Malaria Indoor Residual Spraying (IRS)

Supplementary Environmental Assessment: Pyrethroid-Based Indoor Residual Spraying and Piloting of DDT-Based IRS for Malaria Control in Uganda

December 10, 2007

This publication was produced for review by the United States Agency for International Development. It was prepared by RTI International.

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Contract GHN-I-01-06-00002-00

Prepared for
U.S. Agency for International Development
Washington, DC

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SUPPLEMENTARY ENVIRONMENTAL ASSESSMENT: PYRETHROID-BASED INDOOR RESIDUAL SPRAYING AND PILOTING OF DDT-BASED IRS FOR MALARIA CONTROL IN UGANDA

PROGRAM/ACTIVITY DATA:

Program/Activity Number:
Country/Region: Uganda/AFR
Program/Activity Title:
Sub-Activity: IRS for Malaria Control in Uganda

Funding Begin: FY07 Funding End: LOP Amount:

EA Prepared By: Research Triangle International

Current Date: December 2007

IEE Amendment (Y/N): Yes
Filename & date of original IEE: Strategic Objective 8: Improved Health Status of Ugandans

ENVIRONMENTAL ACTION RECOMMENDED: (Place X where applicable)

Categorical Exclusion: ____ Negative Determination: ____
Positive Determination: __**X**_ Deferral: ____

ADDITIONAL ELEMENTS: (Place X where applicable)

CONDITIONS: _X_ PVO/NGO: ____

SUMMARY OF FINDINGS:

As part of the United States Presidential Malaria Initiative (PMI), the United States Agency for International Development (USAID) proposes to support indoor residual spraying (IRS) in Uganda in 2007/8, in collaboration with other partners and funding from the Global Fund for AIDS/TB and Malaria (GFATM), the World Bank Booster Program, and the World Health Organization (WHO). Technical and logistic support will be provided centrally through an agreement between USAID and Research Triangle Institute International (RTI), which will also provide country-level support, including technical, personnel, and logistics support.

The 2006 – 2010 Health Sector Strategic Plan (HSSP) of Uganda envisages IRS operations as part of an integrated vector management (IVM) program that will include an accelerated scaling-up of the use of insecticide treated nets (ITNs), and be supplemented with environmental management and larviciding to reduce vector breeding sources.

The National Malaria Control Program (NMCP) of the Ministry of Health (MOH) intends to implement IRS in selected districts in epidemic prone as well as endemic districts. The objective is to cover 15 districts (between 1.0 – 1.6 million households or about 21% of the total national population) by 2010. Lambda-cyhalothrin has proven effective for malaria control in Uganda and it is now governmental policy to include dicloro-diphenyl-trichloroethane (DDT) in the IRS program in 2008. In response, it is proposed that DDT be introduced on a pilot basis in Apac and Oyam Districts in FY08 in a program to be implemented and supervised by RTI to provide opportunity for assessing the effectiveness of relevant safeguards, build the capacity of the Ministry of Health and the Ministry of Agriculture in the use of DDT for IRS, and inform future decisions on the use of DDT in the country. If successful, the pilot would be the first step of a gradual scale-up of DDT dependant on the capacities of the Ugandan Ministries. The two insecticides will be applied in strict compliance with environmental safeguards stipulated by the National Environmental Management Agency (NEMA) and the National Drugs Authority (NDA), as well as WHO guidelines and recommendations.

USAID support for malaria control also includes provision of long lasting insecticide-treated nets (LLINs), support for malaria diagnosis and treatment, activities to reduce the burden of malaria among children and during pregnancy, and facilitating active involvement of the private sector in malaria control.

A **Positive Determination** is recommended for this program per 22CFR216.3(a)(ii)(3) because the pesticides proposed for use have a potential for significant impact on the environment, and per 22CFR216.3(b)(iii)(b) because the U.S. registration of DDT was canceled for cause by the U.S. Environmental Protection Agency (USEPA). The requirement is that RTI, in collaboration with NMCP, NEMA, and NDA, will implement the risk reduction actions outlined in this Supplementary Environmental Assessment (SEA) as summarized below with respect to the DDT-based IRS pilot in Apac and Oyam districts, and presented under the section entitled "*Required And Recommended Mitigation Measures: The Safer Use Action Plan."*

Recommended Mitigation Measures: The Safer Use Action Plan (SUAP). An overview of conditions of the SEA is as follows:

1. *In support of subsequent IRS campaigns supported by USAID, this Environmental Assessment will be reviewed and revised* to ensure that

USAID support remains consistent with stipulations of the Stockholm Convention on persistent organic pollutants (POPs) (http://www.pops.int), including reporting requirements by parties (http://www.pops.int/ddt_info/default.htm), as well as the Uganda National Implementation Plan (NIP) on POPs.

2. *The SEA will re-examine the need for DDT and identify the best choice for IRS chemicals,* in line with the 3-yearly review by the Stockholm Convention on the continued need for DDT for disease vector control, as outlined in Annex B, Part II of the Convention. This document provides authorization for DDT use for one year only. This SEA must be amended to reflect the continuing need, if appropriate, for the proposed insecticide, before USAID can support use of DDT beyond one year.
3. *NEMA and the NMCP will fulfill the reporting requirement under the Stockholm Convention on POPs, relevant to the use of DDT in disease control.*
4. *Relevant categories of workers involved in IRS operations (e.g., storekeepers, pesticide transporters/drivers, spray operators, team leaders, supervisors, coordinators, and district program managers) will be trained and supervised on best practices* in accordance with national pesticides regulations and recommendations/guidelines of WHO, the 2006 EA, and this SEA.
5. *Occupational exposure to insecticides will be minimized through the use of personal protective equipment (PPE),* in accordance with WHO specifications and NEMA standards. Recognizing the ongoing scientific debate on potential reproductive impacts of DDT, women will be excluded from teams using DDT for IRS. As a general rule, the ongoing practice of excluding pregnant women and nursing mothers as spray personnel using any IRS pesticides will be strictly enforced. The safety of beneficiary households will be adequately addressed through an information, education, communication (IEC) campaign. The spray teams will remind residents of their responsibilities as well as the expectations from the IRS operations.
6. *District capacities will be established for the management of pesticide poisoning*. Training will be provided to relevant health workers and district reference hospitals will be appropriately equipped to serve as reference points to manage any incidents of pyrethroid and DDT poisoning within their catchment areas.
7. *Environmental contamination will be kept to a minimum through strict auditing of pesticide stocks and use, handling, washing, storage and disposal practices,* including the use of ablution blocks and evaporation

tanks, and progressive use of waste/wash water. Using a strict 'chain-of-custody' framework, RTI will ensure that empty DDT sachets are strictly audited, retrieved, and stored at a central secure location. There will be strict compliance with relevant national legislation/regulations on pesticide management. The provisions of the Basel Convention and Rotterdam Convention will apply where trans-boundary movement of the waste is envisaged, and the laws prevailing in transit countries and the recipient country will be fully considered.

8. *An Environmental Assessment Plan, including an environmental monitoring (sampling) scheme*, will be implemented as an integrated activity of the IRS program, to verify and document compliance and enable evaluation of the environmental impact of the pesticides used for IRS.

While DDT has a potentially important role to play at present time in assuring the efficacy of the IRS program in Uganda, the potential for environmental impacts and of economic impacts to export agriculture from the use of DDT is sufficient that USAID should be working on an ongoing basis with the Government of Uganda toward the phase-out of this chemical's use as soon as possible. In the meantime, adherence to the conditions above related to the environmentally sound management of DDT used in this program is of great importance. USAID IRS program managers in Washington and in Uganda must take all necessary steps to actively monitor IRS activities for compliance with the requirements and recommendations in this assessment, as required by Automated Directives System (ADS) 204.5.4.

If additional activities are added to this program that are not described in this document, an amended EA must be prepared and approved prior to implementation of those activities. This includes any commodities and pesticide products being considered under the program but not covered in the present EA.

Conditions for Apac/Oyam Pilot

1. The environmental monitoring plan must incorporate samples from before the spraying and after, including biota. The baseline shall be completed prior to the use of DDT in any location.
2. A detailed analysis of the area shall be completed to determine which areas will not be sprayed with DDT prior to the spraying of DDT
3. All NEMA conditions must be met in the pilot area before using DDT
4. As per ADS 204.3.4 if during the pilot phase the SO Team, CTO or Activity Manager determine that activity is not in compliance with the SUAP (e.g. inappropriate use of the pesticide), they must modify or end the activity.

APPROVAL OF ENVIRONMENTAL ACTION RECOMMENDED:

CLEARANCE:

Mission Director,
USAID Uganda: _____ Date: _____
Margot Ellis

CONCURRENCE:

Bureau Environmental Officer,
AFR/SD: _____ Date: _____
Brian Hirsch

Bureau Environmental Officer,
Global Health: _____ Date: _____
Michael Zeilinger

ADDITIONAL CLEARANCES:

Uganda PHN Director _____ Date: _____
Kathryn Panther

Mission Environmental Officer
USAID/Uganda: _____ Date: _____
Jody Stallings

Regional Environmental Advisor
USAID/EA _____ Date: _____
Walter Knausenberger

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Acronyms

ACT	artemisinin-based combination therapy
ADS	Automated Directives System
ANC	antenatal care
AU	African Union
BCC	behavior change communication
CDC	U.S. Centers for Disease Control and Prevention
CQ	chloroquine
DDT	dichloro-diphenyl-trichloroethane
DHS	Demographic and Health Survey
EA	Environmental Assessment
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EOS	Enhanced Outreach Strategy
EPA	Environmental Protection Agency
EPI	Expanded Program on Immunization
FAO	Food and Agriculture Organization
FBO	Faith Based Organizations
MOH	Ministry of Health
GEF	Global Environment Facility
GFATM	The Global Fund to Fight AIDS, Tuberculosis, and Malaria
GST	glutathione S-transferase
HBMF	home-based management of fevers
HDP	Health development partner
HEW	health extension worker
HSSP	Health Sector Strategic Plan
ICON	lambda-cyhalothrin
IDP	internally displaced person
IEC	information, education, and communication
IPM	integrated pest management
IPT	intermittent preventive treatment
ITN	insecticide treated nets
IVM	integrated vector management
IRS	indoor residual spraying
kdr	knockdown resistance
LLIN	long-lasting insecticide-treated nets
MAAIF	Ministry of Agriculture, Animal Industry, and Fisheries
MEO	Mission Environmental Officer
MOP	Malaria Operational Plan
MOH	Ministry of Health
MOA	Ministry of Agriculture
MPCP	Malaria Prevention and Control Program
MRL	maximum residual limit
NEMA	National Environmental Management Agency

NDA	National Drugs Authority
NGO	nongovernmental organization
NIP	national implementation plan
NMCP	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 Malaria Initiative
POP	persistent organic pollutant
PPE	personal protective equipment
RBM	Roll Back Malaria
RDT	rapid diagnostic test
RTI	Research Triangle International
SADDC	The Southern Africa Development Coordination Conference
SEA	Supplementary Environmental Assessment
SP	sulfadoxine-pyrimethamine
SUAP	Safer Use Action Plan
UNDP	United Nations Development Program
UNEP	United Nations Environmental Project
UNICEF	United Nations Children's Fund
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

Summary and Context

Malaria is the leading cause of morbidity and mortality in Uganda. Malaria control is integrated into an overarching Health Sector Strategic Plan (HSSP), which provides a unified framework to guide interventions by parties at all levels of the national health system.[1] The HSSP is being implemented in five-year investment cycles. The current cycle (HSSP II) covers the period from 1 July 2005 to 30 June 2010.[2] USAID has been supporting a range of malaria control activities aligned with the objectives of the HSSP. These include[3]:

1. Distribution of free ITNs to vulnerable groups through antenatal care (ANC) clinics and large-scale campaigns, and to net facilities where non-governmental organizations (NGOs) and faith-based organizations (FBOs) can subsidize sales of ITNs to the lower wealth quintiles as well as the sale of ITNs through the retail market;
2. Implementation of IRS in epidemic-prone districts, selected high-transmission districts, as well as internally displaced persons (IDP) camps in Northern Uganda;
3. Artemisinin-based combination treatment (ACT) policy implementation and strengthening of diagnosis, logistics, and distribution systems (both health facility and community-based distribution) to ensure increased availability of ACTs ;
4. Revitalization of the national intermittent preventive treatment (IPT) plan by continuing to support and train private and NGO health workers. The goal is to increase the percentage of women receiving two doses to 40% in 2008;
5. Technical assistance to improve the detection and response to epidemics in the fifteen epidemic-prone districts; and
6. Involvement of the private sector/NGOs/FBOs in malaria control activities.

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[1] ADB (2006). Uganda: Proposal for an ADF Loan of UA 20 million to Finance the Support to Health Sector strategic Plan Project II (SHSSPP II). African Development Bank. ADF/BD/WP/2006/112

[2] MOH Uganda (2005). *Health Sector Strategic Plan II 2005/6 – 2009/2010* Volume 1. Ministry of Health Uganda, Lusaka. 103 Pages

[3] USAID (2007). *President's Malaria Initiative – Uganda: Malaria Operational Plan (MOP).*United States Agency for International Development. Washington DC, USA. 50 pages.

The FY08 PMI Malaria Operational Plan (MOP) indicates a $22 million budget for Uganda, of which 39% will be used for IRS, 26% for procurement and distribution of ITNs/long-lasting insecticide treated nets (LLINs), 4% for IPT for pregnant women, 14% on diagnosis and malaria treatment, 8% for monitoring and evaluation (M&E);40% of the total budget will be applied towards the procurement of commodities.

One of the objectives of HSSP II with regards to malaria is to increase the proportion of targeted structures for IRS in epidemic-prone areas from 0% to 80% by 2010.[2] Beginning in FY06 USAID has supported IRS of synthetic pyrethroid-Lamda cyhalothryn (brand name-ICON) in Kabale and Kanungu districts. IRS coverage was expanded to seven districts in FY07 in epidemic prone areas and endemic IDP camps in the north. To date, over 600,000 households have been covered and about 1,500 local spray personnel trained. The IRS target for 2008 is about 800,000 households. USAID support for IRS will cover, among others:

- Procurement of insecticides (ICON and DDT), spray equipment, parts, and PPE.
- IRS implementation activities in selected districts (targeted spraying in epidemic-prone areas and blanket spraying in endemic areas), including Kitgum, Pader, Gulu, Amoro, Amolatar, Apac, Oyam, Kabermaido, Amuria, Soroti, endemic sub-counties of Kabale and Kanungu, as well as Lira and Dokolo and adjacent districts, and targeted training at the district level relevant to the proper implementation of IRS.
- Support MOH in IEC/behavior change communication (BCC)/community mobilization related to IRS implementation and assuring household and community safety.
- Support entomological M&E, including baseline and post intervention surveillance, susceptibility, bio-assays, and vector bionomic studies related to IRS.

The current supplementary EA is therefore conducted to fulfill the requirement established by Title 22, Part 216 of the United States Code of Federal Regulations. This SEA relates to the procurement of lambda-cyhalothrin, as well as DDT for a pilot DDT-based IRS implementation limited to Apac and Oyam Districts, and in a program that will be implemented and supervised by RTI. The SEA complements an earlier Environmental Impact Statement (EIS), which provides extensive review on the introduction of IRS as a malaria vector control intervention in Uganda. It takes guidance from the recommendations within the

Programmatic Environmental Assessment for Integrated Vector Management (PEA for IVM) of USAID.[4]

Environmental Assessment Plan

The environmental assessment of IRS activities is established for the proposed piloting of DDT-based IRS in Apac and Oyam Districts. Two data sources will be utilized: (a) compliance inspections/evaluations of IRS-related activities linked to assuring execution of the SUAP outlined in the present SEA, and (b) environmental monitoring (sampling of soil, air, stored crops, crops in the distribution chain, and environmental and biological samples representing sensitive habitats and species) in the proposed area of IRS implementation to evaluate the potential for environmental exposure/release of DDT from IRS operations. The results generated from these two data sources will be reviewed with partners during a final review meeting.

A. Compliance inspections/evaluations

The following inspection regime is established, all of which will be fully documented and reports disseminated to relevant parties. RTI is USAID Uganda's current contracting partner to conduct IRS, and as such:

1. RTI will conduct and document inspections prior to, during, and following IRS operations to establish compliance with all requirements of the SUAP. RTI will provide results from each of these inspections to the USAID/Uganda Mission Environmental Officer (MEO) and designated points of contact for the NMCP and NEMA. RTI will advise the MEO, NMCP, and NEMA representatives of when these inspections will be conducted so they may participate at their option.
2. The USAID Regional Environmental Advisor (REA) will conduct inspections of IRS operations in selected districts, including unannounced spot inspections. The objective will be to ascertain compliance with all relevant national regulations and guidelines and the SUAP. The USAID/Uganda CTO and Activity Manager are responsible for the activity. The MEO and/or alternate MEO will assist as well.
3. NEMA and NDA will conduct at least one round of independent compliance inspections of IRS field activities and facilities in Apac and Oyam Districts. RTI will make funds available to cover the per diem and

[4] United States Agency for International Development (USAID). *Draft Programmatic Environmental Assessment for Integrated Vector Management*. Accessed September 2006 www.fightingmalaria.gov/news/docs/pea_03-14-06.doc

travel costs of NEMA and NDA inspectors unless USAID/Uganda elects to use another mechanism for this purpose.

B. Environmental monitoring

An environmental monitoring plan will be prepared and implemented in association with IRS operations using DDT in Apac and Oyam Districts. The monitoring plan will, at minimum, include baseline data collection and analysis of the following:

- Dust samples collected indoors, at several time intervals post-spraying, to evaluate the concentration of DDT in soil/dust on the floor of houses that have been sprayed with DDT;
- Soil samples collected at community gathering places (e.g., water points, markets) at several time intervals post-spraying, to evaluate the potential for DDT transport into the environment via soil being tracked from indoors to outdoors;
- Air samples collected indoors at several time intervals post-spraying, to evaluate the concentration of DDT in vapors and airborne particles in houses that have been sprayed with DDT;
- Samples of crops stored indoors in houses sprayed with DDT, at several time intervals post-spraying, to evaluate the potential for contamination of crops stored indoors.
- Samples of crops, or processed agricultural products from such crops, taken at one or more points in the distribution chain leading to export, to evaluate the current background concentration of DDT in such crops or products before the use of DDT for IRS has been generally introduced;
- Samples of selected environmental media (e.g., soil and sediment, water) and biological tissues (e.g., raptor shells) that are known sinks for DDT accumulation transported to the environment, to evaluate the current background concentration of DDT and/or its associated metabolites and breakdown products before the use of DDT for IRS has been generally introduced. Samples will also be taken at least once more after spraying to compare levels.

Detailed protocols for environmental sampling, laboratory analysis, quality control, and data analysis are under preparation and are incorporated by reference into the SEA, to ensure that their implementation is required as part of the SUAP as applied to the trial use of DDT for IRS in Apac and Oyam Districts. RTI will incorporate the District Environmental Officers of Apac and Oyam Districts and the National Forest Authority Range Manager, based in Apac, that is responsible for the Central Forest Reserves in these two districts into these monitoring activities. Results from environmental monitoring during the trial in Apac and Oyam Districts will be used to develop the design

of, and refine protocols for an environmental monitoring program that could be implemented in association with the general introduction of DDT-based IRS.

C. Final review meeting

A joint meeting will be held by the technical partners (e.g., USAID, RTI, and the national agencies identified in **Annex 1**) at the conclusion of the spray season to review the findings from the above evaluations, generate lessons learned, and identify remedial actions as necessary. The report of the joint meeting will inform decisions on future implementation of DDT-based IRS in the country.

Conclusions and Recommendations

- This SEA recognizes the current policy of the Government of Uganda to include DDT as part of the arsenal of insecticides for IRS to control the vectors of malaria, beginning in 2008. It is noted that the proposed reintroduction of DDT follows a break of over 30 years, during which time the technical capacity and other capacities for IRS were severely eroded. While the pyrethroid-based IRS undertaken since 2006 with USAID support has yielded excellent results, both in terms of best practices and outcomes, and has also resulted in some limited capacity building for IRS, the restrictions placed on DDT under the Stockholm Convention, the specific recommendations and guidelines of WHO on the use of DDT for disease vector control, as well as the potential human and environmental health implications of DDT as a pesticide with POP properties, demand the establishment of robust safeguards before the insecticide is re-introduced in Uganda. The safeguards needed to ensure adequate protection of environmental and human safety are evaluated in **Annex 1**, in terms of their role in ameliorating specific potential risks linked to DDT-based IRS implementation. **Annex 2** reviews ongoing preparations by the country for a generalized re-introduction of DDT.[5]
- To promote rational reintroduction of DDT and an opportunity for adequate assessment of the effectiveness of safeguards, it is recommended that DDT-based IRS be piloted in Apac and Oyam Districts in FY08, in a program to be implemented and supervised by RTI. RTI will ensure the full implementation of relevant safeguards, as reviewed in **Annex 1** of this SEA.
- Close and functional collaboration between all the primary national entities identified in **Annex 1** (e.g., MOH/NMCP, NEMA, NDA) and RTI is

[5] NEMA gave its approval for the use of DDT by a letter dated 22 December 2006 to the Permanent Secretary of MOH under the heading "Approval of the Environmental Aspects for the Proposed Re-introduction of DDT for Indoor Residual Spraying for Malaria Control in Uganda." The approval was subject to general and specific conditions, and these are reviewed in Annex 2.

necessary to ensure that the proposed piloting is appropriately executed with full implementation of the anticipated safeguards.

- Recognizing the ongoing scientific debate on the potential reproductive impact of DDT, a precautionary policy to protect women of childbearing age is advisable. Hence, it is recommended that women should not be engaged as DDT spray personnel. They could be assigned to non-spraying duties (e.g., IEC communicators, community mobilization), which minimize potential contact with the insecticide.
- The experiences from the proposed piloting in Apac and Oyam Districts should be comprehensively documented in order to adequately inform future decisions on DDT-based IRS in Uganda.
- If approved, the implementation of the pilot in Apac and Oyam Districts will be reviewed at the end of the spray cycle (FY08). A determination will be made, at that time, on the continuation of USAID support for DDT-based IRS in Uganda.
- USAID support for general introduction of DDT use for IRS remains contingent on the full satisfaction of all NEMA conditions.
- Future decision by NMCP to scale-up DDT-based IRS in Uganda should be preceded by appropriate orientation of relevant policies and the ensurance of pre-requisite conditions in the proposed area(s) of implementation.
- While recognizing the proposed reintroduction of DDT will be limited to Apac and Oyam Districts as a pilot, it is worthwhile to note that in the context of a broader intervention strategy, DDT must be seen as a complimentary addition and not an automatic replacement for lambda-cyhalothrin, especially where the pyrethroid continues to be effective. Decisions on insecticide selection should be informed by a sound knowledge of the local eco-epidemiology of malaria and vectors, as well as a clear perspective on the enhanced benefits that will result from the anticipated insecticide change (e.g., potential for enhanced resistance management).
- A newer formulation of lambda-cyhalothrin (branded as ICON CS) has been determined by World Health Organization Pesticide Evaluation Scheme (WHOPES) to provide comparable or better performance in all aspects, compared to the original WP formulation. A comprehensive evaluation of the length of residual efficacy on the different local wall substrates should be evaluated as soon as practicable to inform decision making on the appropriate use of ICON CS formulation.
- The proposed PMI support (re: FY08 MOP) for entomological monitoring, including baseline and post-spray assessments, and susceptibility bioassays will assist the development of these critical vector control functions in Uganda

and provide a technically sound basis for decision making on the selection of insecticides and IRS targeting.

Required and Recommended Mitigation Measures: The Safer Use Action Plan

This SEA develops a SUAP for the implementation of best practices with regards to a proposed piloting of DDT-based IRS limited to Apac and Oyam Districts of Uganda, in a program to be implemented and supervised by RTI on behalf of MOH/NMCP. It is based on an assessment of potential risks linked to the proposed intervention and the mitigation measures needed (**Annex 1)**. The goal of the SUAP is to enable actions to minimize and monitor the impacts on human health and the environment. It establishes guidance in accordance with the PEA for IVM of USAID, the recommendations of the WHO, and other related international agreements such as the Stockholm Convention on POPs,[6] and the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal.[7]

Operational Requirements

- ***Initiate environmental monitoring of pesticides used in IRS to the extent feasible and relevant.*** Title 22 Section 216 of the U.S. Code of Federal Regulations stipulates the measurement of any changes to environment quality to the extent feasible and relevant. Technical assistance will be provided to NEMA, as relevant, to assess the impact of IRS activities on the environment, promote compliance, and support obligations under the Stockholm Convention on POPs.
- ***Establish quality assurance/control schemes for commodity procurement and IRS operations to minimize risk to human health and the environment.***
- ***Ensure compliance with national regulations on pesticide and MOH guidelines on IRS and vector control.*** This includes compliance with established procedures for registering, importing, transporting, labeling, handling, use, conditions of storage, and disposal of pesticides.
- ***Train relevant categories of workers involved in IRS operations (e.g., storekeepers, pesticide transporters/drivers, spray operators, team leaders, and supervisors)*** in accordance with national pesticide regulations and best practices recommended by WHO, and outlined in the MOH guidelines and this EA.

[6] www.pops.int/documents/convtext/convtext_en.pdf
[7] www.basel.int/text/con-e-rev.pdf

- ***Ensure adequate protection of spray operators through the use of appropriate PPE.***
- ***Train health workers in the management of insecticide poisoning***, and ensure the availability of appropriate treatment for insecticide poisoning at the districts targeted for IRS.
- ***Enforce protection of fetus and suckling-children against exposure in spray operations.*** Appropriate policy will be established to ensure that women do not serve as spray personnel on teams using DDT for IRS. As a general rule, the existing practice of excluding pregnant women and breast-feeding mothers as spray personnel in any IRS operation will be strictly enforced. IEC messages will address potential risks to mothers and infant residents of the households and mitigation measures.
- ***Educate target communities and households to reduce exposure*** through an IEC campaign on the removal of food, cooking, and water utensils, as well as covering of unmovable furniture with cloths prior to spraying; avoid spraying rooms stored with agricultural products and food items; prohibiting the spraying in rooms inhabited by sick persons or pregnant women who are unable to leave the home; prevent re-entry of sprayed rooms for at least one hour after spraying; careful sweeping of floor residues before re-entry of children or animals and what action communities need to take to dispose this sweepings. In addition, work with agribusiness and farming co-ops/communities in the target district to encourage reporting of misuse/inappropriate applications of the insecticide to relevant authorities, to educate them about the program and best practices to avoid exposure to their crops, and about the environmental monitoring that will be conducted.
- ***Secure transport, storage and chain of custody of insecticide.*** DDT used for IRS operations will be kept under RTI's control at all stages of the pilot program.
- ***Reduce environmental contamination*** through strict practices for auditing stocks, use, handling, washing, and disposal of pesticides, including progressive use of waste/wash water, ablution blocks, and evaporation tanks.
- ***Prohibit IRS in sensitive ecosystems.*** Measures will be established to ensure adequate protection of protected areas and sensitive ecosystems, consistent with the established country criteria/guidelines on IRS and relevant USAID policies.
- ***Inform fire brigades*** of the location and contents of storage facilities.
- ***Return empty DDT sachets to a central secure location and removal by vendor for final disposal .*** Strict auditing and a mechanism for retrieving

empty sachets of DDT from the districts will be established. Once retrieved the empty sachets will be kept in secured designated location. The vendor will be responsible for the final disposal of the empty sachets in accordance with relevant provisions and guidelines under the Stockholm Convention on POPs, Basel Convention, and Rotterdam Convention on Prior Informed Consent.

