Health SO team - Health Districts
Procurement of appropriate sprayers, barrels and PPE	Prior to spraying campaign	- Targeted districts - Spray operators (sprayers &PPE)	- Compliance with WHO specifications - Availability of barrels	- Information provided by the manufacturer - Team leaders reports - Environmental	- RTI - USAID/Senegal Health SO team

				Compliance reports	
Procurement and distribution of treatment medicines for insecticide exposure	Prior to commencement of spraying activities	- Poste de Sante and distribution outlets - Spray operators and other people involved in the handling of pesticides	- Medication for poison treatment available at health facilities and pharmacies	- Visits to health care facilities and pharmacies - EC reports	- MOHMP - Health Districts
Management of personal hygiene among spraying operators/organization of a drill for collecting contaminated waters	Drill organized prior to spraying campaign	- Spray operators - Natural resources (surface/ground waters, soils)	- Compliance of sprayers with WHO specifications and national regulations; - Appropriateness of rinse water disposal - Pollution cases in relation with the drills.	- Visits to drill sites - Environmental Compliance reports	- RTI - USAID/Senegal Health SO team - Health Districts - DEEC
Improvements to warehouse facilities	Once- prior to delivery of pesticides and equipments	DPV and/or DHP warehouses in Dakar and in Districts areas	- Compliance with FAO storage requirements including o Room Temperature, o Order of Stocks, o Leaks or Spills evident, o Stock Records, o Security of the facilities (locked? guarded? etc.), o Etc.	- Reports of visits to facilities - EC reports	- RTI - USAID/Senegal Health SO team - DPV - DHP - Health Districts

Quality Control	Prior spraying campaign	Pesticides use	Concentration measured	Laboratory's results	-MOHMP/PNLP -DPV
Entomological monitoring including resistance	Before, during and after spraying campaign	Malaria vector mosquitoes	Effectiveness of selected pesticide and resistance	- Entomological surveillance monitoring reports	- CDC/UCAD -USAID, Institue Pasteur/OMS -RTI
Ensure safety of people living in homes to be sprayed	Before and during spray operations	District inhabitants/ IRS project beneficiaries	- Compliance with safety requirements including: o People inside/outside house during spraying, o Food and goods in the rooms during spraying, o State of coverage of furniture during spraying, o The time residents spend outside before getting inside after spraying, o When (how long) do residents sweep floor after spraying.	- Team leaders reports - Supervisors reports - Spray operator reports - Environmental Compliance reports	- RTI - Health Districts -MOHMP/USAID
Ensure safety of inhabitants of homes to be sprayed	Before spraying	-Sick people -Pregnant women	Percentage of homes with sick persons or pregnant women	- Team leaders reports - Supervisors reports - Environmental Compliance reports	- RTI/DPH - Health Districts - -MOHMP/USAID
Promote discipline and avoid health risk	Before and during	Spraying operators	- Percentage of	- Team leaders	- RTI

among spraying operators	spraying		spray operators eating, drinking and/or smoking during spray operations - Percentage f pray operators sanctioned for not follow proper procedures	reports - Supervisors reports - Environmental Compliance reports	- District Authorities
Avoid contamination of people's furniture and subsequent risk	Before and during spraying	Beneficiaries assets	The importance of covering of furniture that cannot be moved with cloths as a practice	- Team leaders reports - Supervisors reports - EC reports	- RTI
Disposal of sachets/Waste disposal	During spraying and after spraying operations	Surrounding environment	Number of sachets collected out of number of sachets used -Compliance with WHO recommend waste disposal management	- Team leaders reports - Supervisors reports	- RTI -DPH
Evaluation of environmental compliance	After each spraying campaign	IRS project compliance	Compliance with the different requirements	EC reports	-RTI -DEEC -USAID -MOHMP/PNLP

SEA: Strategic Environmental Assessment report

PPE: Personal Protective Equipment

EC: Environmental Compliance

DEEC: Direction Environnement et des Etablissements Classés

DPV : Direction de la Protection des Végétaux

DPH : Direction de l'Hygiène Publique

SUMMARY OF FINDINGS:

The U.S. President's Initiative on Malaria (PMI) in Africa seeks to reduce malaria mortality by 50% in up to 15 countries in sub-Saharan Africa by 2010. The United States will work in partnership with host governments and build on existing national malaria control plans, policies and resources. The Initiative will support and complement efforts of the Global Fund (GFATM), the World Bank, and other members of the Roll Back Malaria (RBM) Partnership. The Initiative will include detailed reporting on inputs, outputs, and results. Senegal was one of the first seven countries selected for this Initiative.