Policy, Planning, and Institutional Requirements

While the proposed DDT-based IRS will be limited to a pilot program in two districts (Apac and Oyam), due consideration should be given to a longer term goal of establishing an enabling policy and institutional environment to ensure sound re-introduction of the insecticide IRS program:

- ***The NMCP will be assisted as necessary, to re-examine the need for DDT based upon the best available information and to identify the best choice for pesticides for IRS.*** The assessment will be carried out within the context of the cautions on safety, effectiveness, and affordability in Annex B, Part II of the Stockholm Convention on POPs, as well as relevant recommendations and guidelines of WHO. The MOH will establish an appropriate baseline of evidence to guide the selection of pesticides for IRS.
- ***Support, as far as feasible and necessary, capacity strengthening for the review and update of relevant policies for ongoing effectiveness of environmental and human health safeguards relating to the use of DDT.***
- ***Strengthen mechanisms to restrict the use of DDT to IRS for disease vector control.*** Regular assessment of the effectiveness of the safeguards and compliance on the restricted use of DDT in accordance with national and international obligations.
- ***Develop and implement resistance management*** to make sure that the public health pesticides used for IRS in Uganda remain effective. This will include support for the development of insectaries and targeted training, to provide a sound basis for selecting and implementing pesticide-based interventions within a broader context of integrated vector management. Appropriate integration of IVM and IPM practices will be made to prevent/manage cross-resistance.
- ***Strengthen inter-sectoral collaboration frameworks and institutional arrangements for a holistic approach to vector control and the use of pesticides, in particular.*** Coordination between the malaria control program and major stakeholders such as:

  - NEMA – to ensure effective environmental monitoring and fulfill the reporting obligations related to the Stockholm Convention on POPs, of which Uganda is a party.
  - Ministry of Agriculture – to enable appropriate integration of vector and pest management activities aimed at enhancing judicious use of insecticides.
  - Ministry of Water Resource Development – to ensure adequate consideration of measures to mitigate the impact of water resource development of vector dynamics in the planning and execution of projects.
- ***Ongoing enhancement of institutional capacity to improve core vector control functions for better targeting of IRS, epidemic response, and judicious use of public health pesticides.*** This will include the establishment of sentinel surveillance and eco-epidemiological evaluations, and the rehabilitation of insectaries for entomological evaluations.
- ***Establish clear policy basis for environmentally sound disposal of DDT waste from IRS operations.*** RTI will secure the explicit agreement of MOH that the disposal of DDT sachets and contaminated packaging, will strictly follow approved international procedures, with due regards to the Stockholm Convention on POPs, and that until such time that this is achievable within Uganda, the empty sachets and contaminated packaging from IRS activities will be securely stored in a central location. RTI will also explore opportunities for the empty sachets to be retrieved by the pesticide supplier for disposal outside the country (possibly country from where the DDT was imported). This will, however, require prior governmental agreement between GoU and the source country as per the provisions of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal.

The above operational requirements are summarized in **Annex 3** of this EA, according to the time that the mitigating actions should be taken.

Upon signature of this EA (preferably through a separate memorandum of understanding between RTI and the Government of Uganda), it is understood that the mitigation activities outlined in this SEA will be implemented. A review of this SEA is required by USAID before any decision to continue the proposed use of DDT beyond FY08 is made, and before any alterations in coverage are authorized.

8. Background and Purpose

Need for Action

Malaria Burden in Uganda

Malaria is the leading cause of morbidity and mortality in Uganda. It is estimated to depress GDP growth by 1.3% annually and result in a projected 30% reduction in economic growth over a 15-year period. Over 90% of the population (29.4 million) live in endemic areas with perennial transmission, while the remaining 10% live in epidemic prone areas in the highland areas and along parts of the border with Kenya and Sudan (**Figs. 1** & **2**). Malaria annually accounts for up to 35% of hospital admissions, 40% of outpatient consultations, and up to 14% of all hospital deaths. Among under-five-year-olds, malaria accounts for up to 70% of outpatient cases, over 50% of admissions, and a case fatality rate of 8-25%. About 50% of deaths among children under five years old are attributed to malaria.[8] The specific death rate among this age group is 37/1000 and 18/1000 live births in high and low malaria endemic areas respectively,[9] which translates into annual child deaths of between 70,000 and 110,000. The total number of fever cases for all ages was about 65 million and 70 million in 2004 and 2005 respectively (Pers. Comm., Michael Okia, NMCP/MOH, Uganda). Of these cases, approximately 12 million were treated in the public and not-for-profit sector. Prevalence rates for malaria asymptomatic parasitemia range from 50% to 80% in young children, and 20% to 50% in older children. A 1999 study indicated that malaria was responsible for about 60% of miscarriages,[10] and is a major cause of anemia and low birth weight among infants. It is estimated that 30% of all recorded deaths during pregnancy are a direct result of malaria infection.[11] About 10 % of the average household monthly income is spent on treatment, while about 33-54% of work absenteeism is due to the disease. Malaria is also a leading cause of mortality among refugees and IDPs.[9] As of mid-2005, there were an estimated 1.8 million IDPs and 220,000 refugees in Uganda. It is worthwhile to note that the

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[8] "Malaria Control in Uganda - Towards the Abuja Targets Disease Burden and Epidemiology. Centers for Disease Control." Accessed 1 April 2007, at http://www.cdc.gov/malaria/control_prevention/uganda.htm

[9] Kiwanuka, G. (2003). Malaria morbidity and mortality in Uganda. *J Vect Borne Dis.*, 40:16 -19

[10] Ndyomugyenyi, R., Magnussen, P., (1999). Anemia in pregnancy: Plasmodium infection is an important cause of anemia in primigravidae in Hoima district, western Uganda. *Ann. Trop. Med. Parasitol.*, *93*(5) : 457–65.

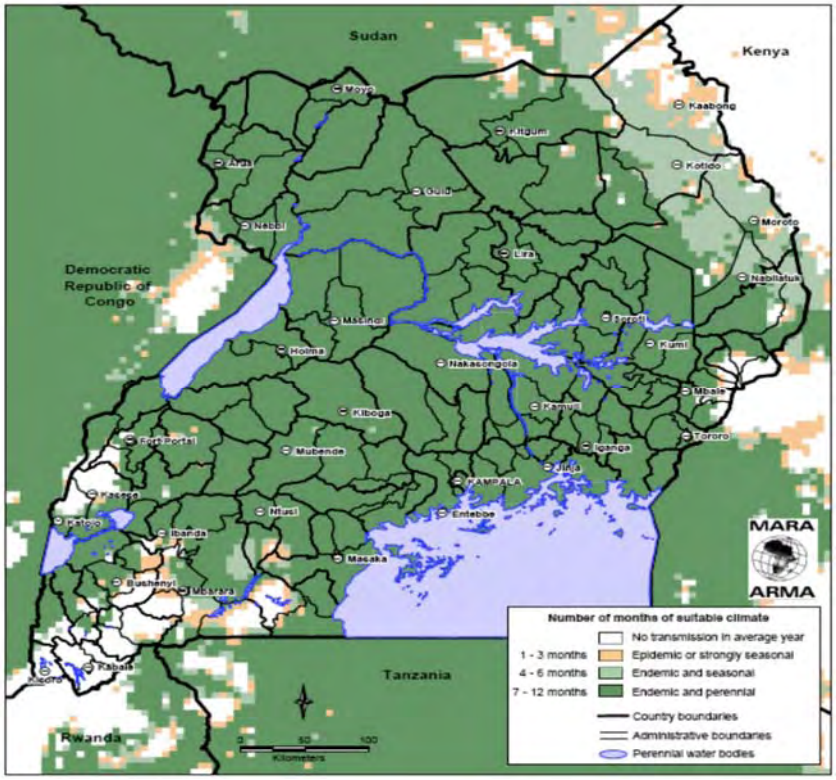
[11] "Uganda Malaria Pernerhsip Project. African Medical and Resaerch Foundation (AMREF. Accessed 20 April 2007 at http://www.amref.org/index.asp?PageID=63&PiaID=1&CountryID=3&ProjectID=57

above data sets are considered under-reported, as a significant number of cases are not reported at the hospitals.

Although recent data on malaria cases in Uganda is limited,[12] available data indicate a rise in the number of reported cases during the last decade (**Fig. 3**). The greatest rise has been among children under five years. It is reported[9] that the number of malaria cases nationwide doubled between 1995 (1,444,352 reported cases) and 1999 (2,923,620 reported cases) – a period of just four years. The extent to which the increase may have been confounded by increased reporting cannot be fully assessed.

Figure 1. Distribution of Malaria Transmission in Uganda

Source: MARA (www.mara.org.za)



[12] Okello, P.E., Van Bortel, W., Byaruhanga, A.M., Correwyn, A., Roelants, P., et. Al (2006). Variation in malaria transmission intensity in seven sites throughout Uganda. *Am J Trop Med Hyg*., 75(2):219-25

Figure 2. Malaria Endemicity in Uganda

Source: MARA (www.mara.org.za)

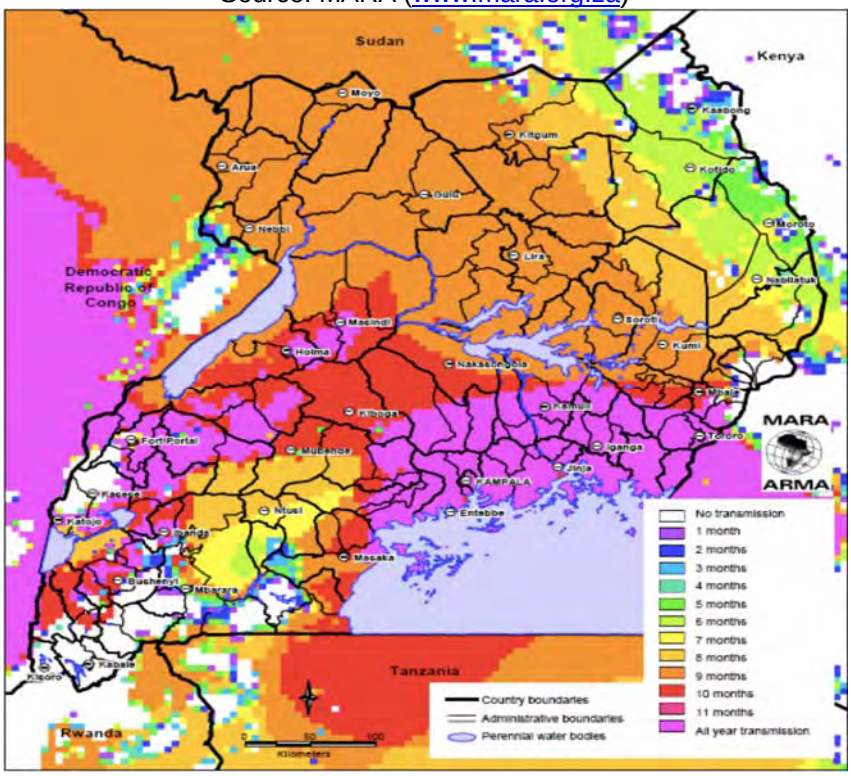
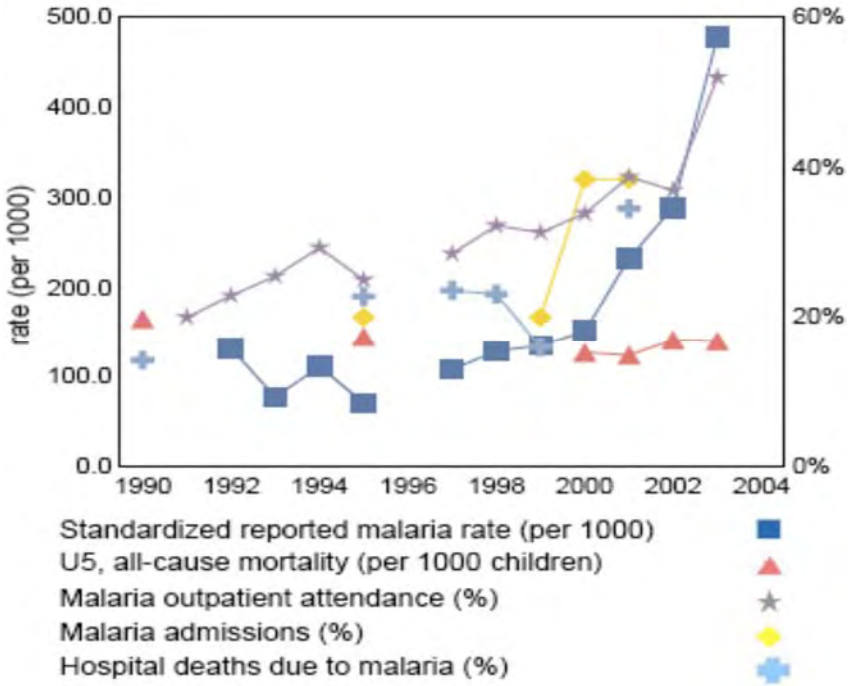


Figure 3. Annual Malaria Burden in Uganda 1990 - 2004

Source (WHO, 2000)



The highlands of eastern, southwest, and western Uganda (**Fig. 1-3**) are prone to pronounced peaks in malaria transmission between June and July and also to epidemic outbreaks (**Fig. 4**). The incidence of epidemics has increased in recent years. There were epidemic outbreaks in 1992, 1994, 1996, 1997/8 and in 2000/1, 2001/02, 2003, and 2005 (e.g., **Figs. 5** & **6**). The most affected areas of the country have been the southwestern highland districts of Kabale,[13, 14, 15] Rukungiri, Kisoro, Ntungamo, and Bushenyi, and occasionally, Kapchorwa, Kasese, Mbarara, Mbale, Sironko, Kabarole, and Kibaale Districts (Pers. Comm., Michael Okia, NMCP, Uganda). The reasons for the epidemics in the highland areas are varied and range from natural anomalies in temperature and rainfall, to man-made contributions such as resource development and changes in land use (e.g., open cast gold mining in Kanungu and Bushenyi Districts and swamp reclamation in Kabale District), which also impact temperature, mosquito population dynamics, and malaria transmission.[16] Conflict-induced mass population movement, such as the displacement of a large numbers of non-immune populations from the Mt. Rwenzori highland to the malarious lowland areas of Kasese District during the Allied Democratic Forces (ADF) wars have led to epidemic outbreaks. Epidemic outbreaks have also been observed among the IDP camps in northern Uganda, where large numbers of immune and non-immune people live in congested and waterlogged conditions.

Generally, two malaria transmission patterns are observed in Uganda. For most of the country malaria is endemic and transmission perennial, with very little seasonal variability. Low transmission with seasonal peaks around June-July occur in the highlands of the eastern, southwestern, and western parts of the country. The major malaria vectors are *Anopheles gambiae* senso lato and *An. funestus*.

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[13] Lindblade K.A., Walker, E.D., Onapa, A.W., Katungu, J., & Wilson, M.L. (1999). Highland malaria in Uganda: prospective analysis of an epidemic associated with El Niño. *Trans. R. Soc. Trop. Med. Hyg.*, 93, 480–487

[14] Mouchet, J., Manguin, S., Sircoulon, J., *et al.* (1998). Evolution of malaria in Africa for the past 40 years: Impact of climatic and human factors. *Journal of the American Mosquito Control Association* 14, 121–130

[15] Kilian, A.H.D., Langi, P., Talisuna, A., Kabagambe, G., (1999). Rainfall pattern, El Nino and malaria in Uganda. *Trans. R. Soc. Trop. Med. Hyg.*, 1999; *93* : 22–3.

[16] Lindblade, K.A., Walker, E.D., Onopa, A.W. Katungu, J. and Wilson, M.L. (2000). Land use change alters malaria transmission parameters by modifying temperature in a highland area of Uganda. *Trop. Med & Int. Hlth*. 5(4): 263-274.

Figure 4. Distribution of Epidemic Risks in Uganda Highlands

(Source: MARA)

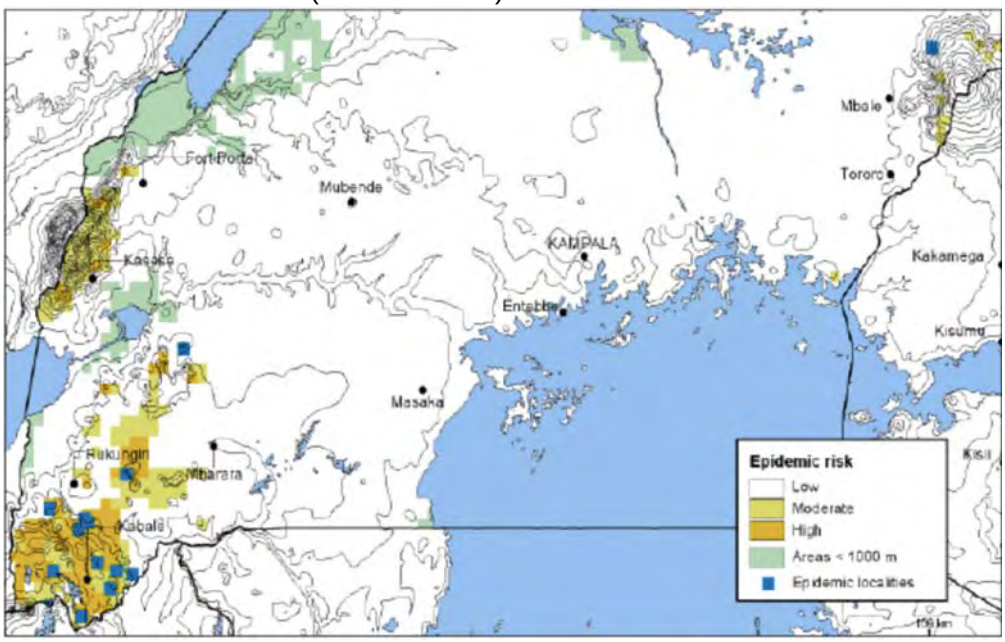


Figure 5. Reported Malaria Cases in Kabale District

(Source: MOH, Uganda)

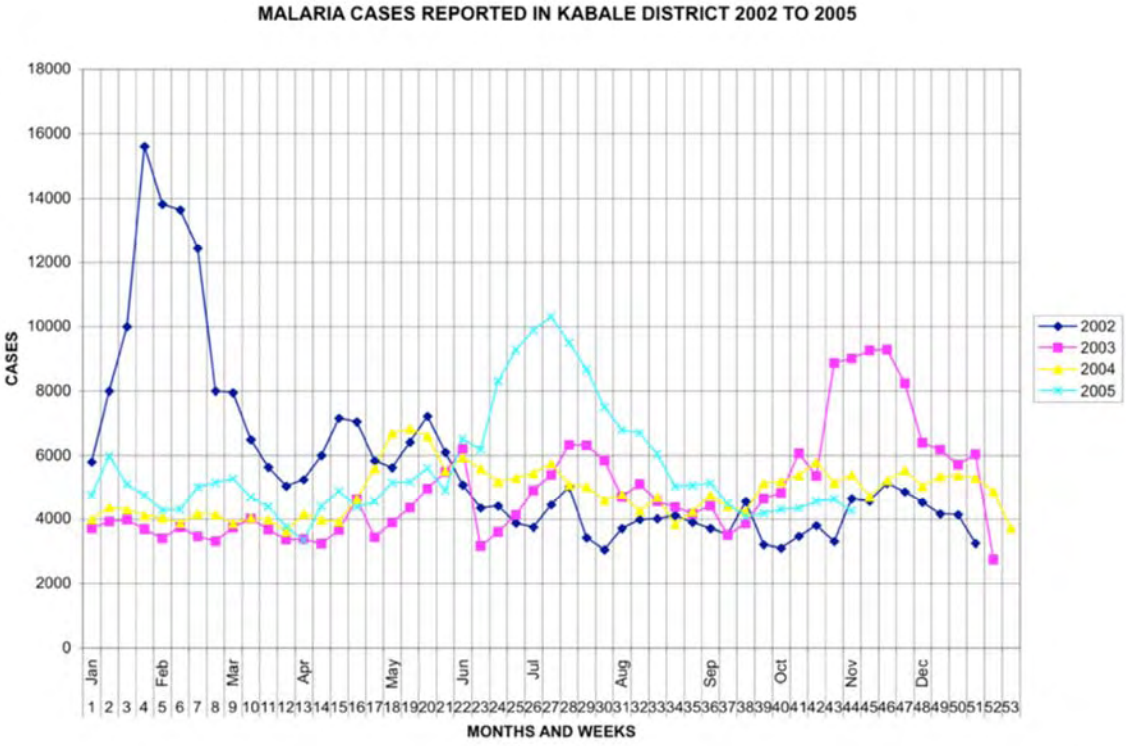
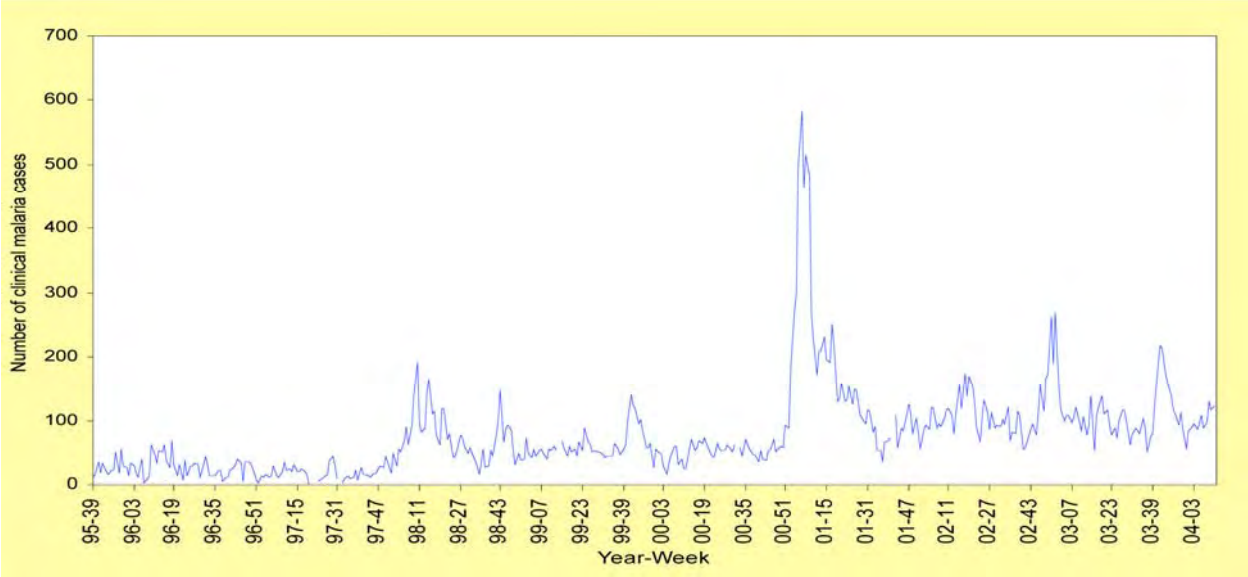


Figure 6. Weekly Malaria Cases in a HC in Kabale District (Sept 1995-Apr 2004)

(Source: MOH, Uganda)



Note peaks in transmission as well as the general rise in reported cases over the years

Malaria Control in Uganda

Malaria control in Uganda is integrated within the HSSP. The HSSP forms the basis for (i) developing the long- and medium-term expenditure frameworks and the Annual Budget Framework Paper for the health sector, (ii) guiding investment by the health development partners, including project support, and (iii) developing and implementing the respective operational plans of the departments, divisions, and units of the central MOH, the district and health sub-district plans, and community health action (**Fig. 7** shows the administrative districts of Uganda).

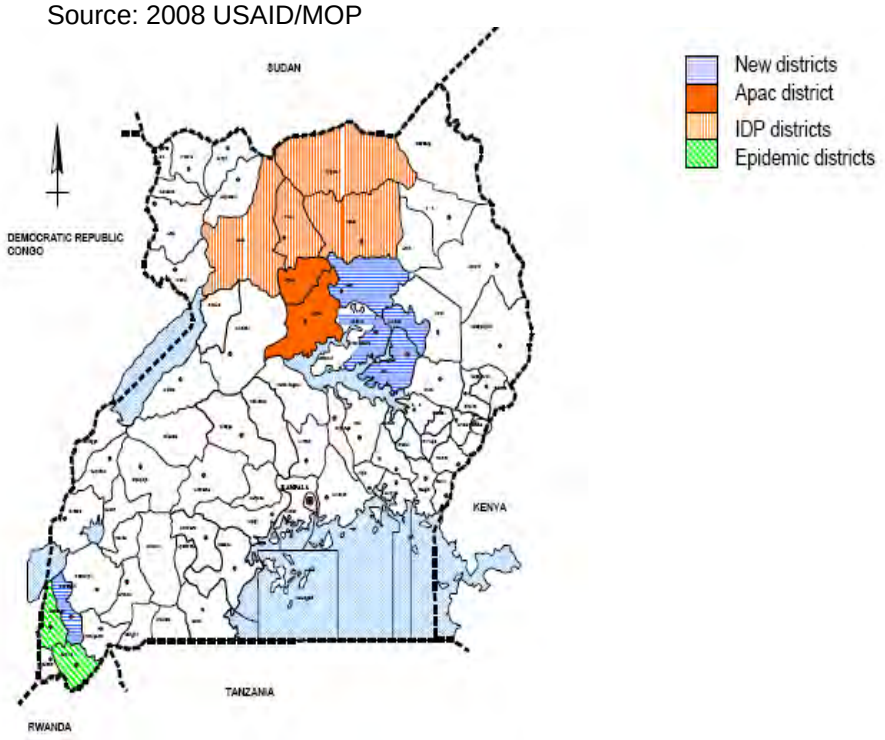
The HSSP is being implemented in five-year investment cycles. The first cycle (HSSP I) was from 2001 to 2005. The second investment cycle runs from 2006 to 2010. The national vector control strategy is developed in step with the HSSP cycle, and the current strategy also covers 2006 – 2010. The major interventions for malaria control are:

- Improved diagnosis and effective case management of malaria
- Selective vector control including IRS, ITNs, and environmental management
- IPT to pregnant women
- Malaria epidemic preparedness and response
- IEC/BCC for malaria prevention and control

- Integration of malaria control into the overall development of the health system (underscoring human resource development)
- Monitoring, evaluation, and operational research

Figure 7. Administrative Districts of Uganda Indicating IRS target districts in 2008

Source: 2008 USAID/MOP



In spite of the serious resource and technical constraints faced by the country, Uganda has made significant progress in malaria control, compared to the baseline HSSP I year of 2000/1. **Fig. 8** presents an overview of the progress as at the end of HSSP I (2004/5), while **Table 1** summarizes the specific objectives of these components as well as the status of implementation at the end of 2005.

Figure 8. Progress of Malaria Control Indicators under HSSP I

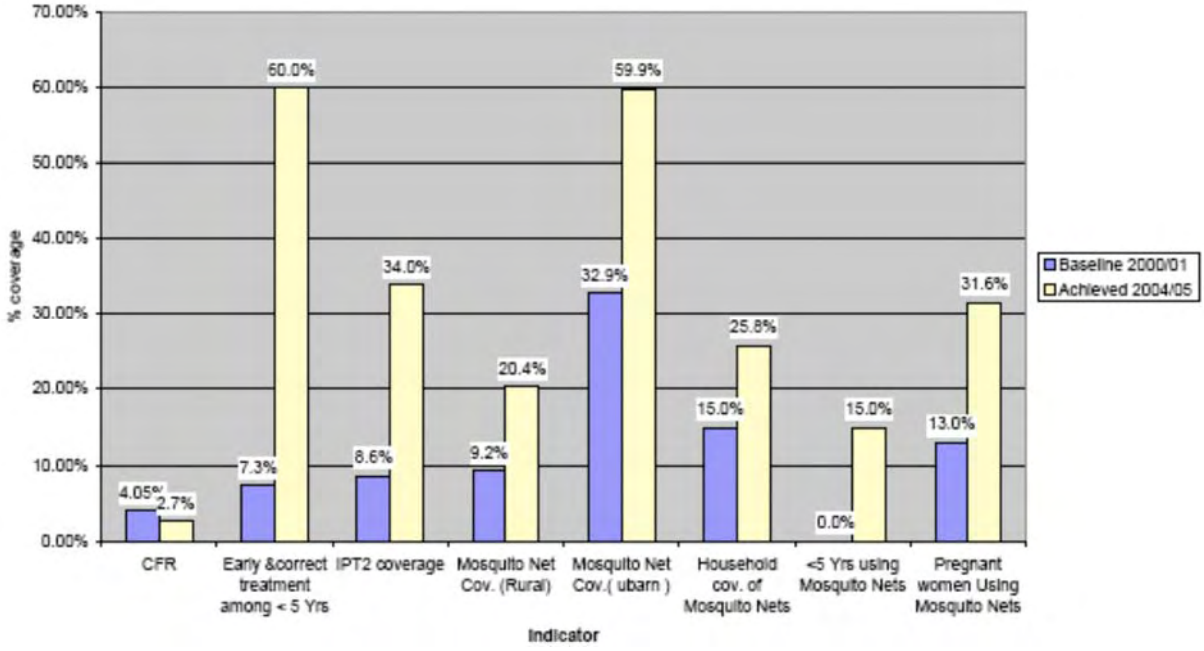


Table1. Specific Targets for Malaria Control Under the HSSP II (2006-2010)

Program Component	Baseline (2005)	2010 Target
Increase the proportion of pregnant women who have completed IPT2	34%	80%
Increase the proportion of households having at least one ITN	15%	70%
Increase the proportion of targeted structures for IRS in epidemic areas	0%	80%
Increase the proportion of children under five getting correct treatment within 24 hours of onset of symptoms from	55%	80%
Reduced the case fatality rate among malaria in-patients under five	4%	2%

Malaria control in Uganda faces significant financial and technical constraints. The lack of adequate technical expertise limits national capacity for planning, implementing, monitoring, and evaluating the programs. Critical vector control functions such as eco-epidemiological evaluations, including vector surveillance and monitoring, and resistance management are currently not systematically carried out, thus undermining program decision making. **Annex 4** provides a list of available vector control expertise in the country. As a result of financial constraints faced by the Ministry, however, not all of these individuals have been engaged by the MOH. The U.S. Centers for Disease Control and Prevention (CDC) and RTI hope to play increasing technical roles in supporting the development of such capacities under the PMI initiative.