As part of PMI, the United States Agency for International Development (USAID) proposes to implement Indoor Residual Spraying (IRS) in Senegal for malaria vector control during the 2007-2010 project period. The pesticide that will be used for the first spray rounds is ICON Wettable Powder (WP), composed of the active ingredient lambda-cyhalothrin. In the first year, IRS will be conducted in one round of spraying in the three following districts: Richard Toll, Velingara and Nioro. A second round of spraying may take palace in the district of Richard Toll. Following analysis of the first year's effectiveness in the different ecological zones, expansion of the program may be considered to other districts for future years.

A **negative determination with conditions** is recommended on the basis of the completion by USAID/Senegal health SO team of a PERSUAP for pesticide use, addressing ISAID's Pesticide procedures pursuant to 22 CFR 216.3 (b) (1) (I) (a-1). The conditions to be met are listed in the final section of this PERSUAP. The conditions are as follows:

1. USAID/Senegal Health SO team and the MOHMP implement the risk reduction actions outlined in the Pesticide Evaluation Report and Safer Use Action Plan (PERSUAP) and summarized in the section entitled REQUIRED MITIGATION MEASURES: The Safer Use Action Plan (see table 5 and 6)
2. USAID/Senegal Health SO team and the MOHMP will conclude a Memorandum of Understanding (MOU) assigning roles and responsibilities for these risk reduction actions.

The PERSUAP was prepared in accordance with guidance contained in the USAID Bureau for Global Health "Programmatic Environmental Assessment (PEA) "Integrated Vector Management Programs for Malaria Vector Control (2006). To the extent possible relevant analysis in that PEA is cited herein rather than repeated. This document focuses on elements that are specific to the activities in questions and risk mitigations that can be taken within these activities

Monitoring

As required by USAID's Automated Directives System (ADS) 204.5.4, the USAID/Senegal Health (SO) team and its implementing partners will ensure that procedures spelled out in the Pesticide evaluation report and safer use action plan (PERSUAP),addressing all IRS activities in Senegal are followed: actively monitoring ongoing activities for compliance and modifying or ending activities that are not in compliance. If additional activities are added to this program that are not described in this document, an amended PERSUAP or Environmental Assessment must be prepared and approved prior to implementation of those activities. This includes any commodities, pesticide products being considered under the program but not covered in the present PERSUAP.

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ANNEX 1: IRS Campaign Oversight Checklist

Activity	Best Practice	Best Practices Followed?		Corrective Action Taken
House Preparation	Furniture Moved	Yes	No	
	Foodstuffs/Utensils not moved	Yes	No	
	Cloth covering furniture	Yes	No	
PPE Worn	Hat	Yes	No	
	Gloves	Yes	No	
	Facemask	Yes	No	
	Overalls	Yes	No	
	Boots	Yes	No	
Personal Hygiene	No eating/chewing	Yes	No	
	No drinking	Yes	No	
	No smoking	Yes	No	
	No wiping part of body with contaminated clothing	Yes	No	
	No touching nozzle to mouth	Yes	No	
Sprayer Calibrated		Yes	No	
Spraying	Correct distance from wall	Yes	No	
	Correct rhythm	Yes	No	
	Proper surface sprayed	Yes	No	
	Gaps in sprayable surface	Yes	No	
Maintenance of	Body rinsed (progressive rinse)	Yes	No	

Sprayers				
	Nozzle rinsed (progressive rinse)	Yes	No	
	Nozzle does not need replacing	Yes	No	
	Filter/strainer cleaned	Yes	No	
	Filter present	Yes	No	
	Hose not worn	Yes	No	
	Hose connection tight	Yes	No	
	Trigger operation smooth	Yes	No	
	Seal or washer condition good	Yes	No	
	No leaks	Yes	No	
	Trigger valve/pressure release valve	Yes	No	
Wash-up		Yes	No	
Storage Facility	Orderly	Yes	No	
	Double-padlocked	Yes	No	
	Guarded	Yes	No	
	No spills or leaks	Yes	No	
	Stock record sheet up-to-date	Yes	No	
	Emergency equipment present	Yes	No	
Decontamination/ Disposal	Progressive rinse or decontamination/latrine disposal	Yes	No	(If no, was the water dumped in latrine or body of water?)

ANNEX 2:
Toxicological Profile for Lambda-Cyhalothrin, *PEA for IVM*

Summary of Insecticide

Chemical History

The synthetic pyrethroid lambda-cyhalothrin is a relatively new addition to this insecticide group. It was developed in 1977 and consists of one enantiomeric (i.e., nonsuperimposable, mirror image) pair of isomers and is a more biologically active form than cyhalothrin (IPCS, 1990a). It is used in the control of pests, including mosquitoes, in agricultural and public and animal health settings (EXTOXNET, 1996). The risks of occupational exposures and exposures to the general public are expected to be very low if proper precautions are followed. At the recommended application rates, lambda-cyhalothrin is not expected to cause adverse environmental effects. As is typical of synthetic pyrethroids, the typical symptoms for acute exposure are neurological and include tingling, burning, or numbness sensations (particularly at the point of skin contact), tremors, incoordination of movements, paralysis or other disrupted motor functions. These effects are generally reversible because lambda-cyhalothrin beaks down rapidly in the body (IPCS, 1990a; EXTOXNET, 1996).

Description of Data Quality and Quantity

Lambda-cyhalothrin and cyhalothrin are basically the same chemical and differ only in their stereo chemistry and the number of isomers in each mixture (U.S. EPA, 2002a). Cyhalothrin consists of four stereo isomers while lambda-cyhalothrin is a mixture of only two isomers. The two lambda-cyhalothrin isomers are contained in cyhalothrin and they represent 40 percent of the cyhalothrin mixture. The majority of toxicity studies available were conducted using cyhalothrin as the test chemical. Evidence based on sub chronic studies in rats suggests that the two mixtures are not biologically different with respect to their mammalian toxicity (U.S. EPA, 2002a).
EPA and ATSDR have developed quantitative human health benchmarks for cyhalothrin (EPA's acute and chronic oral RfDs and short-, intermediate-, and long-term dermal and inhalation benchmarks, and ATSDR's acute and subchronic oral MRLs). Recommended resources include:

Environmental Health Criteria 99: Cyhalothrin (IPCS, 1990a)

Toxicological Profile for Pyrethrin and Pyrethroids (ATSDR, 2003a)

Pesticide Information Profiles (PIP) for Lambda-cyhalothrin (EXTOXNET, 1996)

Specifications and Evaluations for Public Health Pesticides for Lambda-cyhalothrin (WHO, 2003)

Integrated Risk Information System (IRIS) summary review for cyhalothrin (U.S. EPA, 2005a).

Summary Table

Duration	Route	Benchmark Value	Units	Endpoint	Reference
Acute, Subchronic, Chronic	Inhalation	0.0008	mg/kg/day	Inhalation NOAEL for neurotoxicity in rats at 0.08 mg/kg/day (0.3 µg/L) with uncertainty factor (UF) of 100 applied	U.S. EPA (2002a)
Acute	Oral	0.005	mg/kg/day	Acute RfD based on neurotoxicity in dogs	U.S. EPA (2002a)
Subchronic	Oral	0.001	mg/kg/day	Adopt chronic RfD for subchronic duration	
Chronic	Oral	0.001	mg/kg/day	Chronic RfD based on neurological effects in dogs	U.S. EPA (2002a)
Acute, Subchronic, Chronic	Dermal	0.1	mg/kg/day	Dermal NOAEL in rats with UF of 100 applied	U.S. EPA (2002a)