The status of the major malaria control interventions is now reviewed in the following sections.

Effective Case Management of Malaria: Similar to other countries in Africa, Uganda changed the first line of treatment of malaria in 2002, from chloroquine (CQ) monotherapy to a combination of CQ and sulfadoxine/pyrimethamine (SP), as a result of parasite resistance (treatment failure rate of 33% was reported for CQ monotherapy at the time). With a fairly strong drug sentinel surveillance system,[17] a growing resistance to the CQ/SP therapy was quickly detected; by 2004 resistance rates of 16% were being reported for CQ, and 12% for SP. The decision was made to again change the first line of treatment to ACT involving artemether-lumfantrine (Coartem®) and artesenate-amodiaquine. ACT was implemented in 2006, with support from the Global Fund for HIV/AIDS, TB and Malaria (GFATM). In preparation, a *National Policy on Malaria Treatment* was established in 2005. A *Guide for Health Workers in Management of Uncomplicated Malaria* was also developed. Approximately 30,455 (87%) health workers were trained on the new malaria treatment policy, and about 15,431,040 doses of Coartem® were purchased. A total of about 37.5 million doses of ACT have been procured to date, with an additional 42 million doses planned for 2008-2009.

Priority areas with regards to malaria case management in Uganda are (i) improving access to effective antimalarial drugs, including assuring adequate funding to support the comparatively expensive ACT as first line treatment to malaria infection, and addressing logistic challenges to timely distribution, (ii) improving the quality of care in public and private health facilities, (iii)

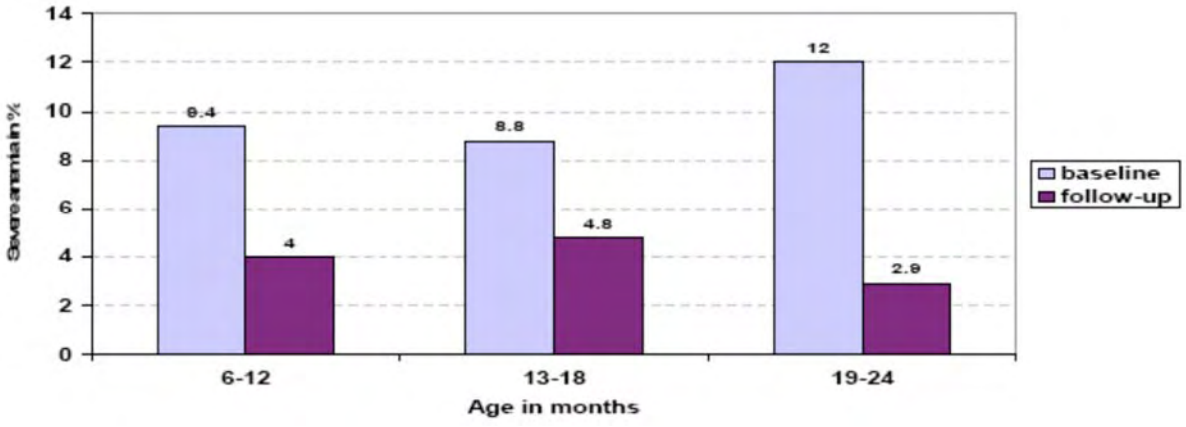
[17] The national surveillance system engaged in sensitivity testing for antimalarials, with complementary efforts by other initiatives such as the Uganda Malaria Surveillance Project (a CDC-funded collaboration between MOH, Makerere University, and the University of California), MRC, and the GTZ.

strengthening the capacity of health facilities, and (iv) integrating community-based malaria control activities.

Treatment guidelines have been developed for severe malaria. PMI has supported the quantification of needs for four severe and pre-referral malaria drugs.

Home-Based Management of Fevers (HBMF): Uganda also initiated a HBMF in 2002, as a strategy to increase access to quality antimalarials. The HBMF involved the distribution of pre-packaged unit doses of combination SP and CQ ("HOMAPAK") to be administered to febrile children.[18] The program was initially piloted, with the support of WHO, in 10 districts in 2002, during which a unit-dose of HOMAPAK was distributed freely for children under five years of age. The distribution was done through communities (voluntary drug distributor) and the public health sector.[19] By the close of 2003, it had been scaled up nationally. Significant progress was made in a very short time (**Fig. 9**): Prior to the HBMF program, the number of fever cases receiving prompt (within 24 hours) and correct treatment was 10%, but this rose to 25% just 18 moths into the program. In certain places, close to 60% of children under five in the HBMF implementation areas were receiving treatment within 24 hours.

Figure 9. Changes in Severe Anemia in Children Age 6-24 Months Following the Introduction of HBMF, IDP Camps, Kitgum



In spite of the success of the HBMF and drug policy changes, progress towards the achievement of set targets for malaria treatment has been significantly constrained by limited financial resources, as well as a propensity for self-medication. The 2004 HSSP I report estimated that the first-line treatment of

[18] Nsabagasani, X., Nsungwa-Sabiiti, J., Källander, K., Peterson, S. Pariyo, G. and Tomson, G. (2007). Home-based management of fever in rural Uganda: community perceptions and provider opinions. *Malaria Journal* 2007, 6:1

[19] MOH Uganda (2005) Annual Health Sector Performance Report Financial Year 2004/2005. Ministry of Health, Uganda. 147 pages

malaria with ACT would result in an additional $1.00 per capita annually. Securing funding to sustain the ACT treatment is a perennial challenge, and its deployment has been frustrated by stock-outs. Rapid diagnostic test kits (RDTs) are being used to confirm cases and improve efficiency in the use of antimalarials by reducing the proportion of presumptive or unnecessary treatments.

IPT of pregnant women: A policy of two doses of SP after the first trimester was adopted in 1998. The implementation of IPT was jointly handled by the NMCP and the Reproductive Health Unit of MOH, and was linked to antenatal clinic visitations. Current national coverage for IPT is 35%, although coverage in the districts ranges between 10% and 50%. Constraints to the program include (i) stock outs, (ii) inadequate record keeping, (iii) lack of patient compliance for visitations, and (iv) general fatigue and lack of enthusiasm among health workers.

Selective Vector Control Interventions under the HSSP II and the NMCP Strategic Plan involve ITNs, IRS, and to a limited extent, larviciding and source reduction (environmental management), where it is cost-effective.

ITNs: Together with IRS, ITNs form the major malaria vector control interventions in Uganda. The deployment of ITNs in Uganda began in the early 1990s as pilot projects by NGOs. Since then, their use increased as a result of the creation of a favorable policy and institutional environment: ITNs became a governmental policy for malaria vector control for the first time in 1998. By 1999, taxes and tariffs on ITNs and netting materials had been removed by the government. A WHO-recommended quality standard for ITNs was adopted by 2002, and a national ITN implementation strategy was developed in 2003, as part of HSSP I. The strategy had the following components:

- Promotion of a commercial market for ITNs, netting materials, and related insecticides
- Targeted subsidies for vulnerable groups (children and pregnant women), and utilizing innovative approaches such as linking distribution with immunization campaigns and antenatal care clinics
- Free net distribution in emergency situations (e.g., refugees, AIDS patients)
- Awareness raising for demand creation and utilization.

A vibrant commercial market for ITNs and insecticides has been created, which is estimated to be growing at about 20% volume per annum.[20, 21] Annual sales of

[20] USAID has played a leading role in fostering the growth of the commercial market, with its support to the activities of NetMark. The FY07 budget allocation to ITNs is over 6 million to support procurement and distribution of LLINs, re-treatment of traditional nets, standardization, net use evaluations. Other entities involved in ITNs are MSI, PSI, etc., as well as about four local distributors.

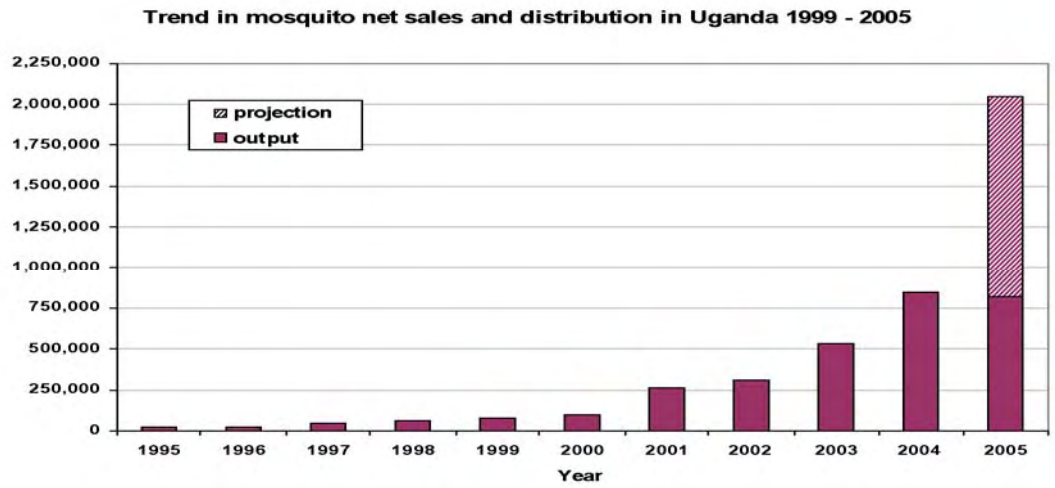
[21] USAID/NetMark (2006). USAID/NetMark FY2006 Work Plan- Uganda. United States Agency for International Development, Washington DC, USA. 11 pages.

ITNs rose from 40,000 nets in 1999 to over 467,000 by 2003 (**Fig. 10**). By the end of HSSP I, the proportion of households with at least one ITN had risen from 15% (2003 survey) to 25.8%, on the average. Achievements by the end of 2006 include the following (Pers. Comm., J. Rwakimari, Program Manager, NMCP/MOH, Uganda):

- The percentage of households owning mosquito nets increased: 23.5% of rural households and 59.9% of urban households had at least one net.
- The proportion of pregnant women sleeping under a mosquito net rose from 13.1% in 2001 to 31.6%
- The proportion of children under five years sleeping under an ITN increased from 0.2% in 2000 to 31.6%.
- A system for biannual re-treatment of mosquito nets had been established in 20 districts.

The current achievements, outlined above still fall far short of the desirable Abuja Targets, and there is an urgent need to increase ITN coverage. The major constraints to the deployment and utilization of ITNs include the high cost of ITNs, which makes governmental subsidy a prerequisite to access by most rural dwellers, and inadequate national capacity to deliver ITNs to the remote rural areas. It was also noted that the white ITNs were being used as substitute materials for wedding gowns in Uganda. There is still a need to increase IEC and BCC efforts to promote compliance.

Figure 10. Trends in ITN Sales and Distribution in Uganda 1999 - 2005
(Source NMCP-MOH, Uganda)



Environmental Management and Larviciding: HSSP II identifies the improvement of environmental management (which it lists as sanitation, including waste and drainage management, water quality, etc.) as important contributors to lowering

morbidity and mortality from diseases. The current strategic plan of the NMCP (2006 – 1010) indicates the use of environmental management methods and larviciding as vector source reduction interventions. While limited studies on larviciding have been conducted in Uganda, the full potential of this intervention is yet to be realized. Section C of *Pesticides Procedures* reviews the potential complementary role of environmental management and larviciding in malaria vector control in Uganda.

Malaria Epidemics Preparedness and Response: As noted in earlier sections, Uganda has highland areas that are increasingly prone to epidemic outbreaks. Hence the development of capacities to adequately prepare for and respond to epidemic outbreaks is important to the national strategy. Unfortunately, local health services have usually been unable to predict and detect the onset of epidemics. They also do not have the capacity to effectively respond and provide timely and suitable interventions to control the epidemics. The major limitations to effective prevention and control of epidemics in African countries generally relate to inadequate (i) surveillance systems, (ii) targeting of IRS intervention, (iii) reporting relating to outbreaks, and (iv) resources.[22] Kiszewski and Taklehaimanot[23] indicate vestigial contingency planning and a general orientation of resources and clinical services towards inter-epidemic patient loads as primary reasons for the inability of the health systems of many African countries to meet the challenges of epidemics. Uganda has initiated action to strengthen national capacity to predict and manage malaria epidemics. It includes:

- Establishment of a Highland Malaria Project Surveillance System by the NMCP and clarification of modalities for collating and reporting of relevant information, resulting in about 85% of health facilities in all districts reporting weekly on diseases of epidemic potential to the offices of the District Director of Health Services, and the publication of the weekly estimates in the news media to inform local population.
- Enhanced case management at health facilities through the provision of additional drugs.
- As necessary, temporarily relocating medical personnel to areas most affected by epidemics and mass fever treatment at village level, whenever necessary, using the Community Drug Distributors.
- Use of IRS (although current capacity does not allow a desirable level of responsiveness).

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[22] "Environmental Assessment for Indoor Residual Spraying for Malaria Vector Control In Ethiopia" Report prepared by Williams, J., & Biscoe, M. for RTI/USAID (Nov. 2006 draft)

[23] Kiszewski, A.E. and Teklehaimanot, A. (2004). A review of the Clinical and Epidemiologic burdens of epidemic malaria. *Am. J. Trop. Med. Hyg.*, 71(2):128–135

Indoor Residual Spraying

This EA supplements the EIS on the introduction of IRS in Uganda. The EIS provides a lengthy review of the justification for IRS as a vector control intervention in Uganda, and it will not be repeated. The present assessment evaluates the proposed piloting of DDT-based IRS in Apac and Oyam Districts, as a complement to ongoing lambda-cyhalothrin-based IRS in diverse parts of Uganda.

DDT-based IRS was first used in Uganda in 1953 to 1963, under the Pilot Malaria Eradication Project, with support from the WHO. The pilot project almost eliminated malaria from the highland districts of Kabale, Kanungu, Kisoro, and Rukungiri. It almost eliminated the *Anopheles funestus* populations in those areas and dramatically reduced the *An. gambiae s.l.* densities [24] [25].

Following the conclusion of the pilot project, IRS implementation by the formal health sector was sporadic and reactionary, at best: IRS operations were mainly carried out as hurried interventions against epidemic outbreaks in the highland areas (Kisoro in 1998, and Kabale, Rukungiri, and Bushenyi in 2005). In 2006, PMI supported a systematic implementation of IRS (with lambda-cyhalothrin 10 WP) in Kabale District. The IRS program is being implemented with technical support from a USAID partner, RTI. Coverage in the first year of operation was 96.2% of the households (i.e., 103,329 houses), which provided protection for 95.9% of the total population (i.e., 488,502 persons).[26]

Based on positive first year results of what was essentially a startup program, IRS operations were expanded to include two rounds of operations in the district of Kanungu and one round of spraying of the IDP camps in Amuru, Gulu, Kitgum, and Pader Districts. The intention, with regards to the IDP camps, is to achieve quick suppression of the high malaria transmission in those areas, and then to complement with ITNs to maintain the reduced transmission rate.

As part of the preparations, a joint WHO/MOH mission carried out an IRS feasibility study of the IDP camps in 2006. The objective was to determine suitability in terms of the extent of available structures that could be sprayed, the population sizes of the camp, the availability of water for use in potential IRS operations, security, as well as previous IRS operations in the camps. A summary

[24] Zulueta, J. de, Kafuko, G.W., McCrae, A.W.R., Cullen, J.R., Pedersen, C.K., Wasswa, D.F.B., (1964). A malaria eradication experiment in the highlands of Kigezi (Uganda). *East African Med. J. 41:102-120*

[25] Lindblade, K.A., Walker, E.D., Onapa, A.W., Katungu, J., Wilson, M.L. (2000). Land use changes alters malaria transmission parameters by Modifying temperatures in a highland of Uganda. Trop. Med. Int. Hlth. 5(4): 263 – 274

[26] USAID (2006). *Uganda IRS Project. Kabale District Project Report*. Prepared by Research Traingle International, North Carolina, USA. 33 Pages.

of the findings is presented in **Table 2**. Given a total surface area of 19, 219,845 m^2, a recommended dosage of $2g/m^2$, a rough estimate of 9,609,922.5 g (or 9,610 kg) of DDT was estimated for the single round spray that is planned in the northern districts to protect 2,037,931 people.

Table 2. Feasibility Study for IRS in IDP Camps in Northern Uganda

Name of District	Camps Total (surveyed)	Population	Structures	Available Water Points	Corresponding Surface Area for Spraying (m^2)	Camps Previously Sprayed
Apac	19 (19)	171,458	86,374	85	1,718,842	7
Gulu	54 (36)	579,745	207,501	334	5,146,024	3
Kitugum	24 (19)	345,502	129,816	309	2,323,706	3
Lira	43 (43)	600,537	248,520	332	5,442,588	5
Pader	57 (23)	340,689	164,469	250	4,588,685	5
		2,037,931			**19,219,845**	

(source: MOH, Uganda)

The above rollout of IRS is part of a broader objective of the 2006 – 2010 National Malaria Control Strategy, which aims at covering 15 selected district (estimated 1.0 -1.6 million households; about 21% of the national population) with IRS by 2010. The specific objectives of the strategy are:

- To develop adequate capacity in 15 epidemic prone and endemic districts to implement effective IRS for malaria vector control
- To achieve at least 80% geographical coverage of targeted areas in the 15 selected districts
- To achieve at least 80% operational coverage of targeted households in selected epidemic prone districts
- Protecting 60% of targeted population residing in targeted areas by IRS.

The progress made in developing requisite capacities for IRS in the areas it has been implemented (up until 30 June 2007) is noteworthy (**Tables 3** and **4**). As with all startup IRS programs, the first few rounds of operation test the robustness of measures put in place to achieve program effectiveness, internal efficiency, and the desired outputs and outcomes. There was a reported incidence of poisoning, which was promptly given appropriate medical attention. Post-operation evaluation by the International Union for the Conservation of Nature (IUCN) indicated general compliance with environmental and human health safety. As part of the preparation for this supplementary EA, the author visited Kabale during the first round of spray operations in February 2007 and witnessed what the IUCN post-operation evaluation mentions as a high level of compliance by the households. On the other hand, the program underestimated the misconceptions and anxieties of the few who did not wish to have IRS operations in the area, and

therefore found itself fighting a rear-guard media action to address erroneous stories and statements on a local FM station.

The FY2008 PMI/MOP for Uganda lists IRS target districts as including Kitgum, Pader, Gulu, Amoro, Amolatar, Apac, Oyam, Kabermaido, Amuria, and Soroti as well as Lira and Dokolo and their adjacent districts; endemic sub-counties of Kabala and Kanungu (**Fig. 7**). Recognizing the policy of the Government of Uganda to re-introduce DDT in 2008, this SEA proposes a piloting of DDT-based IRS in Apac and Oyam Districts to evaluate the effectiveness of safeguards and gain insights that will be useful in considering the general re-introduction of DDT for use in IRS. The proposed piloting in Apac and Oyam Districts will be implemented and supervised by RTI in close collaboration with MOH/NMCP and primary national agencies.

Table 3. IRS Coverage in Uganda

Indicator		IRS coverage				Total
		Kitgum - IDP Camps (2007)	Kabale		Kanungu (2007)	
			(2006) 2 Rounds	(2007)		
Household coverage						
Number sprayed		84,007	103,329	76,084	45321	308,741
Number targeted		88,849	107,400	53,700	44,799	294,748
% Coverage		**94.6%**	**96.2%**	**142%***	**01%***	
Number of residents in sprayed households						
Children under 5 years		86,811	82275	60,698	36222	266,006
Pregnant women		14,709	Not captured	6,022	5580	
Gender	Male	175,153	234,592	172,979	90,266	672,990
	Female	196,693	253,910	191,805	101133	743,541
Total persons protected		**371,846**	**488,502**	**364,784**	**191,399**	**1,416,531**
Population coverage						
Number protected		371,846	488,502	364,784	191,399	1,416,531
Number targeted		342839	508,857	244,251	169,654	1,265,601
% Coverage		**108%***	**96%**	**149%***	**112%***	**112%**
Number of personnel trained						
Spray personnel		1088	449	449	441	2427
Clinicians on poison management		30	37	37	35	139
Environmentalists		0	0	0	1	1
Total persons trained		**1,118**	**486**	**486**	**477**	**2,567**

(Source: NMCP/MOH, Uganda)

* Exceeded target set at the start of the IRS operation.

(2007) = Period between 1 April and 30 June 2007, involving one round of spraying

Table 4. IRS Program in Uganda: Results of IEC Activities

Activities	Participants/Copies/Prints
1. District leaders sensitization	133

2. Sub-county leaders sensitization	1140
3. Brochures distributed	1400
4. IRS pamphlets distributed	1140
5. Film shows held (Kitgum & Pader)	26
6.Radio Talk shows held (Kitgum & Pader)	6
7.IRS T-shirts distributed (Kitgum & Pader)	327
8. IRS banners distributed (Kitgum & Pader)	34
9. Radio spot messages	42

(Source: NMCP/MOH, Uganda)

Relevance of Experiences to a DDT-Based IRS Intervention: The reason for highlighting these incidents is because they are typical indicators of the kinds of issues that will need to be dealt with, particularly in relation to the reintroduction of DDT-based IRS, as there is still significant anxiety among sections of the general public.

Uganda currently has a limited capacity for a national scale-up of IRS. The credible human and other technical capacities that have been developed in Kanungu, Kabale, Kitgum Pader and Amuru districts will have to be repeated in each of the other districts targeted for IRS. In addition, basic infrastructure (e.g., storage and ablution facilities, evaporation tanks) as well as technical capacities for core vector control functions (eco-epidemiological evaluations, including vector surveillance and monitoring, pesticide bioassays, planning, and M&E) will need to be developed. This will take some time to fully develop. However, ongoing IRS activities and partnering with other national institutions (e.g., Uganda Virus Research Institute, Makerere University, etc.), provide innovative and effective opportunities to quickly mobilize available national assets and expertise.

The FY08 PMI/MOP proposes $8,520,000 in support to provide protection for 895,000 households. Specifically:

- Second round of spraying in four IDP camps in northern Uganda: Pader, Kitgum, Gulu, and Amuru ($2,000,000)
- One round of IRS in six highly endemic districts: Lira, Dokolo Amolatar, Kabermaido, Amuria, and Soroti ($4,400,000)
- One round of targeted IRS in the highland Rukungiri District ($750,000)
- Entomological M&E ($70,000)
- IEC/BCC/community mobilization ($500,000)

- Third round of targeted IRS in Kabale and Kanungu ($800,000)

Annex 1 reviews the potential risks associated with the proposed piloting of DDT-based IRS in Apac and Oyam Districts, and proposes mitigation measures for the various stages of the life cycle of the insecticide. Additionally, the NEMA-set conditions under which DDT may be re-introduced in Uganda are reviewed in **Annex 3**. The evaluation of proposed piloting of DDT-based IRS is reviewed in-depth under the sections on *Pesticides Procedures.*

Administration of Malaria Control Activities

The districts have the responsibility for planning, implementing, and reporting on malaria control activities. The administration of malaria control is extensively reviewed in **Annex 5** and will not be repeated under this section. With the onset of decentralization in the early 1990s, administrative authority was transferred to the local government councils. The district and sub-county levels were gazetted as corporate government structures with the district council (DC) constituted by directly elected leaders, as the decision-making body at the local level.[27]

Malaria vector control operations are integrated into the structure of the health system (**Fig. 11** and **Table 5**). **Fig. 12** provides a schematic presentation of the interrelation between the health system structure and the vector control operations.

Table 5. Levels of Administration - Uganda Health System and Population Served

	• Level of Administration/Facility	• Population Serviced
1.	Ministry of Health and other national- level institutions	27 million approx. national population
2.	National referral hospitals	27,000,000
3.	Regional referral hospitals	2,000,000
4.	District health services	District level, 500,000
5.	Health sub-district	
	• Referral Facility	General Hospital (district level - 500,000 pop) or Health Centre IV (county level - 100,000 pop.)
	• Health Centre III	(Sub-country level - 20,000 pop.)
	• Health Centre II	(Parish Level – 5,000 pop.)
	• Health Centre I	(Village Health Team - 1,000 pop.)

[27] "Human resources for health in decentralized Uganda: developments and implications for health systems research." Ssengooba, F., Rutebemberwa, E., and Hongoro, C. Paper presented at Forum 9, India, 12-16 September 2005.

Figure 11. Structure of the Health System, Uganda

(Source: MOH, Uganda)

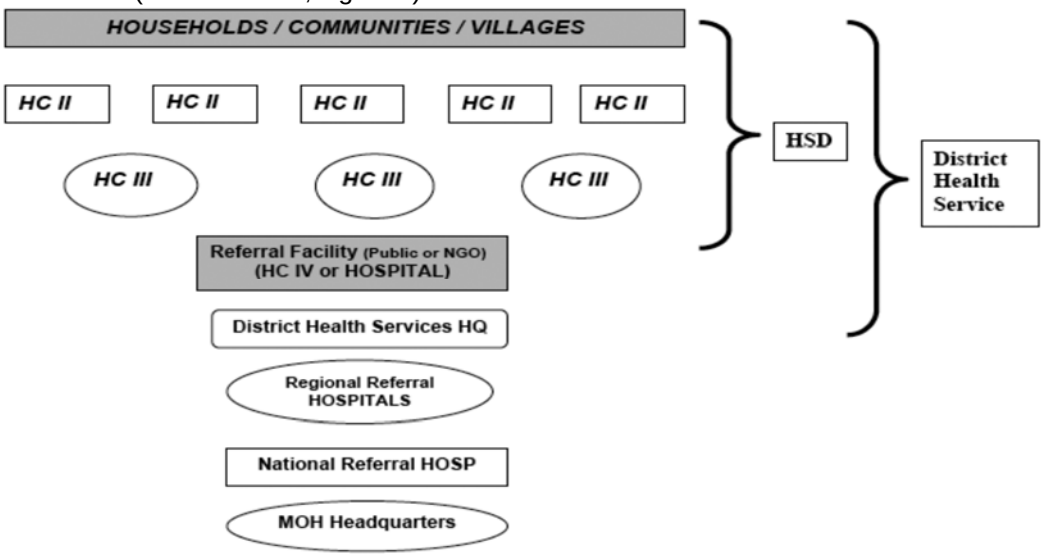
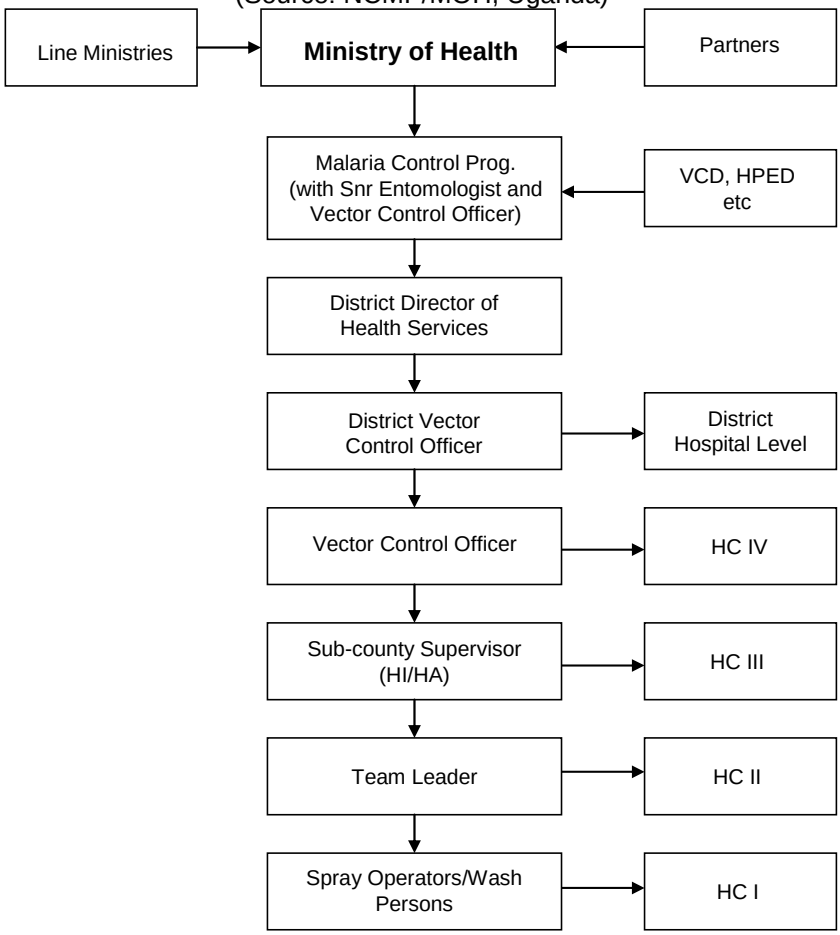


Figure 12. Schema of the Structure of IRS Implementation in Uganda

(Source: NCMP/MOH, Uganda)



Coordination and Partnership –The HSSP II lists strengthened coordination between the stakeholders as a priority objective. Partnerships are described under the broad framework of the Health Sector Wide Approach, with the MOH in the lead and with responsibility for delivering the outputs of the HSSP. The role and expected contributions of other partners are defined and formalized through memoranda of understanding or other formal arrangements (e.g., regulations, policy documents, and contracts).[2] The various partnership outfits for effecting coordination are:

- The Health Policy Advisory Committee, which provides overall policy guidance to the sector.
- The annual Government-Development Partner Joint Review Missions for joint monitoring of the sector performance and setting priorities, key process outputs, and determining broad allocations for the budget cycle.
- The Health Sector Working Group, under the Ministry of Finance, Planning and Economic Development, to evaluate the budget cycle and manage the approval and alignment of project inputs to the sector.
- The National Health Assembly, which provides an annual forum for the broader health partnership (central and local governments, civil society, and development partners) to review sector policy, plans, and performance. MOH serves as the secretariat.
- The health development partners (HDPs), which provide a forum for information sharing, consensus building, and collating and coordinating responses to government.

Activity of donors toward health sector and malaria control - A considerable number of partners provide significant technical and financial support to the health sector and to malaria control specifically. The GFATM has awarded three grants to Uganda for malaria control - $23 million from Round 2, $66 million Round 4, and $51,422,198 from Round 7. Other major partners such as USAID, The U.K. Department for International Development (DFID), and the World Bank, as well as international organizations (WHO, UNICEF) and international NGOs (MSF, AMREF, RTI, etc.) provide much needed technical and financial resources. **Fig. 13** presents a breakdown of financial contributions of donors for 2004/5. For FY06 and FY07, PMI set aside $9.5 million and $22.5 million respectively, to support malaria prevention and treatment. The FY08 PMI MOP indicates a $22 million budget for Uganda, of which 39% will be used for IRS, 26% for procurement and distribution of ITNs/LLINs, 4% for IPT for pregnant women, 14% on diagnosis and malaria treatment, 8% for M&E; 40% of the total budget will be applied towards the procurement of commodities.

The implementation of the HSSP has been/is constrained by chronic under-funding of the health sector. The government budget allocation was US$5 per

capita (10.5% of overall annual budget) in 2001, with additional US$3 from donor projects. This is much lower than the government commitment to the Abuja Declaration to provide 15% of the government budget. It is also lower than the HSSP costing target of US$28 per capita. By FY 2004/05 both government and donor projects amounted to a per capita expenditure of US$10.5 in FY 2004/05, which was still lower than the US$28 per capita needed to deliver the minimum health care package under HSSP.

Figure 13. Donor Project Expenditure Against Budget FY 2004/05

(source MOH, Uganda)

Donor /Initiative	Budget (MoFPED) shs '000	Expenditure Ug. Shs '000	Expenditure as % of budget
UNICEF**	11,183,201	1,921,515	17%
USAID	39,940	104,996,060	262884%
DfID	998,500	2,223,853	223%
EU *	1,498,801	3,033,672	202%
DCI		735,764	
WHO	19,970,000	5,069,149	25%
Italian coop	9,785,300	14,051,036	144%
Germany	2,569,100		0%
JICA	599,100	0	
China	79,880		
World Bank		22,286,109	
UNFPA	1,797,300	2,691,345	150%
DANIDA	19,970,000	16,725,562	84%
SWEDEN	399,400	9,194,387	2302%
Spain	12,962,600		
Netherlands	3,275,080		
AfDB		21,619,935	
GAVI		3,782,000	
Global fund	68,635,000	46,516,271	68%
Overall	**85,128,202**	**254,846,658**	**299%**

Preferred Alternatives

USAID intends to support Uganda to improve on its IRS program. The 2008 Uganda/MOP indicates support to the following areas:

- Procurement of insecticides, spray equipment and parts, and PPE.
- IRS implementation activities at selected districts (targeted spraying in epidemic-prone sub-counties of Kabale, Kanungu and Rukungiri and

blanket spraying in the endemic districts of Kitgum, Pader, Gulu, Amuru, Apac, Oyam, Lira, Dokolo, Amolotar, Kabermaido, Soroti and Amuria) as well as targeted training at the district level relevant to the proper implementation of IRS.

- Support MOH in IEC/BCC/community mobilization related to IRS implementation and ensuring household and community safety.
- Support entomological M&E, including baseline and post-intervention surveillance, susceptibility, bio-assays, and vector bionomic studies related to IRS.

Based on Government of Uganda commitment to reintroduce DDT-based IRS in Uganda in 2008, DDT/IRS is proposed as a pilot program in Apac and Oyam Districts, to be implemented and supervised by RTI.

The comparative assessment of the impacts of the proposed pilot spraying of Apac and Oyam with DDT as a complementary part of Uganda's IRS program is compared to alternatives not considered, as well as the reason for their exclusion, in **Table 6**.

Malaria is the leading cause of morbidity and mortality in Uganda. The preferred alternative (ongoing ICON-based IRS and a piloting of a DDT-based IRS in Apac District) will protect over 5 million persons in Uganda from immeasurable suffering from malaria and its sequele (e.g., miscarriage, low birth-weight, stunted growth) and general negative impacts of poverty on social development. In contrast, the potential human and environmental impacts from the DDT can be mitigated and even prevented by the implementation of effective safeguards and best practices, which have been outlined in this EA.

Table 6. Alternatives Considered and Not Considered

Alternatives Considered	
IRS using DDT to complement current program using lambda-cyhalothrin (ICON)	USAID Support for IRS to the NMCP includes:
	Procurement of ICON 10WP and DDT 75WP, spray equipment and parts, and personal protection equipments
	IRS implementation in selected districts and IDP camps, including a piloting of DDT-based IRS in Apac and Oyam Districts by RTI
	Conduct training relevant to the proper implementation of IRS
	Support vector surveillance and monitoring, and the development of an insectary to enable entomological evaluation, including pesticide resistance monitoring
	Environmental monitoring
ITN/LLIN deployment	USAID, WB, GFATM, and UNICEF provide financial and program support for ITN

	deployment and private sector development
Alternatives Not Considered	
IRS program using carbamates or other organophosphates	Currently, the Government of Uganda does not intend to introduce other pesticides apart from ICON and DDT for IRS: There are no data on vector susceptibility/ resistance on carbamates or other organophosphates. Carbamates are generally considered expensive. The selection of insecticides for IRS by NMCP must be informed, among other things, by knowledge of vector susceptibility and the opportunities the insecticides present for enhancing resistance management. The selection of insecticides for IRS will be revisited at a future review of this SEA in collaboration with the NMCP.
Larviciding	The draft IRS policy document of MOH (2006) indicates IRS within the context of IVM including, ITNs, larviciding, and environmental management. There is currently no malaria vector control based on larvicides. NMCP does not consider larviciding cost-effective compared to IRS and ITNs, and specific settings will need to be identified for its application.
Environmental Management	Use of environmental management is very limited.
No Action	The high risk for and burden of malaria in Uganda makes a no-action consideration unacceptable. Use of DDT for IRS is approved by WHO and allowed under the Stockholm Convention. Uganda is reintroducing DDT after decades of nonuse. Given the continued anxiety in sections of the public, its introduction should first be piloted in a few districts to assess the effectiveness of safeguards in place, implementation experience, and to assuage lingering anxiety among sections of the public.

Affected Environment

The FY08 PMI/MOP indicates ICON-based IRS will be implemented in the districts of Kitgum, Pader, Gulu, Amuru, Amolatar, Apac, Oyam, Kabermaido, Amuria, Soroti, the endemic sub-countries of Kabala and Kanungu, as well as Lira and Dokolo, and adjacent districts (**Fig. 7**). Recognizing the Government of Uganda's policy of introducing DDT-based IRS in 2008, a piloting of DDT-based IRS is proposed for Apac and Oyam Districts.

The environmental conditions under which DDT may be used are described in section H in the *Pesticide Procedures* in accordance with guidance of the PEA IVM.

Unavoidable Detrimental Effects

Environmental and human exposures from incidents such as accidental spills from vehicle accidents, as well as unavoidable residential or occupational exposure, are some of the potential consequences in relation to the preferred action of the use of pesticides (DDT).

Inferences, largely from animal studies, suggest a number of potential adverse human health effects associated with exposure to DDT. While some recent findings suggest plausible correlations between exposure and adverse impacts in humans, continued conflicting scientific findings add to the uncertainty on the potential human health effects of DDT.[28] Inferences to potential adverse effects are varied, and include neuro-endocrine disruption,[29] reproductive impairment (fertility impairment, sperm motility and count reduction),[30] and developmental impacts (fetal mortality, premature birth and low birth weight, hypospadias and polythelia among male offspring).[31,32]

Possible diversion of DDT for unauthorized use (e.g., in agriculture) remains a major source of concern in relation to potential release of the pesticide into the general environment and the contamination of agricultural products. The very strict conditions of piloting as proposed in this SEA, including a secure chain of custody and a robust auditing of the pesticide, will significantly moderate such risk. . The safeguards for preventing such diversion are discussed under Section G, while the current status of pesticide regulation in Uganda is briefly reviewed under Section J.

Irreversible or Irretrievable Commitments of Resources

Most financial investment in the proposed malaria control program is for labor, transport and consumables and is therefore not recoverable. The compression sprayers are the only durable equipment that can be reused should the program be terminated.

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[28] Turusov, V., Rakitsy, V., and Tomatis, L. (2002). Dichlorodiphenyltrichloroethane (DDT): ubiquity, persistence, and risks. Environ Health Perspect. 110(2):125-8

[29] Dorner G., and Plagemann, A. (2000). DDT in human milk and mental capacities in children at school age: an additional view on PISA 2000. *Neuro Endocrinol Lett.2*3(5-6):427-31

[30] Damstra, T.; Barlow, S.; Bergman, A.; Kavlock, R.; and Van Der Kraak, G.,, ed. 2004. *Global Assessment of the State of the Science of Endocrine Disruptors.* International Program on Chemical Safety. Geneva, Switzerland: World Health Organization. http://www.who.int/ipcs/publications/new_issues/endocrine_disruptors/en/

[31] Longnecker, M.P., Klebanoff, M.A., Brock, J.W., Zhou, H., Gray, K.A., Needham, L.L., and Wilcox, A.J. (Maternal serum level of 1,1-Dichloro-2,2-bis (p-chlorophenyl) ethylene and risk of cryptorchidism, hypospadias, and polythelia among male offspring. *American Journal of Epidemiology*, 155(4): 313-322.

[32] Longnecker, M. P., Klebanoff, M. A., Zhou, H., and Brock, J. W. (2001). Association between maternal serum concentration of the DDT metabolite DDE and pre-term and small-for-gestational-age babies at birth. *The Lancet*, 358: 110-114

Direct and Indirect Effects and Their Significance

The proposed program of ongoing ICON-based IRS, alongside piloting of a DDT-based IRS in Apac and Oyam Districts, is expected to protect up to 5 million people from malaria and prevent the high annual morbidity and mortality associated with it. The impact of malaria on the socio-economic development of the area will be significantly ameliorated. The negative effects of the selected intervention include possible human and environmental exposure and the irretrievable loss of invested funds. The negative and positive impacts of the selected intervention are reviewed under appropriate sections in this EA.

Complementary and Conflicting Policies, Plans, or Control for the Areas Under Consideration

The selected intervention of continued implementation of ICON-based IRS with a piloting of DDT-based IRS in Apac and Oyam Districts is not inconsistent with USAID policies, the policies and regulations of the host country (Uganda), or international treaties or legal frameworks that both USAID and Uganda ascribe to. Although Uganda has a legislative and policy framework that supports DDT-based IRS implementation, some areas may need to be strengthened. Existing legislation includes:

- Constitutional Provision [Article 17 (j)] of Uganda which declares the creation and protection of a clean and healthy environment as the duty of every Ugandan
- The enactment of a National Environment Act, which outlines a principle of environmental management and a requirement for an environmental impact assessment of any project, which may have significant effect on the environment or the use of natural resources
- Control of Agricultural Chemicals Statute 8/1989, which establishes an Agricultural Chemicals Board vested with the authority to ensure that agricultural chemicals are properly managed through registration, labeling, issuance of licenses regulating quality and importation
- The establishment of a National Drug Authority, premised on the National Drug Policy and Authority Statute 13/1993, and vesting it with responsibility to regulate all chemicals used for Animal and Public Health
- The National Environment Statute 4/1995, which among others:
  - Calls for guidelines and measures to manage chemicals including *inter alia*, registration, labeling, packaging, advertising, control of importation and exportation, distribution, storage, transportation, monitoring of effects, disposal, restriction and banning of toxic and hazardous chemicals and materials,

  - Prohibits the discharge of hazardous chemicals, substances, materials into the environment,
  - Empowers the Minister of Environment to take measures to give the support of the law to any Convention or Treaty that has been ratified by Uganda and enable Uganda to perform its international obligations
- The Water Statute 9/1995, which prohibits the pollution of water, and provides a basis for categorizing types of discharges (effluents) and regulate their discharge.
- The Waste and Hazardous Wastes Regulations, 1999, which makes provision for the disposal of expired and surplus chemicals and materials, which have then become waste
- Public Health Act Cap. 269, which empowers local authorities to take lawful, necessary and reasonably practicable measures to prevent pollution of water supplies and food, with emphasis on the prevention and suppression of infectious diseases and epidemic or endemic diseases
- The establishment of NEMA as the principal agency for the management of the environment (coordinates, monitors, and supervises all activities in this field). NEMA has vested authority to prepare environmental protection policies, strategies, and laws; enforce and monitor compliance of approved legislations; establish systems for environmental impact assessments and prepare standards to protect soil, water, air and biological systems
- Acceding to the Stockholm Convention on POPs in 2004, thus committing the country to comply with the provisions of the Convention regarding the management, use, and environmentally sound disposal of DDT
- The development of a "national profile on the assessment of chemicals management infrastructure in Uganda" in 2004, for environmentally-sound management of toxic chemicals
- The drafting of a 2006 "*Policy and Strategy for Indoor Residual Spraying"* by the MOH, which also includes a draft training manual on IRS **(Annex 5)**
- The drafting of "Regulations to Limit Human and Environment Exposure to DDT" by the MOH **(Annex 6)**

Further to the above, Uganda has developed a National Implementation Plan (NIP), as part of the preparatory activities to implement the provisions of the Stockholm Convention on POPs. The NIP, which provides a framework for prioritizing and coordinating national action on POPs, was approved for funding by the Global Environment Facility (GEF) in 2005 and is being executed by

NEMA.[33] Primary objectives of the NIP include strengthening national capacities to manage POPs and chemicals generally in an environmentally sound manner and enable required reporting under the Convention.

Uganda has acceded to the Basel Convention on Transboundary Movement of Hazardous Wastes and their Disposal (acceded in 11 March 1999). The Basel Convention is relevant to ensuring final and environmentally sound disposal solutions for the waste associated with DDT use and to prevent accumulation. DDT waste is generated as end-use accumulation of empty sachets and contaminated paper/polythene containers after IRS operations. There are presently no appropriate disposal facilities in Uganda. Establishing and maintaining a disposal facility for DDT (e.g., high temperature incinerator) is a prohibitive endeavor and will require significant external financial and technical support. A regional solution is proposed and discussed further under Section E of the Pesticides Procedures *("The Requesting Country's Ability to Regulate or Control the Distribution, Storage, Use, and Disposal of the Requested Pesticide*").

Pesticide residues in food and international trade products: Uganda has an agriculture-based economy, with over 80% of the population engaged in that sector. Agricultural exports make up over 60% of the total annual exports and include organic and non-organic crops (coffee, fruits, vegetables, spices, cut flowers, oil seeds, cereals and pulses, essential oils), animals and animal products, honey and beeswax, fish and fish products, silk cocoons, beef and cattle by-products (**Fig. 14**). Almost all developed countries have varying maximum limits for pesticide residues in foods and food products. Thus, the proposal to pilot DDT-based IRS in Apac and Oyam, will include a secure chain of custody and strict auditing of the pesticide, to reduce the risk of unauthorized use in agriculture.

[33] "Uganda POPs Situation Report" Climate and Development Initiatives (CDI), The International POPs Elimination Project (IPEP). Accessed on 10 April 2007. www.oztoxics.org/ipepweb/library/news%20documents/Summary%20Uganda%20-%20Situation%20Report.pdf

Figure 14. Exports from Uganda by Value ('000 US$), 2002 – 2006

(2006 figures provisional)

Source: Uganda Export Promotion Board (http://www.ugandaexportsonline.com/)

Commodity	Unit	2002	2003	2004	2005	2006
Traditional Export Crops						
Coffee	Tonne	201,591	146,299	159,983	142,513	126,887
Cotton	Tonne	12,322	16,762	29,293	30,403	18,480
Tea	Tonne	30,400	36,669	36,874	36,532	30,584
Tobacco	Tonne	23,266	24,669	27,843	23,730	15,794
Non-Traditional Exports						
Maize	Tonne	59,642	60,298	90,576	92,794	115,259
Beans and other legumes	Tonne	10,753	18,070	26,233	28,332	27,087
Fish and fish products	Tonne	25,525	26,422	31,808	39,201	36,461
Cattle hides	Tonne	20,049	18,565	18,502	25,349	22,214
Sesame seeds	Tonne	1,380	4,108	4,283	7,412	7,568
Soya beans	Tonne	499	592	468	574	3,048
Soap	Tonne	7,594	11,402	16,281	17,072	11,681
Electric current	000 Kwh	264,685	217,486	193,104	62,577	53,019
Cocoa beans	Tonne	1,626	4,328	5,155	7,600	7,632
Cobalt	Tonne	8,748	-	438	582	861
Hoes and hand tools	'000	169	407	180	466	68
Pepper	Tonne	128	103	394	817	218
Vanilla	Tonne	63	91	71	234	195
Live animals	'000	24	8	37	12	0
Fruits	Tonne	708	425	1,297	3,061	7,821
Groundnuts	Tonne	45	4	1	22	63
Bananas	Tonne	1,561	1,646	1,792	2,196	494
Roses and cut flowers	Tonne	4,504	5,636	6,092	6,162	4,989
Ginger	Tonne	28	13	14	8	4
Gold and gold compounds	Kg.	7,117	3,478	5,465	4,241	6,937
Other precious compounds	Kg.	0	22	0	2	20
Petroleum products	Litre	25,090	63,645	65,277	74,380	81,977

Pesticide Procedures

Section 216.3 (b) of Title 22 of the United States Code of Federal Regulations, establishes a list of procedures governing the full cycle of pesticide usage (selecting, distributing, storing, using, and disposal) which must be satisfied. These are considered under twelve Sections (A to L) relating to the proposed IRS support for Uganda.

A. The United States Environmental Protection Agency's Registration Status of the Requested Pesticide

Table 7 describes the registration status of DDT in Uganda and the United States, while **Table 8** presents the toxicity classes for these chemicals.

Table 7. Registration Status of Suggested Pesticides

Registration status	DDT
Registered by the host country (for public health use)	Not yet registered.[34] Authorized for use by MOH with consent of NDA and NEMA (for disease vector control only)
Registered by USEPA?	NO
WHO-recommended for IRS?	YES

Table 8. Toxicity Classes of Suggested Pesticides

	DDT
EPA Toxicity Class	II: Warning
WHO Toxicity Class	II: Moderately Hazardous

B. The Basis for Selection of the Requested Pesticide

Criteria for selecting the requested pesticide are evaluated in **Box 1**. These include registration of pesticide for suggested use in the host country; effectiveness against the targeted vectors, including known tolerance or resistance levels, and residual efficacy on sprayed surfaces; comparative risk to human health, environment, and livestock; the cost of using the pesticides compared to

[34] NDA, a corporate body of MOH, is developing a regulatory framework for registration, and all other stages of the life cycle of DDT (procurement, transportation, storage, handling, use, disposal). Progress is far advanced; consultations and expert review of draft completed.

alternatives; general public acceptance; effectiveness of existing safeguards against non-recommended and unauthorized use.

The information provided to the sections on pesticide selection criteria is gathered from multiple sources, including formal publications of the Ministries of Health and Agriculture referenced within this EA, PEA for IVM, journal publications, first-hand information through direct observation, and interview of several country staff (MOH, NEMA, NDA, Ministry of Agriculture, Uganda National Bureau of Standards).

Box 1: Criteria Guiding the Choice of Insecticides by NMCP for IRS (including DDT)

The following threshold criteria must be met in making decisions on pesticides used in malaria vector control:

- Pesticide registration in the host country
  - *NEMA has given conditional approval to the MOH to use DDT for IRS in Uganda. Formal registration of DDT for IRS is yet to be completed by the NDA, a corporate body of MOH. MOH has duly informed the Stockholm Convention Secretariat and WHO of its intention to use DDT for malaria vector control.*
- Acceptability of the pesticide to the NMCP
  - *Current government policy is to use DDT for IRS in 2008. The NMCP has developed policy and strategy document on IRS, as well as guidelines on the use of DDT for IRS to guide implementation.*
- Risk to human health: pesticides must be approved by WHO and should be preferred based on their safety as described in USAID's *PEA for IVM.*
  - *WHO recommends DDT for IRS and also provides specific guidelines and recommendations governing its use to prevent or minimize human and environmental exposure. WHO classifies DDT as moderately hazardous (class II). DDT is not registered by USEPA. However, the current policy of USAID allows the use of DDT for IRS in countries that voluntarily opt to use the pesticides in accordance with the recommendations of WHO and provisions of the Stockholm Convention on POPs.*
- Risk to environment, livestock, and/or agricultural trade
  - *DDT bioaccumulates in the environment and body fat. Hence, its use must therefore be strictly limited to IRS in accordance with guidelines and recommendations of WHO and this EA. Developed-country trading partners of Uganda have established strict maximum residual limits (MRLs) of pesticides in food and food products. DDT in particular has very low MRLs that vary by country or regional grouping. Thus, diversion of DDT for non-recommended use in agriculture has the potential to adversely impact international trade of agricultural produce. This risk may be effectively addressed by implementing robust safeguards to prevent unauthorized use and contamination of agriculture products (see Section J of Pesticide Procedures). The environmental monitoring plan for the trial use of DDT in Apac and Oyam Districts will evaluate the potential for contamination of crops stored in homes sprayed with DDT, and will also estimate the background concentration of DDT and associated compounds in Apac and Oyam, in crops, related processed agricultural products, and selected environmental media and biological tissues that are known to be DDT "sinks" prior to the general introduction of DDT for IRS.*

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
    - *There is limited information on the resistance levels of the local mosquito vectors to DDT. Isolated studies from 2005 indicate generally high susceptibility to DDT (Table 7). There is very little national capacity for entomological surveillance and resistance monitoring (e.g., Uganda has no insectaries). The presence of kdr genotype has been found in An. arabiensis s.l. and An. gambiae s.s. in Uganda, indicating a need to initiate pesticide management practices. USAID support for establishing a vector monitoring and surveillance system, including insectaries and relevant training, is seen as critical to informed decision making in the selection of pesticides and the management of vector resistance.*

Secondary factors include:

- Appropriateness of surface for spraying
    - *Traditional/informal houses - with mud, thatched surfaces, or porous surfaces – will be targeted, all of which are well suited for IRS with DDT.*
- Duration of effectiveness (and implications for cost)
    - *WHO estimates the residual activity on sprayed surfaces of up to at least 6 months for DDT, although effective residual activity of up to 12 months has been observed elsewhere in Africa. Uganda experiences year-long malaria transmission with peaks around June-July. Therefore opportunities presented by long residual activity to spray only once a year may arguably cut down on operational cost, compared to using an insecticide with a shorter residual action, which may then require additional spray rounds. The proposed piloting of DDT-based IRS under the control and strict supervision of RTI will enable local validation of the length of residual efficacy on the various surfaces in the country. Currently two rounds of spraying with lambda-cyhalothrin (ICON) WP are carried out in Kabale and in the other districts as well. The availability of ICON CS, with proven residual activity of up to 8 months elsewhere, presents additional opportunities to extend the utility of the insecticide. Wall bioassays will be conducted routinely to ascertain the residual efficacy (see also Sections D and F of Pesticide Procedures).*
- Cost of insecticide
    - *Although it is not registered in Uganda and is not currently used, the MOH has expressed a strong preference for using DDT in indoor spraying programs. MOH stresses the comparatively lower cost of achieving effective control of malaria vectors using DDT. A comparative analysis of costs for DDT and lambda-cyhalothrin in two formulations indicates that the estimated annual cost of maintaining effective control of the malaria vector population with IRS in Apac and Oyam Districts is $32.90 per household using lambda-cyhalothrin in the WP formulation; $24.67 per household using lambda-cyhalothrin in the CS formulation; and $15.51 per household with DDT. Because DDT has a longer residual effect than lambda-cyhalothrin, it is feasible to control malaria vector populations with a single round of IRS each year using DDT, whereas achieving the same result with ICON WP would require two rounds of spraying each year in Apac and Oyam and ICON CS will require three rounds over a two year period. This analysis is specific to current conditions in Apac and Oyam Districts, where there is no significant resistance to DDT in the malaria vector population, and is based on recent prices of commercial purchases made in 2007. Details of the analysis are presented in **Annex 10**.*

Tertiary factors include:

- The need for an insecticide of a different class to prevent resistance
    - *Currently lambda-cyhalothrin (ICON),a pyrethroid, is used in Uganda for IRS. DDT is the second pesticide suggested for IRS. As discussed under Section F of Pesticide Procedures,*

limited tests indicate the local vectors are highly susceptible to permethrin (pyrethroids). It is however noted that the development of resistance to ICON may confer similar resistance to permetrhin. The potential for malathion as an alternative pesticide could be assessed to inform future decisions by the program. ❖ Major classes of insecticides used in other vector control interventions that could promote resistance ▪ *The pesticides registered for other vector control interventions include cyfluthrin, cypermethrin, deltamethrin, fenitrothion, permethrin, pirimiphos-methyl, and malathion. The authority for registering public health pesticides is currently vested in the NDA.* ❖ Major classes of insecticides used in the agricultural sector that could promote resistance ▪ *The use of pyrethroids in agriculture and animal husbandry (e.g., tsetse fly control) may potentially increase the selection pressure for resistance and cross-resistance for DDT, and should be carefully evaluated.* ❖ Host-country capacity to prevent pilferage ▪ *The NMCP has developed draft guidelines for the management and use of DDT for malaria control. Subsequent to the DDT-based pilots in the 1960s, the implementation of IRS has been sporadic until 2005, when structured implementation was initiated in Kabale with support from USAID/RTI. Hence, national experience on IRS is comparatively limited. Secure storage places need to be established for the proposed piloting of DDT-based IRS in Apac and Oyam Districts. The piloting will enable careful evaluation of relevant safeguards to inform decisions on the continuation or scaling up of the use of DDT.*

C. The Extent to Which the Proposed Pesticide Use Is Part of an IVM Program

IVM is defined by as *a process for managing vector populations in such a way as to reduce or interrupt transmission of disease.*[35] The major characteristics of IVM include:

- *Methods based on knowledge of factors influencing local vector biology, disease transmission, and morbidity;*
- *Use of a range of interventions, often in combination and synergistically;*
- *Collaboration within the health sector and with other public and private sectors that impact vectors;*
- *A public health regulatory and legislative framework.*

The draft *"Policy and Strategy for Indoor Residual Spraying"* of the MOH/NMCP (**Annex 5**) indicates that IRS will be implemented as a component of IVM for malaria control, which includes the use of IRS, ITNs, larviciding, and environmental management. These interventions are described, in depth, in a preceding section on *Malaria Control in Uganda*. There is a deliberate effort by NMCP to use eco-epidemiological criteria in the selection of local interventions.

[35] WHO (2004). *Global strategic framework for integrated vector management.* World Health Organization, Geneva, Switzerland. WHO/CDS/CPE/PVC/2004.10. 12 pages

For example, IRS has largely targeted epidemic prone areas, while ITNs have been deployed largely in areas of perennial transmission. The FY08 PMI/MOP however indicates IRS will be implemented in epidemic-prone areas, as well as selected endemic districts (e.g., Apac, Oyam, Amuria, and Soroti) and endemic sub-counties in Kanungu and Kabale districts. The potential complementary role of environmental management, larviciding (e.g., biopesticides and larvivorous fishes), and other complementary interventions such as insecticide treatment of cattle, have not been fully explored. Limited studies supported by USAID/RTI evaluated the use of environmental management methods by local government and community teams on the control of malaria.[36] Malaria prevalence was reduced by 11% and 36% at study sites in Kampala and Jinja, respectively, through improved peri-domestic drainage, filling of depressions in roadway tracks, and draining burrow and brick pits. The use of bovine-insecticiding to control malaria vectors [37] &[38] is another potential complementary intervention which is also yet to be fully explored: *An. arabiensis* is known to exhibit varying degrees of zoophilism[39, 40, 41] and exophily (further discussed under Section J), which could be exploited for potential complementary interventions, especially among the cattle-rearing communities in Uganda.