For inhalation exposure, a NOAEL of 0.3 µg/L (0.08 mg/kg/day) was identified for neurotoxicity, decreased body weight, and slight changes in urinalysis parameters in rats exposed to lambda-cyhalothrin via inhalation for 21 days. An uncertainty factor of 100 was applied, for an inhalation benchmark value of 0.0008 mg/kg/day. This value is appropriate for all exposure durations (U.S. EPA, 2002a).

For oral exposure, an acute RfD of 0.005 mg/kg/day was derived based on a NOAEL of 0.5 mg/kg/day for neurotoxicity (ataxia) observed in dogs exposed to lambda-cyhalothrin, with an uncertainty factor of 100 applied (U.S. EPA, 2002a). A chronic oral RfD of 0.001 mg/kg/day was derived based on a NOAEL of 0.1 mg/kg/day for gait abnormalities in dogs exposed to lambda-cyhalothrin, with an uncertainty factor of 100 applied (U.S. EPA, 2002a). The chronic RfD was adopted to represent subchronic exposures.

For dermal exposure, a NOAEL of 10 mg/kg/day was identified in rats dermally exposed to lambda-cyhalothrin for 21 days. An uncertainty factor of 100 was applied, for a dermal benchmark value of 0.1 mg/kg/day. This value is appropriate for all exposure durations (U.S. EPA, 2002a).

Insecticide Background

CAS #:91465-08-6

Synonyms: none (WHO, 2003)

Chemical Group: synthetic pyrethroid

Registered Trade Names: Charge, Excaliber, Grenade, Karate, Hallmark, Icon, OMS 0321, PP321, Saber, Samurai, Sentinel, and Matador (EXTOXNET, 1996)

Usage

Lambda-cyhalothrin is a synthetic pyrethroid (IPCS, 1990a) most commonly used for pest control, especially mosquitoes; the insecticide is usually sprayed on interior walls or used to impregnate bed nets (EXTOXNET, 1996). This insecticide is a restricted use pesticide, so it can be purchased and used only by certified applicators (EXTOXNET, 1996). Lambda-cyhalothrin has adulticidal, ovicidal, and larvicidal activity (IPCS, 1990a). In addition to mosquitoes, it is effectively used to control: cockroaches, ticks, fleas, aphids, Colorado beetles, cutworms and butterfly larvae (EXTOXNET, 1996; IPCS, 1990a).

Formulations and Concentrations

There are several formulations for lambda-cyhalothrin, each containing varying amounts of the active ingredient. The typical formulations for lambda-cyhalothrin are

Technical grade (not less than 810 g/kg lambda-cyhalothrin)

Emulsifiable concentrate (at 20 +/- 2^{o}C: up to 25 g/l +/- 15% declared content; > 25 g/l to 100 g/l +/- 10% of declared content)

Wettable powder (up to 25 +/- 15% of declared content: > 25-100 +/- 10 % of declared content)

Slow release capsule suspension (at 20 +/- 2^{o}C: up to 25 g/l +/- 15% declared content).

The main formulation used for agricultural purposes is the emulsifiable concentrate. The wettable powder formulation is mainly used for public health reasons (WHO, 2003). Lambda-cyhalothrin is commonly mixed with buprofezin, pirimicarb, dimethoate, or tetramethrin, resulting in the usual product (WHO, 2003; EXTOXNET, 1996).

Shelf-Life

This insecticide, like many others, needs to be stored in a cool, dry, and well-ventilated facility (IPCS, 1990a). Lambda-cyhalothrin should not be stored or transported with foodstuffs and household supplies to the limit the potential for cross contamination and human exposure (IPCS, 1990a).