Section J describes efforts by the government to provide a policy and regulatory framework to protect human and environmental health in sustainable development, which also presents a basis for initiating informed and effective IVM.

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[36] RTI (2005). *Integrated Vector Management for Malaria Control*. Research Triangle International. Accessed 1 April 2007, at www.rti.org/pubs/rti_malaria_control_brochure.pdf

[37] Rowlands, G.J., Mulatu, W., Leak, S.G., Nagda, S.M., d'Ieteren, G.D. (1999). Estimating the effects of tsetse control on livestock productivity--a case study in southwest Ethiopia. *Trop Anim. Health Prod*.31(5):279-94

[38] Rowland, M., Durrani, N., Kenward, M., Mohammed, N., Urahman, H. and Hewitt, S. (2001) Control of malaria in Pakistan by applying deltamethrin insecticide to cattle: a community randomized trial. *Lancet*, 357: 1837–1841

[39] Tirados, I., Costantini, C., Gibson, G., and Torr, S.J., (2006). Blood-feeding behaviour of the malarial mosquito *Anopheles arabiensis*: implications for vector control. *Medical and Veterinary Entomology*, 20(4):1365-2915

[40] Habtewold, T., Walker, A.R., Curtis, C.F., Osir, E.O., and Thapa, N. (2001). The feeding behaviour and Plasmodium infection of Anopheles mosquitoes in southern Ethiopia in relation to use of insecticide-treated livestock for malaria control. *Trans R Soc Trop Med Hyg*. 95(6):584-6

[41] Seyoum, A., Balcha, F., Balkew, M., Ali, A., and Gebre-Michael, T. (2002). Impact of cattle keeping on human biting rate of anopheline mosquitoes and malaria transmission around Ziway, Ethiopia. *East Afr Med J.* 79(9):485-90

D. The Proposed Method or Methods of Application, Including Availability of Appropriate Application and Safety Equipment

IRS is proposed to control the mosquito vectors of malaria. This will largely involve ICON-based IRS, as well as a piloting of DDT-based IRS in Apac and Oyam Districts under the strict control and supervision of RTI. IRS involves spraying a liquid insecticide with long lasting residual activity on the indoor wall surfaces where mosquitoes usually rest. The pesticide then dries up and leaves a crystalline deposit on the sprayed surface. A lethal dose of the insecticide is absorbed when the mosquito rests on the surface, which kills the mosquito. For IRS to be effective, the targeted mosquito vector must mainly rest and feed indoors. Knowledge of the vector's resting behavior may further improve the targeting of spray on the wall, limiting it to either the lower or upper half of the walls or the ceiling. It may also be important to spray the undersides of furniture and the outside of eaves. Vector susceptibility is a primary criterion for selecting the type of insecticide that is used for IRS. Other factors that may influence the selection of the insecticide include the cost and length of residual activity of the pesticide in relation to the local malaria transmission period. Insecticide residual activity can be shorter on some surfaces, such as walls covered by cement or alkaline whitewash walls, porous mud walls, and surfaces exposed to sunlight.[42]

The aim of IRS is to reduce the life span of the female mosquito vector, which usually requires a blood meal every two to three days. The quest for blood results in entry into the sprayed room, thereby increasing the risk of exposure to the insecticide, which in turn increases the chances that the mosquito will die before the 12 days needed for the malaria parasite to complete the part of its life cycle in the mosquito. The effectiveness of IRS increases with the level of coverage in a locality, and usually a coverage rate of at least 85% is considered ideal for achieving full benefits. Normally, the higher the percentage of gravid mosquitoes caught in a sprayed room, the lower the efficacy of the insecticide (i.e., the ability to kill the vector). IRS has been demonstrated to effectively disrupt mosquito population dynamics and malaria transmission, if implemented properly.

The effectiveness of the IRS program also depends on the availability of adequately trained spraying personnel, well-maintained equipment, competent supervision, strong financial support, as well as end-user acceptability and compliance. Uganda has developed draft guidelines for IRS operations (attached to the draft *"Policy and Strategy for Indoor Residual Spray"* (**Annex 5)**, as well as *"Regulations to Limit Human and Environmental Exposure to DDT"* (**Annex 6**). The program guidelines will be supplemented with guidelines by WHO such

[42] WHO (2006). *Pesticides and their application, for the control of vectors and pests of public health importance*. World Health Organization, Geneva. WHO/CDS/NTD/WHOPES/GCDPP/2006.1

as the *"Manual for Indoor Residual Spraying"*[43], and the *WHO-UNEP Manual on Sound Management of Pesticides and Diagnosis and Treatment of Pesticide Poisoning,*[44] the draft PEA- IVM of USAID, as well as this SEA, all of which provide precise precautions and recommendations on all aspects of IRS operations.

It is noted that RTI is currently supporting the training of spray operators and supervisors, and providing overall guidance and logistic support to the IRS operations in Uganda, with financial support from USAID. RTI will continue to provide technical support, with a medium-term goal of building national capacity to progressively transfer responsibilities. The proposed piloting of DDT-based operations in Apac and Oyam in 2008 will be implemented by RTI. Preparations will include, but will not be limited to, the following[45]:

- A training of trainers program, in which potential supervisors[46] and team leaders are trained on all aspects of IRS operation in collaboration with the MOH and the District Health Service. Areas of training shall include planning of IRS, household preparations, record keeping, community mobilization, rational/judicious use of insecticides including sprayer and PPE cleaning, personnel management, environmental aspects of IRS – including special requirements for DDT, geographical reconnaissance, and data recording and analysis)
- The identification of temporary workers recruited from local areas and trained as spray operators and wash persons. They will receive five to seven days of training prior to the spray operations. Priority areas of training will include:
  - How to properly mix the wettable powder and filling of the sprayer (DDT WP 75%)
  - Correct spraying (maintaining 35-50 psi pressure, spray nozzle at 45 cm from the sprayable surface, spray speed of 19 square meters of surface per minute, swath overlap, etc.)
  - The correct use of protective materials and related safety precautions

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[43] World Health Organization (WHO). 2002. Manual for Indoor Residual Spraying: Application of Residual Sprays for Vector Control (WHO/CDS/WHOPES/GCDPP/2000.3).

[44] WHO (2007). *WHO-UNEP Manual on Sound Management of Pesticides and Diagnosis and Treatment of Pesticide Poisoning: A Resource Tool*. World Health Organization, Geneva. 332 Pages. (Document also accessible at. www.who.int/ipcs/en/a)

[45] Also refer to Annex 5 for areas of training highlighted by MOH

[46] These are usually health-related government staff within the targeted district (health assistants/educators/ inspectors, nursing assistants, and community development assistants).

  - Support to households on safety issues
  - Personal safety relating to the different pesticides used for IRS (DDT as well as ICON which is currently used)
  - Environmental safety in relation to DDT, including management of the empty DDT sachets
  - The use of daily spray cards and data entry
- The spray operators will be provided with complete and functional PPE
- Spray equipment and pesticides will be procured with the support of RTI. RTI will ensure appropriate quality control procedures for the procured materials.
- NMCP will establish explicit policy and guidelines to prevent the exposure of pregnant women and nursing mothers during operations, particularly with regards to DDT. Pregnancy testing (conducted by a fully accredited health outfit) will be instituted to screen out pregnant women and would follow normal ethical and privacy considerations associated with such clinical procedures. Due to ongoing scientific debate of the potential reproductive impacts of DDT and the accumulation of DDT breakdown components in breast milk, women of child bearing age will be excluded from DDT spray teams, but engaged in other duties (e.g., IEC coordinators, community mobilization) that minimize contact with the insecticide.
- Several independent compliance evaluations will be conducted as part of the proposed environmental assessment plan outlined in an earlier section. These will include evaluations by USAID, RTI, NEMA, NDA, and NMCP. Additionally, the local pesticide supplier that will be selected by MOH and NDA will have stewardship services to ensure best practices in the use of products that are sold to the NMCP.

E. Any Acute and Long-Term Toxicological Hazards, Either Human or Environmental, Associated with the Proposed Use and Measures Available to Minimize Such Hazards

The acute and long-term toxicological hazards of DDT are covered in the draft PEA for IVM. Exposure treatment for DDT is attached as **Annexes 7** and **8.** The NMCP has developed draft "*Regulations to Limit Human and Environment Exposure to DDT*" **(Annex 6)**. As part of the selected alternative, USAID will support comprehensive update and periodic review of the relevant national manuals to ensure that they are adequate to guide IRS operations. The national manuals will be supplemented by the draft PEA for IVM, this EA, as well as standardized publications such as the WHO-*UNEP Manual on Sound Management of Pesticides and Diagnosis and Treatment of Pesticide Poisoning,*[44] *"Manual for Indoor Residual Spraying."*[43] Together they present adequate

guidance to minimize the human and environmental risks associated with IRS operations in Uganda.

The risk of exposure (human and environmental release) to the insecticides used for IRS operations is largely determined by the local practices and the effectiveness of the safeguards that are implemented. Exposure may occur at any point from the production or importation of the pesticide through to use and final disposal. Some of the risks therefore relate to exposure of handlers (transporting and storage workers, spray operators, etc.), or environmental release through vehicular accidents during transportation. These have been discussed in the preceding section. The *Pesticide Registration, Management and Prevention of Accumulation of Obsolete Pesticides* by the Ministry of Agriculture provides detailed guidance on proper storage management practices, as well as remedial measures in case of spillage and incidents brought on by natural disasters including flooding. These guidelines therefore provide a sound basis for enhancing the capacity of the country.

Under existing legislation, it is a legal requirement for major incidents resulting in spillage to be reported. However, a general observation is that in most developing countries, a lack of clarity on what constitutes a reportable chemical incident results in under-reporting (e.g., reporting a traffic accident involving a spillage as chemical spillage or as a traditional road accident).

Other main groups of people at risk of exposure are households and the targeted communities. It is important that the targeted community and households are adequately educated on safety. IEC efforts are implemented under the ongoing ICON-based IRS operation. It involves radio for mass media announcements and also directly through the spray operators. Communities are mobilized by each local administration. Clear instructions are provided on what to do before and after the house is sprayed, including the removal of all foodstuffs and cooking utensils, barring of entry into the sprayed rooms for at least one hour, preventing the re-entry of children until the floors have been swept clean or washed, and targeted training of selected health care providers at the region, district, and community levels on the management of pesticide poisoning. The above preparations and precautions will be further tailored to address any peculiar priorities of a DDT-based IRS implementation and safeguard the proposed piloting in Apac and Oyam Districts (also refer to Sections J to L under *Pesticide Procedures*).

F. The Effectiveness of the Requested Pesticide for the Proposed Use

The effectiveness of the pesticides that are selected for IRS is a factor of the efficacy of the pesticides and other extrinsic variables. Pesticide efficacy is affected by vector susceptibility and behavior, insecticide quality, and the residual

action of the pesticide. Acceptability of the pesticide and IRS intervention among the targeted households is a primary external factor and critical for compliance.

Feeding and resting behavior of vector: The probability of vector-pesticide contact depends on whether the targeted vector feeds indoors (endophagic) and rests indoors (endophilic), as this increases the likelihood of the vector resting on the sprayed wall. The efficacy of the pesticide to kill may be either compromised if the vector exits after feeding without resting on the wall, or absent if the vector feeds outdoors (exophagic) and rests outdoors (exophilic). *An. arabiensis* and *An. funestus*, the major malaria vectors in Uganda, are mainly endophagic and endophilic. This makes them suitable targets for IRS. Studies in nearby countries in East Africa (Ethiopia, Kenya) have shown that *An. arabiensis* exhibit significant tendency towards exophagy, postprandial exophilic behavior[47][39], and avoidance of DDT-sprayed surfaces after blood meals.[48] East African species of *An. Arabiensis* are known to demonstrate higher exophilic behavior compared to the West Africa species. Exophilic tendencies may be selected through long-term use of excitorepellant insecticides such as DDT and pyrethroids. This is behavioral resistance as opposed to physiological resistance, which is discussed in the subsequent section. It is also suggested[39] that zoophagy may arise from an inherently anthropophagic population of *An. arabiensis* if the humans are not available to the vectors. The long-term impacts of such behavioral shift in local vectors on the effectiveness of IRS, if any, have not been adequately studied.

Vector resistance to requested pesticides. The FY2008 PMI/MOP indicates support for entomological evaluations, including vector resistance monitoring and general bionomics. Baseline and post spraying entomological surveys/mapping should be supported, including in the proposed DDT pilot districts of Apac and Oyam.

Vector resistance is an inherited characteristic in an insect population, which results in an increased tolerance to a pesticide, or group of pesticides. This makes an insect able to survive a concentration of the compound(s) that normally would be lethal to the species.[49]

There is very little information on the resistance status of the local mosquito vectors to DDT in Uganda. However, available information from 2005 indicates high susceptibility of the local malaria vectors to DDT in some localities (**Table 9**). Comprehensive information is however needed to provide a complete picture of the national distribution of vector resistance.

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[47] The tendency for the mosquito to exist and rest outdoors following a blood meal.

[48] Ameneshewa, B., and Service, M.W. (1996). Resting habits of Anopheles arabiensis in the Awash river valley of Ethiopia. *Ann Trop Med Parasitol.* 90(5):515-21

[49] WHO (1992). *Vector resistance to pesticides*. Technical Report Series 818, Geneva, World Health Organization.

Knockdown resistance (kdr) is a form of resistance brought about by mutations in the voltage-gated sodium channel gene of the mosquito. Kdr is associated with resistance to both pyrethroid insecticides and also to DDT.[50, 51, 52]. Two types (alleles) of mutations of the voltage-gated sodium channel gene have been strongly linked to cross-resistance to DDT and pyrethoids in *An. gambiae s.s.*[53, 54] Until recently, one mutation was found to be widespread in West Africa, while the other, originally found in Kenya, was thought to be limited to East Africa. However, several studies have now shown that both mutations are indeed present in both East and West Africa, and even co-expressed (heterozygotes).

Verhaeghen et. al.[54] found a new *kdr* genotype in Uganda where four *An. gambiae s.s.* mosquitoes possessed both the West (L1014F) and East (L1014S) African *kdr* allele, simultaneously for the first time. The study also found the East African kdr mutation (L1014S) in low frequency in heterozygous state in *An. arabiensis,* confirming the findings of an earlier study of *An. arabiensis* from Kisumu.[55]

There are important implications of the above finding to vector control in Uganda. Low frequency of kdr in a vector population suggests that population has been previously subjected to intensive insecticide selective pressure.[52, 55] Kdr selection has been attributed mainly to the agricultural use of both DDT and pyrethroids, as well as to the widespread DDT-based vector control campaigns undertaken in the 1950s. However, recent studies have demonstrated that large-scale ITN

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[50] Soderlund, D.M., & Knipple, D.C. (2003). The molecular biology of knockdown resistance to pyrethroid insecticides. *Insect Biochemistry and Molecular Biology,* 33: 563–577.

[51] Brengues, C., Hawkes, N.J., Chandre, F. et al. (2003) Pyrethroid and DDT cross-resistance in Aedes aegypti is correlated with novel mutations in the voltage-gated sodium channel gene. *Medical and Veterinary Entomology*, 17: 87–94.

[52] Pinto, J., Lynd, A., Elissa, N., Donnelly, M. J., Costa, C., Gentile, G. , Caccone, A. & Do Rosa ´ Rio, V. E. (2006). Co-occurrence of East and West African kdr mutations suggests high levels of resistance to pyrethroid insecticides in *Anopheles gambiae* from Libreville, Gabon. *Medical and Veterinary Entomology*, 20: 27–32

[53] Martinez-Torres, D., Chandre, F., Williamson, M.S. et al. (1998). Molecular characterization of pyrethroid knockdown resistance (kdr) in the major malaria vector *Anopheles gambiae s.s. Insect Molecular Biology*, 7: 179-184.

[54] Verhaeghen, k., Van Bortel, W., Roelants, P., Backeljau, T., & Coosemans, M. (2006). Detection of the East and West African kdr mutation in *Anopheles gambiae* and *Anopheles arabiensis* from Uganda using a new assay based on FRET/Melt Curve analysis. *Malaria Journal* **5**:16

[55] Stump, A. D., Atieli, F.K., Vulule, J.M., & Besansky, N.J. (2004). Dynamics of the pyrethroid knockdown resistance allele in Western Kenyan populations of *Anopheles gambiae* in response to insecticide treated bed net trials. *Am. J. Trop. Med. Hyg*., 70: 591-596.

interventions can also lead to the selection of kdr alleles,[52,56] while domestic use of insecticides could also lead to the selection of resistance to pyrethroids. Verhaehen *et. al.*[54] argue that an increased insecticide pressure in Uganda can, in turn, increase the *kdr* frequency: In Kenya, the introduction of ITNs doubled the frequency of the L1014S *kdr* allele in *An. gambiae s.s.*

Table 9. Results of Insecticide Rresistance Testing in May 2005 (Results of Standard WHO Bio-Assays. Test Mosquitoes: Anopheles gambiae s.l.)

District	Village	Insecticide	Samples Exposed	Mortality %	WHO*	KDT 50
Tororo	Namwaya	DDT	204	92.0	I	45
		Permethrin	98	77.6	R	20
	Sesere Bendo	DDT	108	82.4	I	50
		Permethrin	215	83.7	I	20
		Deltamethrin	97	98.0	S	20
Apac	Olami A	DDT	101	99.0	S	60
		Permethrin	97	99.0	S	40
	Olami B	DDT	97	96.9	I	68-80
		Permethrin	138	97.8	I	20
Jinja	Masese	DDT	80	81.3	I	60
		Permethrin	79	99.0	S	20
	Kagoma Gate	DDT	202	86.7	I	50
		Permethrin	195	99.0	S	15
		Deltamethrin	77	100.0	S	15
Kanungu	Matanda	DDT	197	97.5	S	45
		Permethrin	198	100.0	S	20
		Deltamethrin	98	100.0	S	15
	Kameme	DDT	201	99.0	S	50
		Permethrin	195	88.7	I	20
Mubende	Myanzi LC1	DDT	88	86.4	I	40
		Permethrin	81	98.8	S	10
	Kakunhube	DDT	79	97.5	I	40
		Permethrin	99	100.0	S	15
Kyenjojo	Kitaleesa	DDT	101	92.1	I	40
		Permethrin	80	95.0	I	20
	Mpara	DDT	80	97.5	I	40
		Permethrin	79	100.0	S	20
Arua	Omi	DDT	198	99.0	S	60-80
		Permethrin	193	100.0	S	20
	Nyanza A	DDT	201	99.0	S	45
		Permethrin	199	100.0	S	20

N.B.: WHO recommendations as Sensitive (S), Intermediate (I) or Resistant (R)
Meaning: S = 98-100% mortality within 50 minutes
I = 80-97% mortality within 50 minutes
R = <80% mortality within 50 minutes
DDT is a slow-acting insecticide requiring more time, up to 80 minutes, to kill sensitive species
Pyrethroids are quick-acting insecticides, killing sensitive species as early as 15 minutes

[56] Kolaczinski, J.H., Fanello, C., Herve´ , J.P., Conway, D.J., Carnevale, P., & Curtis, C.F. (2000). Experimental and molecular genetic analysis of the impact of pyrethroid and non-pyrethroid insecticide-impregnated bednets for mosquito control in an area of pyrethroid resistance. *Bulletin of Entomological Research*, 90: 125 -132.

(Source: NMCP/MOH, Uganda)

The above confirms again the need to be circumspect about the use of insecticides. It is important that public health insecticides be used judiciously, from the viewpoint that they are finite life-saving resources for current and future generations.

Knowledge of vector susceptibility is critical to planning and evaluating the effectiveness of the IRS program. It enables timely forward planning to (i) manage the development of the resistance and (ii) evaluate new or alternative insecticides for possible future introduction should a change of pesticide be required. Resistance testing is done to (i) establish a baseline susceptibility of the local vectors for future reference, (ii) monitor changes that occur as time progresses, (iii) identify the mechanisms of resistance and cross-resistance to inform the resistance management strategy that will be adopted, and (iv) evaluate the susceptibility of the local vectors to potential alternative insecticides, should there be a need to change pesticide.

Vector resistance may differ in origin, intensity, type, and significance for vector/disease control in a given population. The evaluation of the significance of resistance to vector control should therefore consider the biochemical and genetic characteristics of the resistance, as well as the eco-epidemiology of the disease and operational characteristics.[57, 58] Resistance also tends to be highly focal (i.e., limited to a definite area). It is therefore important to ascertain the spatial distribution of the observed resistance to better inform the resistance management strategy to be employed and the geographical extent to which it will apply (e.g., what geographical area a possible change in pesticides for IRS will cover).

The operation criterion for vector resistance is having 20% or more survival rate in the number tested using standardized methods of the WHO.[59] Irrespective of the pesticides used for IRS, national capacity will need to be developed to enable systematic evaluation of the mechanisms for resistance development and the gene frequencies among the local malaria vector populations. There is also a need to evaluate other pesticides and non-chemical alternatives to facilitate the evolution of a full-fledged IVM for malaria.

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[57] WHO (1986) Resistance of vectors and reservoirs of disease to pesticides: tenth report of the WHO Expert Committee on Vector Biology and Control. World Health Organization, Geneva.

[58] Brogdon, W.G. and McAllister, J.C. (1998). Insecticide Resistance and Vector Control *Emerging Infectious Diseases* 4(4): 605-613.

[59] WHO (1998). *Test procedures for insecticide resistance monitoring in malaria vectors, bio-efficacy and persistence of insecticides on treated surfaces.* World Health Organization, Geneva, WHO/CDS/CPC/MAL/98.12

The residual efficacy of the pesticide being used for IRS is crucial to evaluating the implication of vector resistance. Generally, a positive correlation between observed vector resistance and a decline in pesticide efficacy is an important criterion in determining the need for a change of the pesticide in a local area. It is important that wall bioassays be carried out at specified intervals after the IRS operation in order to determine the period and level of residual activity in a given locality and the sprayed surface.

The third major factor affecting the effectiveness of the pesticides is their quality (specification). If the active ingredient, for example, is not up to the recommended specification and concentration, it may lead to under-dosage of deposited pesticide, which then contributes to intervention failure. Poor pesticide quality may present additional risks to the pesticide handlers and spray operators who may be exposed.

Information from NMCP (**Annex 4)** indicates that there is a sizeable number of Vector Control Officers in Uganda, who, with targeted (reorientation) training, could adequately undertake basic entomological activities (vector collection for example) to sustain a robust national vector surveillance and monitoring system. Information from NMCP however indicates that as a result of significant financial constraints, the program is unable to recruit these individuals. Additionally, there is no insectary in the country, which means that core vector control functions are not done.

Priority action: Support will be provided for the development of country capacity for vector surveillance and monitoring (re: p. 8, FY2008 PMI/MOP) to provide an eco-epidemiological basis to enhance the targeting of IRS. Uganda already has highly trained entomologists within the NMCP, the Uganda Virus Research Institute, as well as the Makerere University. However, there is no mechanism in place to mobilize the excellent technical expertise for the benefit of malaria vector control. The absence of such a system is a fundamental weakness for this malaria epidemic-prone country. In 2006, the three institutions initiated collaboration on a vector-resistance monitoring program to support the IRS operations in Kabale. Training on pesticide bioassay was also conducted for insecticide-resistance monitoring with the support of PMI, CDC, and RTI. Based on current stratification of malaria transmission, about six to ten sentinel sites should be established within the country. In addition, reorientation training should be provided to staff at the districts to enhance surveillance operations.

G. Compatibility of the Proposed Pesticide with Target and Non-Target Ecosystems

The potential impacts of the use of DDT are reviewed under *Environmental Consequences—Unavoidable Adverse Effects*. **Annexes 7** and **8** present a summary of the environmental behavior of DDT as well as its impact on non-

target organisms. The following precautions should be taken to prevent bioaccumulation of DDT in the environment:

- ***Release of rinse-water from spray equipment and PPE into water bodies.*** A progressive rinse-water reuse is already employed with regards to ongoing ICON-based IRS, This should be continued and used in the DDT pilot as well. Wash-outs from the previous day will be used for the next day's operation. The washouts from the last day's operation will be decanted into the evaporation tanks built at all the DDT/IRS service points in Apac and Oyam Districts. No rinse water will be released into water bodies.
- ***Release of washouts from transport vehicles into drains and ground.*** Dedicated vehicles will be used to transport DDT. The DDT will be appropriately packaged for transportation (the DDT sachets should be transported in the factory-packed and labeled cartons), to limit contamination of the transport vehicles. The washouts from the transport vehicles should be recovered, and will preferably be done in the same general area where equipment is washed, although at different times. This ensures that the truck washouts are trapped into the evaporation tanks.
- ***Spray operators washing in water bodies.*** *Spray operators are to wash themselves at the washing facilities provided on site.* The water from the ablution blocks will be collected in the evaporation tanks (for DDT) and not allowed into general drainage or water bodies.

Crop contamination/agricultural export restrictions. Pronouncements from the government, MOH, the export sector, and civil society indicate a general high awareness of the potential risks and impacts that might occur if DDT intended for use in IRS were diverted for use in agriculture. Negotiations at the highest level of government have addressed this concern.

During the trial of DDT-based IRS in Apac and Oyam Districts, robust safeguards will be implemented to prevent diversion, based on the risk minimization criteria established in **Annex 1**. These will include:

- Continuous possession and chain-of-custody controls implemented by RTI, from the time DDT is received at the port of entry through its use by IRS spray operators;
- Complete, "cradle to grave" documentation of DDT quantities throughout the chain of distribution and use, including reconciliation of amounts distributed to each warehouse, driver, spray team, and spray operator, and return of spent packaging;
- Proactive communications with stock managers, warehouse personnel, drivers, spray operators, supervisory personnel, community leaders, police

authorities, and the general public concerning the potential risks and consequences of unauthorized sale, purchase, and misuse of DDT;

- Using mobilizers and community members to routinely observe spray operators during IRS operations and provide verification that operators are depositing DDT sachets into the compression sprayers;
- Avoid spraying crop/agri product store rooms. Tailor IEC messages for farming communities and traders involved in agri business on safe food storage and post-harvest crop storage to reduce risk of exposure of crop/agri-products to DDT. This can be done through general IEC and involvement of MOA.
- Routine verification by team leaders and other supervisors of the presence of white, "chalky" deposits on treated walls, as evidence that DDT was present in the mixture applied by spray operators;
- Immediate investigation of any missing quantities of DDT, followed by complete reporting to all relevant agencies (MOH, NMCP, NEMA, NDA, USAID), dismissal of any personnel engaged in unauthorized practices, referral to local police when appropriate, and other relevant mitigating actions.

The environmental monitoring plan being developed will include sampling of crops stored in homes sprayed with DDT and of crops and processed agricultural products at selected points in the distribution chain, to evaluate the potential for DDT contamination of crops stored in homes and to establish current background levels of DDT in crops and processed products. Results from environmental monitoring conducted during the trial will be used to design a routine monitoring program that could provide sufficient information on crop contamination in the event DDT-based IRS is introduced on a larger scale.

The capacity of NEMA to undertake routine operational inspections and environmental monitoring is weak and would need strengthening to support general introduction of DDT-based IRS. NEMA will be invited to designate counterparts, as part of the IRS operational team, to participate in all relevant activities implemented by RTI and training exercises.

The potential implications of DDT residues in food and food products on the export market of Uganda is reviewed in the concluding paragraphs under the section on *Complementary and Conflicting Policies, Plans, or Control for the Areas Under Consideration.*

H. The Conditions Under Which the Pesticide Is To Be Used, Including Climate, Flora, Fauna, Geography, Hydrology, and Soils

An ICON-based IRS, complemented by a piloting of DDT-based IRS in the highly endemic Apac and Oyam Districts, is proposed. The FY08 PMI/MOP indicates longer acting insecticide based IRS will cover a wide and varied geographical area of Uganda. Information on the general environmental conditions where IRS will take place are attached as **Annex 9**, including endangered species.

Conditions:
1. Houses illegally placed in protected areas will not be sprayed.
2. Houses in sensitive areas such as on the edge of wetlands will be evaluated for possible ICON spraying, but will not be sprayed with DDT.
3. Regulatory controls will be put in place to prevent contamination of agricultural products with DDT.