Degradation Products

In the environment, lambda-cyhalothrin degrades through biological and photochemical reactions (IPCS, 1990a). Biological reactions are thought to be more important. Lambda-cyhalothrin will degrade rapidly in soils, remain relatively stable in water, and is usually not found in air due to its low vapor pressure. The main degradation products are 3-(2-chloro-3,3,3-trifluoroprop-1-enyl)-2, 2-dimenthyl-cyclopropanecorboxylic acid, the amide derivative of cyhalothrin, and 3-phenoxybenzoic acid. The degradation is a result of the cleavage of the ester linkage to give two main degradation products, which are further degraded to carbon dioxide. Lambda-cyhalothrin degrades fairly quickly in alkaline conditions, in comparison to neutral or acidic media. It is strongly absorbed in soils and sediments with little tendency for bioaccumulation (IPCS, 1990a).

In water, lambda-cyhalothrin is stable at pH 5. Racemization at the alpha-cyano carbon occurs at pH 7 to pH 9, creating a one to one mixture of enantiomer pairs A and B. The ester bond is hydrolysed at pH 9. Additionally, a moderately high rate of photolysis is seen in dilute aqueous solutions (IPCS, 1990a).

Environmental Behavior

Fate and Transport in Terrestrial Systems

In most soil types, lambda-cyhalothrin is not very mobile. Its high reported organic carbon partitioning coefficient (Koc) value reflects its strong affinity for soil. It is retained more in soil with low sand content or high organic matter content (EXTOXNET, 1996). Studies have shown that lambda-cyhalothrin and its degradation products do not leach through soils into groundwater nor are they transported to other compartments of the environment following agricultural uses (IPCS, 1990a).

Lambda-cyhalothrin is moderately persistent in soil with a soil half-life ranging from 4 to 12 weeks. A longer in-field half-life of approximately 30 days is reported for most soils (EXTOXNET, 1996). The half-life is variable because it is dependent on the availability of sunlight, which speeds degradation (IPCS, 1990a).

Fate and Transport in Aquatic Systems

Lambda-cyhalothrin is not expected to be prevalent in surface or groundwater because it has extremely low water solubility and binds tightly to soil. Lambda-cyhalothrin enters surface water largely through surface runoff. Even so, lambda-cyhalothrin is most likely to stay bound to sediment and settle to the bottom. Studies have shown that hydrolysis of lambda-cyhalothrin occurs rapidly at a pH of 9 but not at a pH of 7, though isomerization was observed at a pH of 7. No hydrolysis or isomerization was seen at a pH of 5.

Human Health Effects

Acute Exposure

Effects/Symptoms

No data on accidental human poisonings have been reported. Additionally, no quantitative epidemiological studies are available (IPCS, 1990a). However, under normal use conditions, acute exposure to lambda-cyhalothrin is not expected to represent a hazard in humans. Transient skin sensations such as periorbital facial tingling and burning have been reported following direct skin exposure in laboratory workers and manufacturing workers handling synthetic pyrethroids. This sensation is possibly due to repetitive firing of sensory nerve terminals and usually lasts for a few hours up to 72 hours post-exposure. No neurological abnormalities have been observed upon medical examination (IPCS, 1990a). Lambda-cyhalothrin can irritate the eyes, skin, and upper respiratory tract. Additionally, oral exposure can cause neurological effects, including tremors and convulsions. Ingestion of liquid formulations may result in aspiration of the solvent into the lungs, resulting in chemical pneumonitis. Based on the acute oral toxicity data, lambda-cyhalothrin has been classified as "Moderately Hazardous" (Class II) (WHO, 2003).

In animals, the technical form of lambda-cyhalothrin is moderately toxic; however, toxicity depends on both the formulation (concentration of active ingredient and solvent vehicle) and the route of exposure (EXTOXNET, 1996). Laboratory data indicate that acute oral exposure to lambda-cyhalothrin is moderately to highly toxic in rats and mice and that mice are more susceptible to the toxic effects than rats (WHO, 2003). The oral LD_{50} for lambda-cyhalothrin in corn oil has been reported to range from 56 mg/kg in female rats up to 79 mg/kg in males. A similar LD_{50} is reported for technical grade lambda-cyhalothrin in rats at 64 mg/kg (EXTOXNET, 1996). The oral LD_{50} in mice is reported as 20 mg/kg (IPCS, 1990a). The effects of acute oral exposure are typical of pyrethroid toxicity, including abnormal motor function (WHO, 2003).

Acute inhalation exposures are also highly toxic to animals (WHO, 2003). In the formulated product Karate, the 4-hour LC_{50} in rats is reported as 0.175 mg/L in females and 0.315 mg/L in males (EXTOXNET, 1996).

Lambda-cyhalothrin is less toxic in animals via acute dermal exposure (WHO, 2003). In rats, dermal LD_{50}s of 632 mg/kg for males and 696 mg/kg for females have been reported for the technical product. Studies have also shown the technical product produced no skin irritation to rabbits and is nonsensitizing in guinea pigs. Mild eye irritation was observed in rabbits. However, dermal exposure to the formulated product Karate causes severe primary skin irritation in rabbits and mild skin sensitization in guinea pigs. Other acute dermal effects are related to the nervous system and include tingling, burning sensations, or numbness (EXTOXNET, 1996).

Treatment

Lambda-cyhalothrin and its breakdown products can be detected in blood and urine, but only within a few days of the last exposure (ATSDR, 2003a). Dermal exposure to lambda-cyhalothrin exposure should be treated by removing contaminated clothing and washing the exposed areas with soap and water. If lambda-cyhalothrin gets into the eyes, they should be rinsed with water for several minutes. Contact lenses should be removed if possible and medical attention should be sought. Vomiting should not be induced following ingestion of lambda-cyhalothrin, and medical attention sought. Inhalation exposures require removal to fresh air and rest (IPCS, 1990b)

Chronic Exposure

Noncancer Endpoints

Based on the available data, it is unlikely that lambda-cyhalothrin would cause chronic effects in humans under normal conditions. No specific target organs have been identified in the available chronic studies (EXTOXNET, 1996). Decreased body weight gain and mild neurological effects have been observed in some animal studies (EXTOXNET, 1996; IPCS, 1990a). Lambda-cyhalothrin is not expected to be teratogenic, mutagenic, or genotoxic in humans. Studies in animals have found no teratogenic or fetotoxic effects in rats or rabbits. Additionally, it was negative in five test strains in the Ames mutagenicity assay (IPCS, 1990a). No mutagenic or genotoxic effects were seen in other in vitro cytogenic assays or chromosomal aberration

tests (EXTOXNET, 1996).

Cancer Endpoints

Data on the carcinogenic potential suggest that lambda-cyhalothrin is not carcinogenic in humans. In rats and mice exposed to cyhalothrin, no carcinogenic effects were observed. EPA has classified lambda-cyhalothrin as a Group D chemical, "not classifiable as to human carcinogenicity" (U.S. EPA, 2002a).

Toxicokinetics

Animal studies have been have been conducted in various species to investigate the toxicokinetics of cyhalothrin and lambda-cyhalothrin. Oral cyhalothrin is readily absorbed, metabolized thoroughly, and eliminated as polar conjugates in the urine (IPCS, 1990a). Studies with lambda-cyhalothrin have shown that it also is rapidly metabolized into less toxic water-soluble compounds and excreted in the urine and feces (EXTOXNET, 1996). In mammals, cyhalothrin is metabolized as a result of ester cleavage to cyclopropanecarboxylic acid and 3-phenoxybenzoic acid, and eliminated as conjugates. Tissue levels decline after exposure stops and residues in the body are low (IPCS, 1990a).

Ecological Effects

Acute Exposure

Toxicity to Non-Target Terrestrial Organisms

Like other synthetic pyrethroids, lambda-cyhalothrin has been shown to be toxic to honey bees but has little effect on birds and domestic animals (EXTOXNET, 1996). In birds, the toxicity of lambda-cyhalothrin ranges from nontoxic to slightly toxic. Oral LD_{50} values in mallard duck are reported as greater than 3,950 mg/kg. Dietary LC_{50} values of 5,300 ppm are reported in bobwhite quail. Additionally, there is no evidence of lambda-cyhalothrin accumulation in bird tissues or in eggs (EXTOXNET, 1996). Lambda-cyhalothrin has shown mixed toxicity to other non-target terrestrial organisms. It is extremely toxic to honey bees, with a contact LD_{50} of 0.9 µg/bee and an oral LD_{50} of 38 ng/bee (EXTOXNET, 1996), but has no adverse effect on earthworms (IPCS, 1990a).