IRS will be prohibited within protected areas or sensitive ecosystems. Protected areas in Uganda fall into two basic categories: Parks and Reserves managed by Uganda Wildlife Authority, and Central Forest Reserves managed by the National Forest Authority. Central Forest Reserves are frequently invaded by people. Houses illegally situated in protected areas such as Central Forest Reserves will be not be sprayed unless it is determined that this will not further harm the environment (i.e. the reserve has already been degraded). Houses within 50 meters of wetlands, such as lake edges, rivers and marshes will not be sprayed with DDT, but should be assessed for other interventions such as IRS with ICON. Prior to spraying, contractor will identify households in sensitive areas, do appropriate baseline samples for ICON, and train sprayers to identify houses not to receive DDT. RTI will consult with the National Environmental Management Authority regarding the application of pesticides near ecologically sensitive areas, such as wetlands, lake shore, river edge and protected areas and follow their policies and guidelines.

Strict regulatory control will be established to prevent contamination of agricultural products. Risk for environmental release will be mitigated by:

- Establishment of best practices for insecticide handling and strict daily accounting (comparing daily rations against unused sachets, empty sachets, and the number of houses sprayed) to prevent pilferage
- Ensuring adequate security for storage facilities to prevent pilferage
- Implementation of measures discussed under the preceding section (G), such as reuse of rinse-water, ablution blocks, and evaporation tanks, within a context of a “minimize environmental release” policy.

I. The Availability and Effectiveness of Other Pesticides or Non-Chemical Control Methods

WHO currently recommends twelve insecticides from four chemical groups for IRS (**Table 10**), each with a specific dosage regime.[60] The insecticides are effective for differing periods, generally categorized as 2-3 months, 3-6 or 4-6 months, and >6 months. Within this range, the effective period depends on local circumstances, including dosage actually applied, wall type, climate (temperature and humidity), and resistance to that chemical in the mosquito population.

Uganda has a complex geography and climate and the average length of the malaria transmission "season" varies considerably across the country. In the northeast, arid conditions limit transmission to less than 6 months. In the southwest, highland geography and the resulting low temperatures at higher elevations create two transmission seasons, each of 3-4 months duration. In central Uganda, transmission generally lasts approximately 9 months each year and is regarded as "perennial." The reader is referred to a useful Web site on "Seasonal Climate Suitability for Malaria Transmission" created by the Columbia University International Research Institute on Climate and Society for graphic depictions that are useful in visualizing the range of conditions found across Uganda: http://iridl.ldeo.columbia.edu/maproom/.Health/.Regional/.Africa/.Malaria/.CSMT/.

For IRS to be effective, the NMCP must either use a chemical that lasts longer than the average malaria transmission season or conduct multiple rounds of spraying to achieve continuous control with a shorter-lived chemical. Thus, current formulations of pyrethroids and other WHO-approved insecticides that are effective for 3-6 or 4-6 months may be sufficiently effective with one application per year in the northeast arid zone, and would require two applications per year if used in the southwest highland zone or central zones with perennial transmission. DDT, with an effective life of over 6 months, should be sufficiently effective with one application per year in all zones of the country, so long as other conditions (dosage and resistance) are acceptable.

Uganda is committed, as a party to the Stockholm Convention on POPs, to complying with the provisions and obligations of the Convention with regards to the use of DDT for disease vector control. Uganda's commitment is demonstrated by the early development of the National Implementation Plan (NIP) on POPs to facilitate the proper management of POPs in the country (discussed in earlier

[60] Najera JA, Zaim M (2002). Malaria vector control – Decision-making criteria and procedures for judicious use of insecticides. WHO, Geneva, WHO/CDS/WHOPES/2002.5. (Document available at: www.who.int/ctd/whopes/docs/JudiciousUseRev.pdf)

sections). Part II, Paragraph 5 (b) of Annex B of the Convention urges parties who use DDT to consider *"Implementation of suitable alternative products, methods and strategies, including resistance management strategies to ensure the continuing effectiveness of these alternatives."*

Although Uganda is currently concentrating on ITNs and IRS as the main vector control interventions, the NMCP is willing to pilot interventions based on environmental management and larviciding in settings where such interventions prove cost-effective, as part of an overall strategy on employing selective vector control. The addition of these complementary interventions within the context of IVM would require relevant local evidence of the effectiveness of alternative intervention options.

Table 10. WHO Recommended insecticides for IRS Against Malaria Vectors

Insecticide compounds and formulations	Class group	Dosage (g/m^2)	Mode of action	Duration of effective action (months)	Hazard Classification of active ingredient
DDT WP	OC	1-2	contact	>6	II
Malathion WP	OP	2	contact	2-3	III
Fenitrothion WP	OP	2	contact & airborne	3-6	II
Pirimiphos-methyl WP & EC	OP	1-2	contact & airborne	2-3	II
Bendiocarb WP	C	0.1-0.4	contact & airborne	2-6	II
Propoxur WP	C	1-2	contact & airborne	3-6	II
Bifenthrin	P	0.025-0.05	Contact	3-6	II
Alpha-cypermethrin WP & SC	P	0.02-0.03	contact	4-6	II
Cyfluthrin WP	P	0.02-0.05	contact	3-6	II
Deltamethrin WP	P	0.01-0.025	contact	2-3	II
Etofenprox WP	P	0.1-0.3	contact	3-6	U
Lambda-cyhalothrin WP, CS	P	0.02-0.03	contact	3-6	II

EC = emulsifiable concentrate; WP = wettable powder; SC = suspension concentrate

OC= Organochlorines; OP= Organophosphates; C= Carbamates; P= Pyrethroids, CS = Capsule Suspension.

Class II, moderately hazardous; class III, slightly hazardous; class U, unlikely to pose an acute hazard in normal use (Reference: http://www.who.int/whopes/en/)

J. The Requesting Country's Ability to Regulate or Control the Distribution, Storage, Use, and Disposal of the Requested Pesticide

The risks associated with DDT-based IRS in Uganda are presented in **Annex 1**, while the status of implementation of the requirements set by NEMA for the re-introduction of DDT is presented in **Annex 2**. It is seen from these two presentations that there are a number of outstanding preparations that need to be completed as a rational first step to introducing DDT use in the country. Cognizant of the deficiencies in the capacities for pesticide management, it is proposed that DDT-based IRS be initially piloted in Apac and Oyam Districts

under the control and close supervision of RTI. This presents adequate opportunity to assess the effectiveness of relevant safeguards in a small-scale implementation. It should also provide a sound basis for rational decision making on the future use of DDT in Uganda.

Uganda has undertaken a number of policy and regulatory actions to strengthen its capacity for pesticide management (see section on *Complimentary and Conflicting Policies, Plans, or Control for the Areas Under Consideration)*. A 2002 evaluation preceding the development of a national chemical profile[61], identified a general "improper management of chemicals" resulting from a variety of factors such as inadequate and fragmented legislation, inadequate enforcement, paucity of relevant information – including public awareness, a general lack of health or environmental monitoring; inadequate number of trained staff, equipment, and other resources; unsafe storage; and lack of disposal facilities for waste chemicals as weaknesses that needed urgent attention. The 2002 evaluation identified the following priority actions intended by government:

(i) Strengthening national capabilities for the management of chemicals,

(ii) Information exchange on toxic chemicals and risks,

(iii) Prevention of illegal international traffic in toxic and dangerous chemical products,

(iv) Establishment of risk-reduction programs,

(v) Harmonization of classification and labeling of chemicals, and

(vi) Expanding and accelerating international assessment of chemical risks.

NDA is responsible for the development and regulation of drugs and pharmaceuticals, as well as all chemicals used for animal/public health. NDA has representation of the MOH on its Board; this is intended to facilitate coordination on the registration and related regulation of public health insecticides. The authority is in the final stages of developing a comprehensive regulatory framework for DDT-based IRS. The regulations cover all the stages in the life cycle of the pesticide (registration, importation, transportation, storage, handling, use, and disposal). This regulatory framework will guide the proposed piloting of the DDT-based IRS in Apac and Oyam Districts in 2008.

The Stockholm Convention on POPs places restrictions on the use, management, and disposal of DDT. These provisions are intended to prevent non-recommended use of the pesticide and its bioaccumulation in the environment. Uganda will need to strengthen existing capacities to fully comply with the obligations regarding the handling, use, and disposal of DDT. With regards to the planned piloting in Apac

[61] NEMA (2002). *National Profile on the assessment of chemicals management infrastructure in Uganda.* National Environmental Management Authority. 104 Pages

and Oyam Districts, a verifiable and secure chain of custody will be established at all stages of the life cycle of the insecticide (from procurement through end-use) and the retrieval and storage of the empty sachets.

There are national regulations covering the transport of pesticides, in accordance with The National Environment Statute 4/1995. Additionally, the NDA and MOH have developed guidelines specifically for the handling of DDT, which together with the recommendations outlined in the present SEA, should provide clear criteria on best practices. As is the case with ongoing ICON-based IRS, dedicated transportation will be used for DDT.

Secure and appropriate storage will be established at all the IRS service points within the pilot districts of Apac and Oyam, in accordance with the FAO *Guidelines on pesticide storage and Stock Control Manual* .[62] The district stores, as well as the sub-county storage facilities, should be equipped with evaporation tanks, equipment wash areas, and adequate ablution facilities commensurate to the size of spray teams utilizing the service point. As discussed under previous sections, store keepers will be trained and strict auditing of insecticides implemented; every sachet of DDT will be accounted for.

Uganda currently has no capacity for the environmentally sound disposal of empty sachets and other containers of DDT. The disposal of DDT waste requires sophisticated facilities such as specialized high temperature incinerators, which are prohibitive and currently not within the means of any of the beneficiary countries of the PMI, with the notable exception of South Africa. It is therefore recommended that priority be given, under PMI, to finding a regional solution. This may involve the location of central incinerators (one each for East, southern, and West Africa) for use by PMI countries. Opportunities for collaborating with major stakeholders such as the GEF, WHO, UNEP, FAO, RBM, and major developmental partners (EU, DANIDA, etc.) should be actively pursued. Regional economic groupings such as SADDC, the East Africa Development Community, and ECOWAS, provide good opportunities for a regional deliberation. In the meantime, a system for retrieving all empty DDT sachets for storage in a secure central location will be established until a final solution of permanent disposal is found. Alternatively, the empty sachets could be returned to the insecticide supplier for onward shipment to origin of manufacture for environmentally sound disposal. This will however require the inclusion of the cost of reshipment of the empty sachet in the procurement budget for the insecticide.

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[62] FAO (1996). *Pesticide Storage and stock Control Manual. Food and Agriculture Organization of the United Nations.* Rome. [Available at http://www.fao.org/docrep/V8966E/V8966E00.htm]

K. The Provisions Made for Training of Users and Applicators

USAID has been supporting IRS implementation in Uganda since 2005. As part of this assistance, training of users and applicators is conducted in the districts as a collaborative activity of MOH and the DHS, with close technical support from RTI. The training is consistent with the recommendations of WHO and PEA-IVM of USAID and is reviewed under Section D under *Pesticides Procedures*. The MOH has also developed a draft training manual for DDT-based IRS (**Annex 5**). The program manuals will be supplemented with other international guidelines such as the WHO-UNEP *Manual on Sound Management of Pesticides and Diagnosis and Treatment of Pesticide Poisoning: A Resource Tool*[44], the *PEA-IVM* of USAID, *"WHO Manual for Indoor Residual Spraying,"*[xxxv] the WHO "*Guidelines on the Management of Public Health Pesticides*,"[63] as well the present SEA. RTI, in collaboration with the above partners, will conduct relevant training for all categories of IRS workers (transporters, storekeepers, spray-operators, washers, etc.) and establish a robust field supervision scheme that will ensure best practices that adequately address all peculiarities specific to DDT-based IRS in the pilot districts of Apac and Oyam.

L. The Provisions Made for Monitoring the Use and Effectiveness of the Pesticide

The districts currently compile daily information during IRS operations. There is very limited capacity for monitoring the effectiveness of the pesticides in use. Two kinds of measurements are needed to provide a complete understanding of the effectiveness of pesticide that is being used for IRS. The immediate (output) level relates to the efficacy of the pesticide, that is, the degree to which the pesticide is able to kill the targeted mosquito vectors, and involves direct entomological evaluations on pesticide contact bioassays and related pesticide resistance methodologies as recommended by WHO.[64] The second broad level of measuring the effectiveness of the pesticides relates to the general goal of reducing the local disease burden. This will require specialized entomological and epidemiological skills and the assessment of the impact of vector control operations, and possibly the assignment of the contributory impact of the IRS operations. This latter measurement is usually done through a combination of methodologies such as measuring the changes in parasite inoculation rates,

[63] WHO (2003) Guidelines on the management of Public health pesticides. World Health Organization, Geneva, Switzerland. WHO/CDS/WHOPES/2003.7. 50 pages.

[64] WHO (1998). Test procedures for insecticide resistance monitoring in malaria vectors, bio-efficacy and persistence of insecticides on treated surfaces WHO/HQ, Geneva, World Health Organization, WHO/CDS/CPC/MAL/98.12

passive case detection at health centers, and periodic community fever and parasite surveys (active case detection).

There is currently very little technical capacity within NMCP to undertake these measurements. It is therefore recommended as a priority area for USAID/CDC/RTI support (refer also to the capacity development needs under the section on *"Preferred Alternatives"*). As necessary, technical support will be provided to support close evaluation in the pilot districts of Apac and Oyam.

Environmental assessment, including monitoring of DDT: RTI will support the fulfillment of the requirement of Title 22 CFR 216 of the United States on environmental monitoring:

> *"to the extent feasible and relevant, projects and programs for which Environmental Impact Statements or Environmental Assessments have been prepared should be designed to include measurement of any changes in environmental quality, positive or negative, during their implementation."*

Pursuant to the above requirement, an environmental assessment plan will be established as outlined previously in this SEA. The assessment plan will include sampling and analysis of environmental media (soil, air, crops, agricultural products, and animal tissues) to evaluate the potential for contamination of crops and DDT transport into the environment, and to establish current background concentrations of DDT in crops, agricultural products, and sensitive habitats and species. The assessment plan will also include compliance evaluations by RTI and various partners, including USAID, NEMA, and NDA. The results of these evaluations will be reviewed at the completion of the trial use of DDT-based IRS to identify lessons learned, the areas requiring priority action and the mitigation measures required.

Public Comments

Extensive public hearing and consultations have already taken place in Uganda linked to the development of the Environmental Impact Statement (EIS) on IRS. In addition there have been several public hearings and expert group discussions over the last few years with regards to the re-introduction of DDT. These have previously been documented and will provide good resources.

With regards to this supplementary EA, there has been a process of direct and small group consultations with major national stakeholders, as well as international partners working in the country, and the organization of another public hearing regarding piloting a DDT-based IRS program. The consultant's report on this process is included below.

PUBLIC VALIDATION OF PUBLIC HEARING OUTCOMES AND CONSENSUS BUILDING ON DDT-BASED INDOOR RESIDUAL SPRAYING FOR MALARIA CONTROL IN UGANDA

1.0 Introduction

The National Malaria Control Strategic Plan (2005/6-2009/10) sets strategies for control and prevention of malaria through case management, vector control, behavioral change communication, and information, education, and communication (BCC/IEC). These strategies are also engrained in the national policy framework, and the Health Sector Strategic Plan (HSSP). Current initiatives have emphasized preventive measures including the use of insecticide treated nets (ITNs) and indoor residual spraying (IRS) using ICON (lambda-cyhalothrin). Use of ICON for IRS has been piloted and proved a very useful strategy in several districts of Uganda. The Ministry of Health (MOH) is in the final planning process of piloting DDT-based IRS for malaria, which was approved by the National Environmental Management Authority (NEMA) in December 2006. DDT-based IRS is part of the national plan to scale-up and expand IRS operations to 15 epidemic prone districts by 2008.

In order to provide support to the MOH in the use of DDT for IRS, the U.S. Government requires additional evaluations in the form of a Supplementary Environmental Assessment (SEA). This assessment describes the environmental and human health situation in which the project operates and, based upon this situation, provides a binding set of guidelines that are followed to best guarantee human health and environmental safety.

After the first submission of the SEA, a number of issues were raised, including the following:

- While concerns were expressed during the public hearing process conducted by NEMA for the Environmental Impact Assessment (EIA), the process was not considered sufficiently exhaustive;
- One-to-one meetings with relevant institutions were considered necessary to discuss economic, social, political, and diplomatic implications and the scientific and technical issues of insecticide-based malaria control and, in particular, a DDT-based IRS program in Uganda;
- There was need for RTI to hold public discussions on the re-introduction of DDT;
- It was considered prudent to undertake a further consultative process with communities and relevant organizations, in an objective manner, to acknowledge previously voiced concerns and provide an opportunity for additional concerns to be expressed from a wider cross-section of stakeholders;

- There was need for consensus not only within executing and implementing agencies but also by the target communities on issues and recommendations of environmental impact assessment reports.

As part of the SEA process, RTI organized district-level validation and consensus building workshops, and planned an open public forum to gather further concerns and recommendations on the forthcoming DDT-based IRS pilot initiative.

2.0 Scope of Current Assessment

The tasks of the consultant were to:

- Study the major concerns surrounding the use of DDT for IRS and consult with a cross section of stakeholders on the re-introduction of DDT IRS. This would instruct an analysis of major challenges to the program as well as identify modalities for addressing concerns voiced and attaining program objectives;
- Undertake a consultative and fact-finding field mission to the project target areas to consult stakeholder communities on issues of reintroduction of DDT for malaria control and how to address identified concerns;
- Convene public stakeholder meetings to seek views and validation of the issues and concerns elucidated in the NEMA-convened DDT public hearing;
- Submit a report of activities and outcomes as well as recommended actions that would serve as a guide for addressing the issues and stakeholder concerns.

3.0 Approach

Following the submission of the EIA report and the public hearing, there were a number of issues and concerns raised regarding the re-introduction of DDT for IRS. The initial draft of the SEA elicited comments regarding the general nature of governance, management, and administration of the proposed DDT-based IRS program, the need to provide more attention to the concerns voiced by the agricultural, livestock production, and produce export sectors, and concerns related to human health, animal health, and environmental contamination. This exercise and report attempt to address these concerns, through a process of small consultative meetings with various relevant stakeholders, and a second public forum on DDT-based IRS, and provide recommendations for moving forward.

As part of the SEA process, USAID and RTI agreed to conduct wider public consultations involving the public and target communities that covered:

- Review EIA, the first NEMA convened public hearing outcomes, SEA critique, MOH National Malaria Control Strategic Plan (2005/6-2009/10), MOH HSSP

- One-on-one consultative meetings with selected strategic stakeholders such as agricultural produce and fish exporting firms and key government institutions
- Consultative, validation meetings with target communities in Apac and Kanungu
- Open public consultative forum to review and seek consensus on issues, concerns, and recommendations stemming from the public hearing.

Methodology:

- Literature review
  - Review of EIA document, EIS, public hearing report and outcomes, SEA first draft critique, MOH National Malaria Control Strategic Plan, MOH HSSP
- One-on-one consultative meetings
  - Meetings were held with various stakeholders to discuss the outcomes of the NEMA convened public comment forum, what issues or concerns came to mind for that particular individual stemming from the initial forum, and what further concerns or issues should be considered. The consultant met with the following stakeholders (please see **Annex 17** for a complete list of participants):
    - Fourways Fish Exporters, Luzira
    - Uganda Fish Processors and Exporters Association
    - Agricultural Produce Exporters (Produce Commodity Exchange)
    - Uganda Grain Exporters Association
    - Uganda Export Promotion Council
    - Ministry of Agriculture, Animal Industry, and Fisheries (MAAIF)
    - Members of Parliament for Apac and Kumi Districts
    - Electoral Commission
    - NEMA
    - MOH
    - Apac District Local Government
    - Makerere University
    - European Union
    - Ministry of Industry
    - Private Sector Foundation
- Consultative meetings with communities in Apac and Kanungu

- The consultant and the RTI Chief of Party communicated with district local governments to let them know of the desire to hold a public consultative workshop regarding the use of DDT for IRS. The district councils of the relevant districts invited participants and convened the workshop in centrally identified areas in the respective districts.
- The workshop consisted of the following:
  - Presentation on the outcomes of the NEMA convened public hearing forum: Issues, Recommendations, and Next Steps
  - Presentation on IRS strategy and policy perspectives
  - Presentation on RTI and the implementation modalities of IRS
  - Open discussion
  - Group formation to discuss issues and recommendations (issues for consideration by groups can be found under **Annex 13C**). The following issues were discussed:
    - Management and administrative arrangements for implementation of the program
    - Measures that were being put in place to address specific issues and concerns on:
      - Governance
      - Leakage into primary agricultural production systems
      - Contamination of food, drinking water, agriculture, and livestock produce
      - Contamination of exports-
      - Contamination of the environment
      - Possible effects on human and animal health

Programs for the district validation meetings can be found in **Annexes 14** and **15**.

- Open public consultative forum to review issues, concerns, and recommendations from the public hearing.
  - A public consultative forum was held in Kampala for open discussions on 13 November, 2007
  - It was deemed prudent to invite participants who attended the initial NEMA convened public forum. Thus, the consultant obtained the list of participants from the NEMA convened public forum and invited them to attend.
  - Those who were unable to attend the public consultative meeting in Kampala were subsequently visited as part of the one-on-one consultative meetings with stakeholders to ensure that their views were represented.

– The forum included the following (the program for the public forum can be found in **Annex 16**):
    - Presentation on forum objectives and outcomes of the Public Hearing on DDT-based IRS Program
    - Presentation on policy perspectives and progress toward program implementation
    - Presentation on RTI and environmental compliance policies and programs
    - General discussion on consideration of issues, concerns, and recommendations from the NEMA-convened public hearing
    - General public discussion

This report presents the views of leaders, community representatives, and the public from selected districts of Apac and Kanungu, and the open public forum conducted in Kampala.

4.0 Outcomes of the Public Hearing: Issues and Concerns

After reviewing documentation for the EIA, the first public hearing outcomes, and various other documentation relating to the use of DDT for IRS as a strategy for malaria control, there were certain views and concerns identified, and these are summarized below.

- Management and administrative framework for implementing DDT-based IRS: The concerns included MOH readiness to undertake DDT-based IRS activities, operational DDT safety issues such as presence of guidelines for pre-use registration, procurement procedures, and safe transportation, storage, application, and disposal of the insecticide.
- Deficient capacity for effective and efficient governance of the program
- Modality of conducting EIA – whether it should continue as a one-time activity or the assessment should be continuous in real time circumstances
- Leakage into agricultural production systems and diversion of DDT for use in agriculture
- Contamination of agricultural produce and livestock products for export
- Contamination of food and water for human consumption
- Contamination of food, feed, and water for livestock and wild life
- Pollution of the environment through leakage and contamination

In addition to suggestions from the public hearing on measures to address the concerns, there are currently examples of best practices in use elsewhere for addressing certain issues, and the MOH and RTI are adapting these to local circumstances for future use.

5.0 District Validation and Consultative Meetings

5.1 Apac District Validation and Consensus Building Workshop on Outcomes

The overall objective of the workshop was to provide a platform for considering issues and recommendations expressed during the public hearing, identify additional issues and concerns, and discuss measures to address identified concerns so as to achieve successful implementation of a DDT-based IRS program.

Prior to the workshop, the RTI Consultant, together with MOH Malaria Program Manager and RTI IRS Program Director, met with district leaders and government officials to seek their views on DDT and the proposed DDT-based IRS.

There was general agreement that the issues and concerns discussed during the NEMA convened public hearing, and recommendations on measures to address them, reflected the views of the people of Apac District.

The workshop participants included district leaders and community representatives from all over the district.

There were 41 participants who fall in the following general categories:

- District political leaders (Councilors)
- Community representatives
- Religious leaders
- Senior district executive members
- District health team members
- Uganda Farmers' Association Vice Chairman

Presentations were made on outcomes of the NEMA public hearing, MOH policy and program implementation perspectives, and a presentation from RTI on IRS program and implementation procedures (please see **Annex 14** for the program and list of participants for the Apac workshop).

Following the presentations, stakeholder representatives participating in the workshop reviewed the outcomes of the first public hearing. Participants then went into the general and group discussion sessions to go over the following:

- Management and administrative arrangements for implementation of the program
- Measures that were being put in place to address specific issues and concerns on:
  - Governance
  - Leakage into primary agricultural production systems

- Contamination of food, drinking water, agriculture, and livestock produce
- Contamination of exports
- Contamination of the environment
- Possible effects on human and animal health

The workshop identified the following additional issues:

- Need for community participation to report improper/misuse of insecticide to relevant authorities
- Absence of recommendations on sustainability of the program beyond project life
- Need for increased support for health education
- Community education –safe food storage and post-harvest crop storage
- Research on other methods of malaria control and on resistance to DDT
- Need to encourage households to construct separate stores for food crops

At the end of the workshop, the participants highlighted their belief that, irrespective of the need to set in motion certain monitoring and regulatory and information dissemination measures, a DDT-based IRS program would be beneficial to the people of Apac in that it would reduce the malaria burden they suffered.

As evidence of their support for DDT IRS, the workshop participants, on behalf of the residents and community of Apac District, decided to draft and sign a statement of declaration affirming their support of a DDT-based IRS pilot program. The statement can be found in **Annex 11**.

5.2 Kanungu District Validation and Consensus Building Workshop on Outcomes of the Public Hearing on DDT-Based IRS Program in Uganda

The workshop was organized in a similar fashion to that of Apac's. As in the Apac workshop, the aim of the discussions was to validate previously identified concerns from the NEMA convened public hearing, identify additional issues and concerns, and determine measures to address them if successful implementation of a DDT-based IRS program is to be achieved.

There were over 100 participants including the bishop, two members of parliament, the speaker and members of the District Council, other district leaders, and representatives of the Kanungu community (please see **Annex 15** for the program, list of participants for the Kanungu workshop, and a list of some questions raised).

During the general discussion, the Bishop of Kihihi commented on the successful history of the DDT-based malaria control program during the 1950s in the then Kigezi District, and spoke in support of the re-introduction of DDT-based IRS. He articulated how DDT was sprayed in huts and assured participants that, as far as he knew, he and other elderly people raised during that time were very healthy. His presentation appeared to mollify many and diminish the number of questions.

The District Speaker and Member of Parliament for the area also actively participated in the discussions and assured those who had concerns and reservations that he believed their worries had no basis, but encouraged skeptics to continue to search for factual information.

While commenting on their current experience with ICON IRS, participants expressed overall satisfaction. They noted that incidences of malaria had been reduced due to IRS and use of ITNs.

A number of additional issues/concerns were identified as follows:

- There was resurgence of malaria in the sprayed area
- Maintenance of frequency of re-spray
- Necessity for close supervision of spray operations to ensure the spraying of all homesteads
- Need for continuous monitoring and quality assurance
- Intensification of community health education and awareness building

A few participants expressed concerns on the grounds that there was a long ban on DDT use for crop protection, DDT persistence in the soil has been reported, accumulation of DDT in human fatty tissues may occur, and that alternative pesticides to DDT are available. Other participants dismissed these arguments as unsubstantiated claims lacking scientific data.

Overall, the participants voiced overwhelming support for the program, even though concerns and issues would still need to be addressed (see **Annex 12** for the statement of public support).

Also of Note:

The workshop coincided with the monthly Kanungu District Council meeting and the Kanungu Development Practitioners Conference. As a result, the RTI team (RTI IRS Program Director, RTI Consultant, and MOH Malaria Program Manager) were invited to present the plan for implementing DDT-based IRS at the meeting and the Development Practitioners Conference. The presentation was received with acclamation and the introduction of a DDT IRS program received overwhelming support from members of the council and conference participants.

5.3 Open Public Validation and Consensus Building Forum on DDT-Based IRS Program in Uganda

Within the overarching objective of undertaking wide and exhaustive consultations to identify issues and public concerns on insecticide-based malaria prevention, an additional open public forum was convened to provide the public another opportunity to review the outcomes of the first public hearing, explore further issues and concerns, and discuss recommendations for the safe re-introduction of DDT for IRS as part of malaria control strategies. The public forum was attended by 31 participants representing the commercial and industrial sectors, chemical quality consultants, civil organizations, community development agencies, environmental NGOs, the quality and standards bureau, academic institutions, government institutions, and WHO.

In addition to the issues and concerns expressed during the public hearing, useful observations and additional concerns were expressed at the open forum. They included the following:

- Public perception of DDT and consequences these perceptions have on agricultural produce for export
- Need for consumer confidence building, locally and abroad
- Lack of information flow among and within interest groups and stakeholders
- Weak chemical monitoring framework
- Inadequate capacity for chemical residue analysis in food and agricultural produce export chain
- Need for intensification of research on alternative malaria control methods and their integration with DDT IRS
- Lack of national chemical management policy
- Need for strengthening monitoring and surveillance capacity
- Need for strengthening MOH capacity for coordination of DDT-based IRS initiative
- Need for an empowered, robust, and efficient multi-sectoral task force to ensure quality assurance

There was substantial evidence throughout the open forum debate, as well as the one-to-one discussions, that many of the critiques of DDT failed to differentiate perceptive issues from scientific and technical issues. When challenged on technical facts many lacked the confidence to defend their information. This suggested that some of the issues raised in relation to the use of DDT for IRS stemmed from a pre-conceived perception of DDT resulting in mainly negative effects.