Toxicity to Aquatic Organisms

Like other synthetic pyrethroids, lambda-cyhalothrin has been shown to be quite toxic under laboratory conditions to both cold and warm water fish. Acute 96-hr LC_{50} values range from 0.2 to 1.3 µg/L. It is also highly toxic to aquatic arthropods with 48-hr LC_{50} ranging from 0.008 to 0.4 µg/L (IPCS, 1990a; WHO, 2003). In the field, however, these effects are not likely to occur under the recommended use scenarios (WHO, 2003). No serious adverse effects have been observed due to the low rates of application and the lack of persistence in the environments (IPCS, 1990a). Accumulation studies have shown that although bioaccumulation is possible in fish, it is unlikely due to the rapid metabolism of lambda-cyhalothrin (EXTOXNET, 1996).

Chronic Exposure

Toxicity to Non-Target Terrestrial Organisms

No data were located on the chronic toxicity to non-target terrestrial organisms.

Toxicity to Aquatic Organisms

No data for chronic duration exposures of aquatic organisms were located; however, a subchronic study in Sheepshead minnow embryos and larvae showed no effect on hatchability or larval survival when exposed to up to 0.25 µg/L through 28 days post hatching. A significant effect on larval weight was observed at 0.38 µg/L. In an additional subchronic exposure study, survival, growth, and reproduction of *Daphnia magna* were seen at 40 ng/L but not at 2.5 ng/L (IPCS, 1990a).

ANNEX 3 : Pesticides used in public health and in agriculture in the 3 targeted districts

District	Main Pesticides used in IRS (Brigades d'Hygiène)	Main Pesticides used in Agri
Richard Toll	DURSBAN® (ai = chlorpyriphos) ; Organophosphate (OP) DECIS® (ai = deltamethrine); Pyrethroid	**Birds and/or grass hoppers control** Chlorpyriphos; OP Malathion; OP Fénithrothion; OP Cyhalotrhrin; Pyrethroid Deltamethrine (DECIS®); Pyrethroid KELTOX® (ai = ??) **In tomato fields** TOMEX® 430 WP (ai = ??); ORTHENE® 97 SG (ai = acephate); ester phospho MOSPILAN®+388EC (ai = Acetamipride); Neonicot insectici CALLIFOL® 480 EC (ai = Dicofol); organochlorine CYPERCAL® 50 EC (ai = Cypermethrine); Pyrethr **In rice fields** Propanyl; acetanilide 2,4-D; phenoxy compound Carbofuran ; carbamate Endosulfan (to a less extend); chlorinated hydroca
Velingara	Chef brigade jointed the district very recently (1 week) ; does not know insecticides that are used; his colleague who may know was absent	**In vegetable crops** DECIS® (ai = deltamethrine); Fenitrothion; OP Dimethoate; OP **In large rain-based crops prote** (groundnut, cereals mostly) Malathion; OP Fenitrothion; OP **Cotton fields** Endosulfan 500; chlorinated hy AVAUNT®: (ma = Indoxacarb 150); LAMBDACAL® (ma = Profenofos 250 cyhalothrine 15) Pyrethroid
Nioro	DECIS® (ai = deltamethrine); Pyrethroid PERCAL® (ai = Permethrine 400 g/l); Pyrethroid AGRISECT Delta® (ai = deltamethrine 7,5); Pyrethroid	**In large scale protection** (groundnut, cereals mos Sumithion (ai = fénitrothion) ; OP Chlorpyriphos; OP DECIS® (ai = deltamethrine) ; Pyrethroid Diméthoate; OP

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