Furthermore, another prevalent concern was the possible effects that the use of DDT for IRS could have on external markets for exported produce. A counter comment suggested that the production of agricultural products for export requires a healthy, malaria-free workforce.

The need for local and external confidence-building was stressed. Participants noted that demonstrated evidence should be provided to the general public and end-consumers of agricultural and livestock produce of Ugandan origin. A key requirement for this would be putting in place an effective monitoring system.

6.0 Consolidated Public Views, Concerns, and Recommendations

The consultations identified the following four categories of concerns on reintroduction of DDT for IRS (more detailed descriptions of each category can be found in section 8.0):

(a) Policy Issues and Concerns

- General views on policy concerning re-introduction of DDT for malaria control
- Appropriateness of DDT as an alternative IRS pesticide
- Resurgence of malaria in sprayed areas
- Context of DDT in IRS
- Investment cost of DDT IRS
- Implementation of NEMA conditions
- Intended areas of IRS
- Government readiness for DDT operations
- Sustainability of DDT-based IRS Malaria Control Initiative beyond the provision of donor funding for the project
- Need for policy on chemical management
- Building/strengthening capacity for risk monitoring and surveillance, particularly food monitoring and residue analysis capacity of MAAIF

(b) Program Management and Implementation Concerns

- Need to address a range of concerns that may emerge due to implementation of the program
- Compliance with NEMA conditions and Stockholm Convention
- Coordination and inter-institutional cooperation
- Governance, management, and administration concerns
- Baseline study as a condition for reintroduction of DDT for IRS
- Public and community education and exposure

- Constant review and revision of strategies
- Building financial and technical capacity to execute and sustain the DDT-based IRS in districts beyond the provision of donor funding for the project

(c) Operational Issues and Concerns

- Safeguards – water quality, food, and livestock feed –monitoring and residue analysis
- Inadvertent use/leakage in agriculture primary production systems
- Dangers and consequences of non-recommended use of DDT in agriculture
- Risk of contamination of produce for export and domestic consumption
- Risk of contamination of food, drinking water, and human and animal habitats (including soil)
- Reactions to environmental monitoring of fauna populations
- DDT toxicity and how to eliminate toxicity risk
- Impact of DDT persistence

(d) Public Information Management Issues and Concerns

- Information feedback
- Information sharing for civic education and literacy
- Need for confidence building among civil society, domestic consumers and international markets, produce exporters, etc.

The general public view is there are indeed issues and concerns regarding the reintroduction of DDT for use in public health. Views from the public hearing and consultative meetings stress that lessons and experiences have been acquired and there are some measures and best practices in use elsewhere that MOH and RTI should adopt and adapt to address local concerns.

Table: 1. Summary of Concerns, Recommended Actions, and Institutions Charged with Action Implementation

Concern	Recommended Action	Institution Responsible	Time Line
1. Policy Concerns			
Reintroduction of DDT	Policy and approval	MOH,NEMA, RTI	December 2007
DDT appropriateness as IRS pesticide alternative	Policy and approval	MOH, NEMA	December 2007
Context of DDT in IRS	Public education	MOH	Continuous
Invest cost of DDT IRS	Provision of quantified data	MOH, RTI	December 2007
Implementation of NEMA	Provision of progress	MOH, RTI	Continuous

Concern	Recommended Action	Institution Responsible	Time Line
conditions	reports		
Definition of IRS areas	Indication of present And intended areas of DDT IRS program	MOH	Immediate and continuous as program upscales
Government readiness For DDT operations	Report	MoH	November 2007
Sustainability of DDT-based IRS program	Policy adoption	MOH	December 2008
Chemical management policy	Policy adoption	NEMA	December 2008
Building risk management capacity	Training, upgrading infrastructure, sensitization, and awareness building	MOH, NEMA RTI	Continuous
2.Program Management and Implementation Concerns			
Addressing emerging concerns	Designing, developing, and implementing procedures and solutions	MOH, NEMA RTI, MAAIF MWE, MTTI, Other stakeholders	Immediate and continuous
Compliance with NEMA conditions	Implementing policy, formulating measures, developing implementation frameworks, provision of reports	MOH, RTI, MAAIF MWE, MTTI	Immediate and continuous
Coordination and inter-institutional cooperation	Establish structure and action plan, secure funding, operationalize	MOH	January 2008
Governance and manage-ment concerns	Develop framework for governance, operationalize	MOH, RTI	Immediate and continuous
Pre-introduction baseline studies	Establish benchmarks And action plan	MOH, RTI NEMA	Immediate and continuous
Public and community education and exposure	Develop and execute Program	MOH, RTI	Immediate and continuous
Constant review and revision of strategies	Constant evaluation and update of operation strategies	MOH, RTI	Continuous
Building financial and technical capacity	Develop strategy and action plan	MOH, RTI	Continuous
3. Operational Issues and Concerns			
Safety safeguards	Develop framework and operationalize action	RTI	Immediate and continuous
Use/leakage in primary agricultural production systems	Develop framework and operationalize action	RTI	Immediate and continuous
Dangers and consequences of non-recommended use of DDT	Develop framework and operationalize action	RTI, MAAIF, MWE, and all stakeholders	Immediate and continuous
Produce contamination risks	*Same as above*	*Same as above*	*Same as above*
Food, water, and habitat contamination risks	*Same as above*	*Same as above*	*Same as above*
Reactions to environmental	*Same as above*	MOH (TF)	*Same as above*

Concern	Recommended Action	Institution Responsible	Time Line
monitoring, fauna populations		RTI, MWE	
DDT toxicity	Develop framework for surveillance and action	MoH, RTI MWE, MTTI, MAAIF	*Same as above*
Impact of long duration DDT residual action	*Same as above*	*Same as above*	Continuous
4. Public Information Management Issues and Concerns			
Information feedback	Provision of reports	MOH, RTI,MWE, MTTI, MAAIF, all stakeholders	Continuous
Civic education and Information sharing	Conducting education sensitization, awareness raising	*Same as above*	
Confidence building	*Same as above*	RTI, MOH, MOFA, MTTI, MAAIF, all stakeholders	Immediate and continuous

MOH= Ministry of Health, MAAIF=Ministry of Agriculture, Animal Industry, and Fisheries, MTTI= Ministry of Tourism, Trade, and Industry, MOFA= Ministry of Foreign Affairs, RTI=Research Triangle Institute International, MWE= Ministry of Water and Environment, NEMA=National Environment Management Authority, TF=Task Force.

7.0 Conclusion and Recommendations

The identified issues and concerns will need to be addressed in several ways by different institutions. Concerns in the policy category are essentially a responsibility of the MOH and relevant governing and monitoring bodies. In general, the policy concerns that were voiced during consultative workshops will need to be addressed by the MOH; there were some key issues that came up that should be considered a priority.

Priority areas of concern that need to be addressed by government are:

- Sustainability
- The need for policy on chemical management
- The need for risk monitoring and surveillance (particularly food monitoring and building the residue analysis capacity of MAAIF)

Sustainability as a policy issue applies to all pesticide-based IRS project initiatives. It is, however, linked to long-term implications of DDT-based IRS efforts, which could lead to DDT resistance in mosquitoes. While monitoring DDT resistance will be undertaken in the process of operationalization of the project, consideration should be given to intensifying research on alternative IRS pesticides for vector control. The MOH has already taken a lead in scaling up its efforts to educate the public and address existing misconceptions on the use of DDT for malaria control. Similar efforts are encouraged in partner institutions that have a stake in the initiative.

It is apparent that project management and implementation concerns are issues that will need to be addressed by the MOH and its implementing partner RTI. Capacity needs to be built within the MOH to efficiently address the increased management and administrative needs highlighted by the concerns articulated during the workshops, and these will have some cost implications for the MOH.

Some operational concerns are already being addressed by measures put in place by RTI and gleaned through lessons learned on other IRS operations in several districts. However, RTI must be prepared to contend with the contemplated increase in demand for IRS following initial successes of the Kanungu and northern Uganda IRS operations. The successes have created hope among the malaria prone communities, who will inevitably press for similar IRS intervention. As the public gains greater confidence in the IRS approach to malaria control, there will emerge increased pressure on MOH to extend the program to other districts. RTI, together with MOH, should take proactive measures in preparation for these demands through (i) capacity building, (ii) strengthening its perspective planning capability, and (iii) seeking financial support for anticipated activities.

The MOH and RTI ventured into the IRS initiative as a pilot program based on the successes of a similar program in Uganda in the mid-1950s. Both the ICON and upcoming DDT IRS initiatives are at trial stages. The Kanungu ICON project has been commended and endorsed as successful by the target community. The lessons and experience from the Kanungu pilot project are strong foundations upon which the Apac DDT-based IRS initiative can be built. The MOH has secured a confident position, and RTI has built the capacity to scale up and expand the IRS program to other Uganda malaria prone areas. It is important that MOH begin planning for an IRS expansion program.

It is recommended that consideration be given to support the following:

- Building capacity for risk monitoring and surveillance, particularly the strengthening capacity for monitoring food contamination and residue analysis
- DDT resistance management through strengthening capacity for monitoring the long-term impact of use of DDT
- Strengthening district-based health education to enhance IRS malaria control programs
- Improving crop storage practices to promote safety of food crops and produce for export
- Strengthening the program coordination framework to increase its effectiveness

- Building RTI capacity for public relations and consumer confidence building in preparation for possible negative press concerning the use of DDT for IRS

8.0 Addendum to the Report

Policy Issues and Concerns

Re-Introduction of DDT for Malaria Vector Control

The issue of public acceptance of DDT was raised for debate in the open public forum in Kampala and at the district workshops in Apac and Kanungu. The argument was that the effectiveness of IRS using DDT could be undermined if it were poorly accepted by the target communities, and that some people could refuse to have their houses sprayed. On the contrary, the target communities of Apac and Kanungu argued in support of DDT, citing examples of DDT use in 1950s and 1960s for control of field pests on cotton, beans, and maize and for control of storage pests throughout Uganda. The participants in the Kanungu validation and consensus-building workshop were quick to point to the useful contribution of DDT in malaria control in the 1950s. While participants agreed that DDT had long-lasting effect where it was applied, they denied any evidence of alleged DDT toxicity on human beings or livestock. While it is good that target communities are supportive of DDT, it is worrisome that they are so supportive for its widespread use in an agricultural context, and this highlights the need for strict controls against its inappropriate use. IEC will educate communities on the risks of DDT, and explain that its sole purpose is for IRS to control malaria. Assessment of this understanding should be done and IEC adapted to ensure that these messages are understood.

There was unanimous approval of reintroduction of DDT for malaria vector control by leaders and community representatives in both Apac and Kanungu Districts and with isolated reservations at the open public forum in Kampala.

However, the issue of perception of DDT reintroduction and how to address it should be put in context of the present DDT-based IRS program. The reserved acceptance of DDT reintroduction is partially fueled by lack of information and misinformation. As part of its integrated approach, RTI will need to consider investing in, or structuring its current initiatives to accommodate, an element of client-tailored education and the provision of accurate information to the public that will help to inform their decisions of acceptance or rejection of DDT-based IRS.

DDT as an Appropriate Alternative

Adoption of alternative chemicals and the question of whether DDT is an appropriate alternative in Uganda's IRS programs were discussed during the open public forum and district validation and consensus building workshops. It was observed that DDT was not an alternative intervention but part of an integrated vector management intervention strategy. In Kanungu, leaders and community representatives observed that ICON had proved effective and successful in reducing malaria incidence, only that re-spray was overdue; confirming the short residual effect of the pyrethroid and risk of malaria resurgence. In this type of spray regime the cost of treatment could likely be more expensive than DDT or even the carbamates and organophosphates endorsed by WHO for use in malaria vector control. The leaders and target communities of Kanungu and Apac questioned the wisdom of condemning DDT in public debates without practical evaluation of its effectiveness and impact in real situations in comparison with available alternatives. It was argued that any decision to exclude DDT or another pesticide option would make sense only after its application in the environment and evaluation thereafter of its impact.

Context of DDT in IRS

DDT for malaria vector control has caused much debate because of information, in some cases misinformation, on its comparative persistence in the environment and possible bioaccumulation in fatty tissues. Its opponents have used these arguments as evidence of the dangers it might pose when applied through the IRS program. In the validation and consensus building workshops, several opponents alluded to DDT being toxic but were unable to provide technical data as evidence. The representative of MOH (Dr. J. Rwakimari) presented the participants with recorded information regarding DDT safety, as well as scientific data on DDT toxicity and residue accumulation trends. He argued that the problems encountered in other countries with the use of DDT in IRS were mostly connected to operational procedures, which in the case of Uganda would be handled effectively by MOH and RTI as implementing agency. For the representatives of the target communities, these explanations cast doubt on speculative claims on the negative effects of DDT use in IRS.

The challenge for the DDT-based IRS program in Uganda is to ensure efficient operational procedures are in place and best management practices during DDT IRS are followed. RTI and MOH are strengthening existing procedures and supervisory capacity currently in place.

Investment Cost of DDT IRS

The Apac District leaders and community representatives were careful in their analysis of operational costs for DDT application and came to the conclusion that operational costs such as transport, spray personnel, and spray equipment were likely to be similar for a given location irrespective of what chemical was used, and that the difference in cost would be based on the type of chemical purchased for use, the quantity applied, and how much labor was involved.

Compliance with NEMA Conditions

The participants in the validation and consensus building workshops and open public forum asked about the specific conditions NEMA set for reintroduction and use of DDT IRS, and the progress made in addressing them or measures put in place to implement them. MOH and RTI responded to these issues by elaborating that NEMA approval was for the use of an integrated approach to malaria control involving chemicals and other approaches, including biological control and environmental sanitation methods. Information given by MOH indicated that the conditions of DDT approval were that:

- Necessary approvals from the Secretariat of the Stockholm Convention and WHO be obtained prior to reintroduction of the pesticide,
- Importation and application of DDT be carried out in accordance with WHO recommendations and guidelines,
- A multi-sectoral/multidisciplinary monitoring committee to oversee implementation of the environmental concerns of DDT re-introduction be established, and that
- The environmental monitoring and management plan as contained in the EIS be implemented, and monitoring reports be submitted as per Section 78 of the NEMA Act.

Other conditions focused on:

- Advance awareness creation to prepare the population for re-introduction of DDT, and awareness building within the target communities on operational aspects of DDT IRS program, and
- Procedures concerning importation, transportation, storage, application, and disposal.

The conditions also require that any other unforeseen undesirable environmental impact that may arise due to implementing the DDT IRS project be addressed.

The participants in all the fora were assured that MOH had addressed the general policy issues; it sought the necessary approvals, had developed a framework and

guidelines for implementation of the environmental monitoring and management plan, and was in the final process of establishing the multi-sectoral/multidisciplinary monitoring committee.

RTI completed arrangements for handling the operational issues and together with MOH had embarked on initial awareness raising initiatives as part of the IEC program. Emerging from the consultative and consensus building workshops, however, it is apparent the awareness program will need to be expanded to include confidence building and public relations to improve the image and public understanding of integrated malaria control strategies, and DDT IRS issues in particular. As part of these latter elements, there will be a need for effective generation and delivery of factual information and data. RTI and MOH are advised to seek USAID support for this initiative.

RTI will be expected to look out for other undesirable environmental impacts not contemplated by NEMA, identify possible hazards that could arise from DDT IRS, and take mitigation action. It follows that RTI needs to put in place proactive surveillance and intelligence analytical frameworks to detect other environmental impacts not contemplated at the time of undertaking the EIA. The efficacy of the surveillance framework will depend on the existence and effectiveness of an environmental monitoring system. USAID, as the agency supporting the DDT IRS initiative, might consider including a budget for financing such a framework.

Safeguards and Government Readiness for DDT IRS Operations

The public hearing recorded concerns of a general nature focusing on governance, management and administration as well as methodological and logistical issues. It also brought up concerns related to agricultural primary production systems, agricultural produce and livestock product exports, human and animal health, and environmental contamination. The issues and concerns dealt with policy, project implementation, and operational issues. Policy, governance, and project implementation management issues were identified and referred to MOH and RTI as issues to be handled, but emphasis was laid on effectiveness and efficiency, which stakeholders felt were deficient in government machinery. Further emphasis was laid on safer use of DDT in IRS for safety of human and animal health and the environment, which public hearing participants stressed as key issues. MOH and RTI took note of the public concerns, and have since taken steps to address them by designing and putting in place measures of good management and spraying practices—such as improvement of decision-making pathways, up-scaling technical proficiency of project actors, designing procedures and mechanisms for minimizing human and environmental safety hazards—required in order to achieve the project objective of reducing the local malaria burden.

Intended areas of IRS

Intended areas of DDT IRS were discussed and both participants and leaders agreed that all households in Apac and Oyam Districts should be covered except those in sensitive ecosystems and protected areas. It was also agreed that much as public health by-laws to enforce IRS in every household existed, the current DDT IRS exercise should be voluntary. The IEC campaign should endeavor to obtain cooperation from the residents of the community as much as possible. However, individuals who refuse the use of DDT for IRS in their homesteads should be left out of the exercise.

Sustainability of DDT-Based IRS Malaria Control Initiative

The challenges of sustainability of the DDT IRS program were discussed in both Apac and Kanungu district workshops. Participants observed that many useful projects collapse when funding expires. The importance of building institutional systems and complementary local efforts to ensure continuation of the IRS program beyond project life was stressed. Ministries in charge of health and local government were urged to plan ahead and develop strategies with donors and development agencies to ensure continuity of IRS as part of institutionalized government programs.

Need for Policy on Chemical Management

At the open public forum participants expressed concern for the absence of a comprehensive national chemical management policy and observed that successful implementation of current IRS initiatives and similar efforts should be guided by a national policy that apportions shared responsibility across stakeholders. This is a policy issue that should receive desired government attention.

Building/Strengthening Capacity for Risk Monitoring and Surveillance

There is need to strengthen the public domain and ensure full, open, and equitable access to scientific and technical data for confidence building. This observation emerged from the open forum as an additional recommendation from participants, which they stressed as critical for the DDT IRS to achieve significant impact on reduction of the malaria burden in Uganda. In the context of present DDT IRS efforts, it is recommended that development partners, particularly USAID, consider supporting a program focused on strengthening the monitoring capacity of existing government institutions involved in the surveillance of risk levels associated with the DDT IRS initiative.

Program Management and Implementation Concerns

The major program management and implementation concerns stressed the need to address a range of other concerns that may emerge during the process of implementation of the program. They further stressed the importance of effective coordination and inter-institutional cooperation, which is a MOH responsibility. Other issues of program implementation that call for attention relate to constant review and revision of strategies to keep the program on course.

Operational Issues and Concerns

Operational concerns focused on possible DDT leakage into agricultural primary production systems, dangers and consequences of non-recommended use of DDT in agriculture, risk of contamination of produce and export products as well as food and water for drinking, misuse of DDT for unintended purposes, and implications of DDT leakage into faunal habitats.

Measures to address these concerns rely heavily on designing functional operating procedures; regulating mechanisms and successful audit and monitoring systems that ensure effective control of chemical procurement; safe storage, application, and disposal of the pesticide; and adherence to safety principles. RTI has designed an implementation framework, and in particular a program for environmental monitoring of DDT IRS in Uganda, that address these concerns and operational issues. Furthermore, RTI is currently working on designing a robust environmental monitoring plan in order to work with the MOH in ensuring the safe use of DDT and limiting any negative consequences of using this particular insecticide for IRS operations.

Public Information Management Issues and Concerns

Development of specific initiatives such as information feedback in the process of project implementation, information sharing for civic education and literacy, and dissemination of information as part of continuous awareness creation and confidence building among civil society, domestic consumers, international markets, produce exporters, and other key stakeholders are issues that will need to be scrutinized in order to find effective means of addressing them.

Document Preparation

This Supplementary Environmental Assessment is prepared by Jacob E. Williams, RTI Consultant. The SEA is based on:

- Direct discussions and other direct communication with staff from a wide range of organizations/stakeholders, who also provided critical reports, including MOH/NMCP, NEMA, NDA, Ministry of Agriculture, Uganda National Bureau of Standards, WHO, District Health/IRS Officials

(Kabale, Kanungu, and Kitgum), Chemistry Department - Makarere University.

- Direct observation of IRS operations and inspection of selected district stores during a compliance evaluation by the Consultant in 2006 and 2007.
- A preceding EA prepared in 2006 by RTI in connection with the original proposal for USAID support of pyrethroid-based IRS in Uganda.

The preparation process was also greatly facilitated by technical discussions with relevant staff of the USAID/Uganda Mission, CDC PMI Advisor Linda Quick, Mike MacDonald, and RTI staff.

A special thanks also goes to the National Malaria Control Program Uganda (Dr. J. B. Rwakimari and Mr. Michael Okia), and to Dr. Nyiira for organizing the public comment hearings and small consultations.

Annex 1: Potential risks related to DDT-based IRS implementation and associated mitigation measures

**RTI will work with relevant primary national agencies, and provide close supervision, to ensure that the safeguards are appropriately established for piloting DDT-based IRS in Apac District.

RISKS RELATING TO DDT LIFE CYCLE	RISK LEVEL	MITIGATION MEASURES	RESPONSIBLE AGENCY
Procurement			
Procurement from uncertified sources	L	▪ Good registration process requiring submission of specification, source of supply etc. ▪ Designation and licensing of a local importer, linked to a known single international supplier ▪ Establishment of a transparent tendering process	NDA & MOH NDA & MOH NDA & MOH
Importing wrong pesticide specification	L	Above listed mitigations plus ▪ Robust inspection at port of entry and manufacture specification	NDA & Customs Dept
Pilferage at port-of-entry and enroute to central storage	H	▪ Linking transportation from port-of-entry to central warehouse as part of importer responsibility ▪ Use of certified/licensed drivers and dedicated transportation. ▪ Use security guard during transportation	NDA & MOH NDA, MOH, Importer Importer & MOH
Pilferage at central stores	L	▪ Pesticide stock protected by same high level security for drugs and other essentials	MOH
Inland transportation			
Inadequate transportation	M	▪ Use of certified/licensed drivers and dedicated vehicles.	MOH & NDA

RISKS RELATING TO DDT LIFE CYCLE	RISK LEVEL	MITIGATION MEASURES	RESPONSIBLE AGENCY
Pilferage	L	▪ Use security guard during transportation ▪ For piloting DDT will be under direct control and custody of RTI.	MOH
Transport relation incidents	M	▪ Transporters trained on first response to incidents (e.g. secure site, call emergency response)	MOH
Storage and pesticide management in districts/ sub-districts			
Pilferage	H	▪ Secure, dedicated and licensed storage facilities ▪ Use Security guard ▪ Strict auditing scheme (e.g. daily spray cards, team leader daily summary cards, supervisor daily summary cards)	MOH & NDA MOH MOH
Inappropriate storage practices	H	▪ Regular inventories ▪ Trained storekeepers in pesticide management ▪ Regular inspections ▪ Stewardship contribution by importer/vendor to facilitate best practices ▪ Good storage maintenance ▪ Effective inspection regimes	MOH MOH MOH Importer & MOH MOH MOH, NDA, NEMA , USAID/P

RISKS RELATING TO DDT LIFE CYCLE	RISK LEVEL	MITIGATION MEASURES	RESPONSIBLE AGENCY
End-use of DDT: Human safety			
Exposure of spray operators and other handlers	H	▪ Training on best practices for all categories of workers ▪ Exclude women from spray operation related activities ▪ Medical check up for spray operators	MOH
		▪ Use of full PPEs by spray operators	MOH
		▪ Availability and effective use of ablution facilities	MOH
		▪ Clear criteria for reprimand for non-compliance	MOH
		▪ IEC implementation to enhance household safety and compliance (2-hr wait time before re-entry etc.)	MOH
		▪ Field supervision to assure best operator practices	MOH
Exposure of households	H	▪ Avenue for receipt of household complaints	MOH, District Administration
		▪ Effective inspection regimes	MOH, NEMA, USAID/P
Poisoning incidents	L	▪ Staff training and IEC with components aimed at preventing poisoning. ▪ Capacity for poison management enhanced: o Training of all category of workers to identify danger signs and required response o Train health workers, designate and equip district reference points for treatment of incidents of pesticide poisoning	MOH
End-use of DDT: Environmental Safety			
Environmental release from handling/spray activities	H	▪ Best practices (triple wash/rinse water re-use)	MOH
		▪ Use of evaporation tanks	MOH
		▪ Prohibition of decanting into streams and open drains	MOH
		▪ Prohibit worker washing in streams	MOH
		▪ Clear criteria for reprimand for non-compliance by IRS workers	MOH
		▪ Effective inspection regimes	MOH, NEMA, USAID/P
Environmental release from other foreseeable activities/incidents	L	▪ Sweeping of household or crumbing of mud walls	
Non-recommended use in agriculture	M	▪ Secure storage, management and inventory system	MOH
		▪ Effective enforcement	Police etc.
		▪ Significant punitive measures against pilferage and unauthorized use of DDT	GoU
		▪ Effective IEC on dangers and consequences of non-recommended use of DDT in agriculture and good storage practices for agri-products stored in homes.	MOH, MOA
		▪ Effective coordination and communication between MOH, MOA and Agric-based NGOs for timely identification and amelioration of any risks brought on by changing situations.	MOH. MOA, NGOs
Disposal			
Release of empty	H	▪ System of strict auditing (see above) enable	MOH

RISKS RELATING TO DDT LIFE CYCLE	RISK LEVEL	MITIGATION MEASURES	RESPONSIBLE AGENCY
sachets/packaging materials general environment or reused for non-recommended purposes.		accounting of each sachet of DDT and packaging materials ▪ Retrieval of all empty sachets/packaging to a central secure location ▪ Prohibiting burning or reuse of empty sachets or packaging materials for ANY purpose.	MOH MOH

Risk: H = High, M = Medium, L = Low USAID/p = USAID and its partners

Annex 2: Status of Implementation of NEMA Requirement for Re-introducing DDT-based IRS in Uganda

NEMA Conditions	Status of Preparation	Outstanding Issues and Needs
General Conditions		
Obtain necessary approvals from Secretariat of the Stockholm Convention and WHO in line with Annex B Part II of the Convention	Uganda has informed The secretariat of the Convention of its intention to use DDT for IRS in accordance with guidelines and recommendations of WHO.	According to Provisions of the POPs Convention Uganda needs to ***inform*** the named recipients of the decision to use the insecticide - not to receive ***approval***. Decision considered a sovereign right of the country.
Importation and application of DDT should be carried out prudently and in line with WHO recommendations and guidelines: - Importation to strictly follow guidelines set by NDA and recommendations of WHO regarding specification, labeling of dangerous chemicals. - Distribution to be done solely by MOH to prevent unauthorized access. Adequate training and contingency planning for managing incidents of spillage. - Storage in secure and appropriate facilities, compliant with standard guidelines. - Application to strictly follow Stockholm Convention on POPs and WHO guidelines, and carried out by trained and adequately protected personnel under strict supervision - All waste (including empty containers, wastewater from operations, obsolete insecticides) properly disposed off in compliance with national environmental (waste management) regulation; ensure	▪ Development of specific regulations on DDT by NDA far advanced. Draft covers all stages of life cycle of the insecticide (registration, procurement, transportation, storage, handling, use, disposal). Consultations and expert review on draft completed. ▪ NMCP has developed guidelines for DDT-based IRS to regulate implementation.	▪ NDA regulations will need to be fully completed and formally adopted by Government. ▪ Following completion of Regulations DDT will then need to be formally registered for IRS in Uganda. ▪ Aside from the risk evaluation in this SEA, the NMCP should carry out full risk assessment based on actual processes to be adopted and devise tailored mitigation. ▪ Current training programs linked to Pyrethroid-based IRS, will need to be adapted to ensure adequate preparation of all category of DDT handlers/users on best practices. ▪ Also see Annex 1 and 2, for additional policy perspectives,

NEMA Conditions	Status of Preparation	Outstanding Issues and Needs
full compliance with Cap 153 of National Environmental Act regarding avoiding/mitigating potential environmental impact.		modifications in best practices, and mitigation measures that may apply
Establish a professional and competent multisectoral/multidisciplinary monitoring Committee to oversee implementation of environmental concerns of DDT re-introduction. Committee should include NEMA, MOA, Animal industry & Fisheries, Tourism, Trade and Industry, Water and Environment, Private Sector, NGOs and other stakeholders deemed necessary and agreed upon.	MOH has formally invited representation from the following Agencies to constitute a committee; MOH; NEMA; Ministry of Agriculture, Animal Industry and Fisheries; Directorate of Water Development; Uganda National Bureau of Standards; NDA; Government Analytical Laboratories; Ministry of Gender, Labour and Social Development; Climate Development Initiative (local NGO to represent the Private Sector); Uganda Consumers Protection Association (UCPA); Uganda Export Promotion Board; WHO; FAO	▪ Committee to be formally constituted, and TOR and roles/responsibilities of partners yet to be outline by a fully constituted Committee
Implement Environmental Monitoring and Management Plan and ensure submission of reports every four months to NEMA.	▪ Yet to be developed. ▪ General guideline outlined by this SEA could contribute to the process of developing the monitoring plan.	▪ This will have to follow the constitution of Intersectoral Environmental Monitoring Committee, and clarity on implementation processes to be adopted for the DDT-based IRS.
Awareness Program		
Ensure effective awareness program through various media and other possible means to prepare population, and in any case not later that 3 months before IRS exercise begins (to include awareness and community mobilization for adequate protection of beneficial households and	▪ Effective IEC campaign already used for pyrethroid-based IRS implementation. Envisaged similar outreach will be implemented for DDT-based IRS with relevant adaptation to address the	▪ Tailoring of IEC to address peculiar issues of DDT. IEC to be preceded by quick on site community. ▪ Improved coordination and communication between MOH, MOA and agric-based NGOs

NEMA Conditions	Status of Preparation	Outstanding Issues and Needs
general environment)	peculiarities of DDT.	to sustain ongoing relevance of IEC messages and delivery.

Annex 3: Required Mitigation Activities for IRS Program in Uganda

The following table summarizes mitigation measure outlined in relevant sections of the SEA (e.g. Section on PERSUAP; Sections D and G of Pesticide Procedures; Annex I) and indicate the timing of these measures. The reader/ IRS implementer should therefore refer to these sections for details and specifics on the mitigation measures.

Pre-Campaign	During Campaign	Post-Campaign
Ensure compliance with national regulations on pesticide and MOH guidelines on IRS and vector control. In particular, specific new regulations under development by NDA on DDT will establish procedures for registration and importation, and outline requirements for transporting, labeling, handling, use, storage, and disposal of the insecticide. ***RTI should ensure full compliance of relevant national and international guidelines, as set out in this SEA***	***Follow guidelines for malaria vector control and Pesticide registration and MOH guidelines on IRS and vector control***. These provide adequate information on appropriate handling for all stages of the pesticides lifecycle. To strictly follow the specific regulations under development by NDA for the life cycle of DDT use in malaria. ***Assure secure chain of custody of pesticide.***	***Ensure compliance with national regulations on pesticide and MOH guidelines***. Ensure that unused pesticides are properly stored and secure. To strictly follow the specific regulations currently being development by NDA for use of DDT for IRS, as well as this SEA.
Ensure effective quality assurance/control schemes for commodity (pesticides, equipments and PPEs) ***Establish verifiable procurement sources and product quality.***	***Reduce household exposure***: cover furniture that cannot be moved with cloths prior to spraying, and prohibit spraying in rooms where sick persons or pregnant women are living and cannot stay outside the home during and one hour after spraying	***Retrieve and store all empty DDT sachets from districts*** in a single designated and secure place until the country reaches a final decision on final disposal.
Train spray operators, team leaders, and supervisors, **store operators and transporters** according to best practices, as outlined by the World Health Organization (WHO), the MOH guidelines on IRS and this EA.	***Ensure adequate protection of spray operators*** *through the use of appropriate personal protection equipment.* ***Exclude females from DDT spray teams. Reassign to IEC and other responsibilities that minimize direct contact with pesticide.***	
Train health workers in insecticide poisoning treatment and ensure availability of treatment medicines in districts targeted for IRS.	***Reduce environmental contamination*** through strict auditing, handling, washing and disposal practices. Each insecticide sachet will be strictly accounted for; contaminated waste-water/rinse-water will be re-used in subsequent days of spraying (progressive rinsing); and use of ablution blocks and evaporation tanks for other contaminated waters from clean-up will reduce environmental contamination.	

Pre-Campaign	During Campaign	Post-Campaign
Educate target communities and households through an Information, Education, and Communication (IEC) campaign – emphasize issues relating to minimizing exposure risks; non-spraying of food stores, (removal of all food, water and utensils from house before spraying: moving furniture to the center of the room or outside: prevent re-entry of sprayed house for at least 1 hour and sweep floor of residues before allowing children or animals in the house; minimizing risks to agric products stored in homes by tailoring IEC to farming communities and increasing collaboration with farmer-group organizations and MOA	***Initiate Monitoring of Pesticides used in IRS to the extent feasible and relevant with technical support from*** ***Establish robust field inspection regime to ensure compliance with SEA and relevant guidelines.***	
Inform fire brigades of the location and contents of storage facilities.		
Initiate monitoring of pesticides used for IRS and impacts on environment, to the extent feasible and relevant, with technical support from EPA and USAID as needed.		***Continue with the monitoring of pesticides used for IRS and impacts on environment as per agreed protocol,*** to the extent feasible and relevant, with technical support from NEMA and USAID, as needed.
USAID will discuss importance of an environmental assessment for any pesticides used in IRS will be discussed with MOH and NEMA staff		

Annex 4: Vector Control Manpower Available In Uganda

NO.	DISTRICT	MANPOWER REQUIRE-MENTS	MANPOWER AVAILABLE	*GAPS*
1.	ADJUMANI	1	-	1
2.	APAC	2	Ogwang Martin-VCO	1
3.	ARUA (Arua, Kaboko, Maracha)	3	Daniel Obiga - VCO Antony Angwaku - VCO	1
4.	BUGIRI	2	Fredrick Kadama - VCO	1
5.	BUNDIBUGYO	1	-	1
6.	BUSHENYI	3	Ephraim Mutuuzi - VCO	2
7.	BUSIA	1	Robert Mulimba - VCO	0
8.	GULU (Gulu & Amuru)	2	Constatine Owoo - VCO	2
9.	HOIMA	1	Isingoma Thompson –VCO -	1
10.	IGANGA (Iganga & Namutumba)	2	Anthony Ochola – VCO	1
11.	JINJA	2	Gilbert Bayenda – VCO	1
12.	KABALE	6	James Turyeimuka – VCO Grace Turyakira – VCD Geoffrey M. Akankwasa – VCO Richard Twijukye – VCO George Mumbere – VCO Julius Mwangusya - VCO	1
13.	KABAROLE	2	Ephraim Tukesiga – VCO Evaristo Cakiira - VCO	0
14.	KABERAMAIDO	2	Charles Elamu	1
15.	KALANGALA	1	-	1
16.	KAMPALA	5	Badru Mukasa - VCO - Kawempe - - Rubaga - - Central Vincent Katamba VCO – Makindye - - Nakawa -	1
17.	KAMULI (Kamuli & Kaliro)	2	Moses Waiswa – VCO	1
18.	KAMWENGE	2	Joseph Wamani - VCO Olowo Vincent – VCO	0
19.	KANUNGU	1	Lauriano Hakiri – VCO	1
20.	KAPCHORWA (Kapchorwa & Bukwa)	2	John Towett – VCO	1
21.	KASESE	2	Edward Banoba - VCO	1
22.	KAYUNGA	2	Cosmas Ganafa – VCO	1
23.	KATAKWI (Katakwi & Amuria)	2	Charles Okiror - VCO Julius Peter Okello - VCO	0
24.	KIBAALE	2	Christopher Twebaze - VCO	1

NO.	DISTRICT	MANPOWER REQUIRE-MENTS	MANPOWER AVAILABLE	*GAPS*
25.	KIBOGA	1	-	1
26.	KISORO	1	Christopher Ruzaza – VCO Hebert Agumeneitwe - VCO	0
27.	KITGUM	1	Komakech John Bosco-VCO	1
28.	KOTIDO (Kotido, Kaabong & Labwor)	2	-	2
29.	KUMI (Kumi & Bukedea)	2	Omase William-VCO	1
30.	KYENJOJO	2	James Katamanywa - VCO	1
31.	LIRA (Lira, Dokolo & Amolatar)	3	Benard Abong Otim- VCO Opio Richard Tom-VCO	1
32.	LUWERO (Luwero and Nakaseke)	2	Daniel Serunkuma - VCO	1
33.	MASAKA	4	-	4
34.	MASINDI (Masindi & Buliisa)	2	William T. Mugayo – VCO	1
35.	MAYUGE	2	Nabonge Juma -VCO	1
36.	MBALE (Mbale, Manafa & Bubulo???)	3	G.O. Ochieng - VCO	2
37.	MBARARA (Mbarara, Isingiro, Kihurura & Ibanda)	5	Benard Abwang- VCO	4
38.	MOROTO	2	-	2
39.	MOYO	1	Nicholas N.A. Ogweng - VCO Asiokpwo Christopher -VCO Edema Micheal Nyaraga -VCO	0
40.	MPIGI	2	-	2
41.	MUBENDE	3	-	3
42.	MUKONO	3	Patrick G. Ssempa VCO	2
43.	NAKAPIRIPIRIT	2	-	2
44.	NAKASONGOLA	1	-	1
45.	NEBBI	2	Dickson Unoba VCO	1
46.	NTUNGAMO	2	-	2
47.	PADER	1	-	1
48.	PALLISA (Pallisa & Budaka)	2	Toppy Amusugut VCO	1
49.	RAKAI (Rakai & Lyantonde)	2	-	2
50.	RUKUNGIRI	1	Michael Bijurenda VCO Badru W. Gidudu VCO Mwesigwa Banga Julius -VCO	0
51.	SEMBABULE	1	-	1
52.	SIRONKO	2	Stephen Bwira – VCO	1
53.	SOROTI	2	Ekaju Peter – VCO	2

NO.	DISTRICT	MANPOWER REQUIRE-MENTS	MANPOWER AVAILABLE	*GAPS*
54.	TORORO (Tororo & Butaleja)	2	Issa Tigawalana VCO	1
55.	WAKISO	3	Juma Mpiima - VCO	2
56.	YUMBE	1	-	1
	VECTOR CONTROL DIVISION HQ		Ambrose W. Onapa – Principal Entomologist Narcis B. Kabatareine – Senior Entomologist Edridah Tukahebwa -Entomologist Francis Kazibwe– Entomologist Gabriel Kayiira Matwale – Entomologist Egumah Pie. - Entomologist Geoffrey Egitat – VCO Anna Mary Auma – VCO Christopher Katongole - VCO Aidah Wamboko – VCO Daniel Niyonsaba – VCO Moses Sooka – VCO	1 Entomologist
	Malaria Control Program		Michael Okia – Senior Entomologist Tom Byembabazi – VCO	0
	Onchocerciasis Control Program		Lakwo Tom- Senior Entomologist	0
	IPH		Lalobo Oryema – Entomologist Buga Rudolf - Entomologist	
	Mulago Hospital		*David Kiwala – VCO*	*Mulago Hospital*
	RESEARCH INSTITUTES: LIRI UVRI MALARIA RESEARCH CENTRE **(MU-UCSF**)		 Dr. Louis G. Mukwaya – Deputy Director/UVRI Dr. Lutwama JJ – Entomologist Odoi-Ogen – Principal Entomologist David Drajole – VCO Kilama Maxwell	 **Assessment Centre-Mulago**

NO.	DISTRICT	MANPOWER REQUIRE-MENTS	MANPOWER AVAILABLE	*GAPS*
	M.O.E.S. – School of Entomology		Anatol Byaruhanga – VCO/Principal Tutor James Kirunda - VCO Sperito M. Kagwa - VCO Wilfred Ouma - VCO Joseph Nanjuna - VCO	
	UPDF		Fortunate C. Maluwe – VCO Dickens Odongo - VCO Boaz K. Nkamwesiga - VCO Nelson M. Ogwang - VCO Stephen Daaki – VCO Solomon Kandole - VCO	
	Ministry of Agriculture Sight Savers International, Hoima Christian Children's Fund World Vision- Katakwi World Vision -Soroti Global care international COVECO, Tororo		Bahati Milton -VCO Stephen Kasolo – VCO Ali Mubajje – VCO Samuel Nadduli – VCO Mugalia Abel - VCO Asubu Stephen -VCO Josue Okoth - Entomologist	
	Makerere University:		Dr. J.B. Kadu – Head of Zoology Department	
	Private Sector: Global Pest Control		Kyalimpa Stephen – VCO Mushikazi Constance - VCO	
	UN-DEPLOYED:		Eric Andama – VCO Mwanga - VCO Peter Musumali - VCO Robert Wedebye - VCO Rogers Batesaki - VCO A.W. Cwinyai - VCO George Kochan – VCO R. Kaguru - VCO J. Komakech - VCO Andrew Etole - VCO David K. Ssedyabane - VCO Charles Mutibwa - VCO	

NO.	DISTRICT	MANPOWER REQUIRE-MENTS	MANPOWER AVAILABLE	*GAPS*
			Geoffrey Otto - VCO Victor Alioni - VCO Nickson Anguyo - VCO Maxwell Kilama - VCO Levi Matua - VCO John Oryema - VCO Patrick Mugenyi - VCO Robert O. Komakech - VCO Alexei Erongu - VCO Emmanuel Bafulwime - VCO Awusi Kuddiza - VCO David Oguttu – VCO Charles Kirya Mwanika – VCO Godfrey Kibwola – VCO Thomas Okwir – VCO Eliab Kapuru – VCO Hellen Amal – VCO Covia Atuheire – VCO Charles Elamu – VCO James Kaweesa – VCO Byaruhanga Oswald - VCO Galimaka Mulindwa Richard -VCO Kibirige Peter - VCO Kiswiriri Swaleh - VCO Ogwal Jonathan - VCO Arinaitwe Moses - VCO Balisanyuka Ronald - VCO Masafu David - VCO Ndashimye Gregory - VCO Otim Joseph - VCO Sekamanje Annet - VCO Kanyike Vincent Alex - VCO Kwagala Noah - VCO Nuwagaba Henry - VCO Tibamwenda Noah - VCO Ssemwanga Edward - VCO Twahirwa Maurice - VCO Adriko Moses - VCO Baguma Herbert - VCO Mwangusya Julius - VCO Nakazibwe Rehema - VCO Twijukye Richard - VCO Sunday Emmily Brenda - VCO Mukyala Judith - VCO Akonyu Charles - VCO Mumbere George - VCO Amalla Boniface - VCO Masaba Benard - VCO	

NO.	DISTRICT	MANPOWER REQUIRE-MENTS	MANPOWER AVAILABLE	*GAPS*
			Ssenyonjo Eric - VCO Baluku Francis - VCO	

N.B.: A Vector Control Officer is expected to be responsible for 1 Health Sub-district according to HSSP.

Annex 5: Policy and Strategy for Indoor Residual Insecticide Spraying

MINISTRY OF HEALTH

POLICY AND STRATEGY FOR INDOOR RESIDUAL INSECTICIDE SPRAYING

Malaria Control Program

Ministry of Health

Uganda

November 2006

FOREWORD

Malaria remains one of the major causes of mortality, morbidity, disability and poverty in Uganda. In most of the country malaria transmission is mainly stable and perennial in nature. However, in some areas such as the highlands transmission is unstable and seasonal in nature. Indoor Residual Spraying is of the most effective ways of controlling malaria transmission in such circumstances and one that can rapidly achieve large-scale impact at a cost. The IRS method involves periodic spraying inside houses with persistent insecticide to reduce mosquito life span and density resulting in reduction of malaria transmission and prevention of epidemics. Moreover, WHO now recommends that IRS can be used even in highly endemic situations for malaria control. The method relies on the fact that the most malaria vectors enter houses during the night to feed on the occupants and rest on the walls or roofs prior to and/or after feeding. If the wall or roof is treated with an effective residual insecticide, the mosquitoes will pick up a lethal dose as they rest and die. The purpose of this IRS policy and strategy is to give guidance in the implementation of indoor residual spraying for malaria control in Uganda.

The indoor residual spraying policy and strategy were developed by the Malaria Control Program with support from World Health Organization.

I would like to acknowledge their contributions in producing this document.

Dr. Sam Zaramba
Director-General, Ministry of Health

NB. This document comprises two separate documents produced by the Ministry of Health on Indoor Residual Spraying. The *Indoor Residual Spraying Policy* includes an Indoor Residual Spraying Strategy and annexes on Strategy on DDT use and an Indoor Residual Spraying Training Manual. These documents together form the Ministry of Health's policy and strategy on indoor residual spraying.

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INDOOR RESIDUAL SPRAYING POLICY

MINISTRY OF HEALTH

POLICY STATEMENT:

Indoor residual spraying (IRS) is the application of long-acting insecticides inside human and animal dwellings in order to repel and kill adult malaria vector mosquitoes coming to rest on these surfaces thus reducing mosquito abundance and lifespan, and human-vector contact. The use of IRS to control and eliminate malaria, is one of the strategies of the current Uganda's Malaria Control Strategic Plan, the Health Sector Strategic Plan and the Poverty Eradiation Action Plan. To support the appropriate use of IRS in Uganda, the Ministry of Health has adopted the following.

1. The objective of IRS is to reduce malaria transmission and to eliminate it from certain areas of Uganda. IRS will be implemented as part of a package of other malaria control interventions such as case management, use of insecticide treated nets (ITNs) and intermittent preventive treatment of malaria in pregnancy (IPT)

2. Indoor residual spraying shall be used in areas where malaria transmission occurs as appropriate However, in Uganda, priority will be in the following areas:

- *Congested areas:* IRS will be applied in selected areas e.g. in high-density slum settlements.
- Institutions e.g. boarding schools, barracks, prisons, agricultural and industrial estates.
- *Emergency situations:* IRS may be used following population displacement (e.g. in internally displaced people's (IDP) and refugee camps).
- *Malaria Epidemic-prone areas:* IRS will be deployed in districts that are prone to epidemics

3. The MOH through the NMCP will establish structures and systems for managing IRS activities at Subcounty, County (Health Sub-district), District and National levels to ensure annual and bi-annual campaigns of IRS.

4. Indoor residual spraying (IRS), using approved and registered insecticides and compression sprayers is an integral part of the malaria vector control strategy for Uganda.

5. Insecticides and relevant equipment for IRS should be registered by the National Drug Authority in consultation with the National Malaria Control Program and the Vector Control Division (MOH). Registration shall conform to WHO specifications and standards (see Table 1 for list of approved insecticides).

6. Private companies and NGOs offering IRS services to the public shall be registered with the National Malaria Control Program and Vector Control Division of the MOH and should offer these services according to NMCP guidelines. NGOs should work

within the national IRS structure and systems.

7. All insecticides and equipment that are donated for IRS should comply with national guidelines and WHO specifications.

8. Malaria vector surveillance and research will be conducted at designated sites to provide regular information about the types, distribution, resting densities and resistance of the malaria vectors in the country. IRS will be adjusted according to the vector types and resistance patterns using techniques of insecticide rotation for management of insecticide resistance.

9. Importation, distribution, storage, use and disposal of insecticide residues will supervised by the NMCP and monitored by the Environment Health Division in line with National Drug Authority (NDA) and National Environment Management Authority (NEMA) guidelines and procedures.

10. MOH shall establish a Multi-sectoral Monitoring and Evaluation Task Force to ensure the safe and correct application of residual insecticides and safe disposal of residues and expired insecticides in order to limit human & environment exposure to residual insecticides. The Team will also ensure that IRS is done in time in the months of January to March before the first rains and in June to July before the second rains.

11. Adequate regulatory control and enforcement measures will be put in place to prevent an unauthorized and un-recommended use of DDT in agriculture and thus avoiding contamination of agricultural products, with stiff penalties for the culprits.

INDOOR RESIDUAL SPRAYING STRATEGY

MINISTRY OF HEALTH, UGANDA

1 INTRODUCTION:

The discovery of residual insecticides and their impact in controlling malaria transmission led to the intensive use of indoor residual house spraying in the 20th century in most malaria endemic countries. Indoor residual spraying remains the most effective method for transmission control and for obtaining a rapid large-scale impact at an affordable cost. The method involves periodic spraying inside houses with persistent insecticides to reduce mosquito life span and density resulting in reduction of malaria transmission and prevention of epidemics. The method relies on the fact that most malaria vectors enter houses during the night to feed on the occupants and rest on the

walls or roofs prior to and/or after feeding. If the wall or roof is treated with an effective residual insecticide, the mosquitoes will pick up a lethal dose as they rest.

Despite increased efforts by Government to reduce malaria morbidity & mortality in Uganda, malaria has continued to be a major contributor to the disease burden in the country. To date, malaria control in Uganda has been by a combination of case management and insecticide treated mosquito nets with occasional indoor residual spraying (IRS) to control malaria epidemics. In the past Uganda has controlled malaria epidemics that have occurred in highland areas of the country. The government has now made a decision to use IRS for malaria vector control using effective and affordable insecticides (refer to Annex 1). The purpose of this strategy is to ensure effective IRS implementation in Uganda.

SITUATION ANALYSIS: HISTORICAL BASIS FOR IRS:

Indoor residual spraying remains the most widely used method of malaria vector control. It is faster in its effect than other vector control methods. The insecticides that are recommended by WHO and that are most commonly used for IRS include lambdacyhalothrin, deltamethrin, cyfluthrin, DDT, bendiocarb and propoxur. These insecticides are safe to humans, domestic animals and the environment when used carefully and skillfully and retain their toxic residual activity on sprayed surfaces for between 3 and 12 months.

DDT was the widely used insecticide for malaria control from the 1940s to early 1970s. However, the tendency since 1970s has been to reduce the use of DDT. The major reason in the decline in DDT use was the alleged safety and environmental hazards and its reduced production and availability. In addition, effective and more environmentally safe insecticides also came into the market.

Experience with IRS in Uganda:

In Uganda, under the Pilot Malaria Eradication Project, near elimination of malaria was achieved in Kigezi highland areas (Kabale, Kanungu, Kisoro and Rukungiri) between 1959 and 1963 through the use of IRS with DDT (de Zulueta, 1962, 1964). *Anopheles funestus* was practically eliminated while *An. gambiae s.l.* densities showed spectacular reductions in the sprayed areas resulting in a marked reduction in hospital mortality, outpatient attendance and hospital admissions due to malaria. In 1998, indoor residual spraying with lambdacyhalothrin (Icon) 10% WP successfully controlled a malaria epidemic in Kisoro District. In early 2001, another malaria epidemic was experienced in highland districts of southwestern Uganda and targeted spraying was used to control the epidemic. Another epidemic occurred in 2005 and IRS was conducted in the districts of Kabale, Rukungiri and Bushenyi. In 2006, the Malaria Control Program with support from USAID under the Presidential Initiative on Malaria (PMI) started a successful large scale IRS program covering the whole of Kabale District, with 96.2% or 103,329 houses sprayed out a total target of 107,400 houses, and 95.9% or 488,502 people protected out

of a total of 508,857 people targeted for protection. This routine IRS program is expected to be extended in 2007 to cover Kanungu and Apac Districts and IDP Camps in Amuru, Gulu, Kitgum and Pader District, in addition to Kabale District, Some schools and agricultural estates in Uganda continue to use IRS with Icon 10% WP to control malaria.

Justification for IRS in Uganda:

In recent years, a series of malaria epidemics have also occurred in highland areas of Uganda. For example in 1992 and 1994 malaria epidemics occurred in Rukungiri and Kabale and in Kapchorwa in 1997. In 1998 most of Uganda and especially highland districts in South-western Uganda experienced a severe malaria epidemic following the El Nino rains. These epidemics resulted in serious loss of lives and socio-economic consequences. Some of these epidemics were partially controlled using IRS with Icon 10% WP. However, these losses could have been minimized if the epidemics had been forecast early enough and control measures including IRS and the use of ITMs could have been put in place early enough.

The major malaria vectors in Uganda, *Anopheles gambiae s.l.* and *An. funestus* are both highly endophagic and endophilic (feed and rest indoors). They are therefore amenable to IRS because of their indoor feeding and resting tendencies. There is therefore a need to establish indoor residual spraying teams in malaria epidemic prone districts in southwestern, eastern and western Uganda. In addition to epidemic-prone districts, indoor residual spraying will also be applied in congested peri-urban areas and areas of economic importance in Uganda.

In Uganda, Indoor Residual Spraying will be implemented as a component of Integrated Vector Management (IVM) for malaria control, which includes the use of IRS, ITNs, larviciding and environmental management.

VISION:

Indoor Residual Spraying becomes institutionalized, with adequate capacity at all levels that will ensure safe and effective implementation of IRS for malaria vector control.

GOAL:

The goal of IRS in Uganda is to contribute to the reduction of malaria related morbidity, mortality, poverty and disability through effective vector control interventions.

OBJECTIVES OF THE IRS STRATEGY IN UGANDA:

1. To prevent and control malaria epidemics in specific malaria epidemic-prone districts;
2. To control transmission in high-risk situations, such as IDP and refugee camps

3. To control malaria in areas of high population density such as peri-urban (slum) areas;
4. To develop capacity at national and district levels capable of implementing effective IRS in Uganda;
5. To strengthen operational research on vector control

TARGETS

Uganda is committed to the WHO IRS strategic targets to attain more than 80% operational coverage of targeted structures in order to achieve effective malaria control in the sprayed areas. The targets for IRS in Uganda include:

1. By 2010 15 epidemic prone and endemic districts will have adequate capacity to implement effective IRS for malaria vector control.
2. By 2010 >80% geographical coverage of targeted areas will be attained in 15 epidemic prone and endemic districts
3. By 2010 >80% operational coverage of targeted households will be attained in selected epidemic prone districts
4. By 2010 60% of targeted population residing in targeted areas will be protected by IRS

IMPLEMENTATION OF THE STRATEGY

The key consideration in the implementation of the strategy will include the following:

What to Apply: Choice of insecticide

Once a decision to use IRS is reached, the next important area to consider is the insecticide to be used. Areas to consider in the choice of insecticide are:

1. **Safety:** the insecticide used should be safe for the inhabitants of the sprayed houses, for the spray operators, domestic animals and the environment; Carbarmates and Organophosphates tend to have higher toxicity levels.

2. **Efficacy and residual effect** of the insecticide against the malaria vector and operational period (i.e. the time it takes) to spray targeted districts;

3. Insecticide formulation: Insecticides are supplied in various formulations that reflect their properties. WHO recommends wettable powder (WP) formulations for IRS.

4. **Cost of the insecticide:** Effective and affordable insecticides will be used.

5. **Acceptability:** Insecticide to be used should be acceptable to the communities in order to reduce re-plastering of sprayed structures and/or refusal by household owners. Acceptability by community is a function of effective IEC.

A list of the WHO recommended insecticides for IRS is given on Table 1 below.

Table 1: WHOPES recommended insecticides for IRS against malaria vectors

Insecticide	Formulation	Class	Dosage (g/m^2	Duration of effective action
Alphacypermethrin	WP/SC	P	0.02-0.03	4-6 months
Bendiocarb	WP	C	0.1-0.4	2-6 months
Bifenthrin	WP	P	0.025-0.050	3-6 months
Cyfluthrin	WP	P	0.02-0.05	3-6 months
DDT	WP	OC	1-2	>6 months
Deltamethrin	WP	P	0.01-0.025	3-6 months
Deltamethrin	WG	P	0.02-0.025	3-6 months
Etofenprox	WP	P	0.1-0.3	3-6 months
Fenitrothion	WP	OP	2	3-6 months
Lambdacyhalothrin	WP	P	0.02-0.03	3-6 months
Pirimiphos methyl	WP/EC	OP	1-2	2-3 months
Propoxur	WP	C	1-2	3-6 months

P=Pyrethroid; C=Carbamate; OP=Organophosphate; OC=Organochlorine; WP=wettable powder;

WG=water dispersible granules; EC= Emulsifiable Concentrate; SC=Suspension Concentrate.

Where to apply: Area selection:

IRS should be applied selectively. Priority areas for selected IRS should be based on where malaria transmission is unstable or in areas where other vector control methods are not feasible. Such targeted areas will include epidemic prone districts; Emergency situations e.g. internally displaced persons (IDP) and refugee camps; peri-urban (slum) areas and institutions with high concentration of people e.g. boarding schools.

IRS is most appropriate where the target malaria vector is endophilic and endophagic; access to early diagnosis and prompt effective treatment for malaria is inadequate; most house structures are permanent, relatively well constructed with sprayable surfaces; outdoor sleeping uncommon or minimal. The malaria vectors in Uganda comprise *Anopheles gambiae s.l.* and *An. funestus* both of which exhibit endophilic and endophagic tendencies and therefore are amenable to control using IRS.

When to apply: Timing of Spraying:

To maintain effective protection during the entire malaria transmission season, spraying of the targeted structures in the whole area to be protected should be completed before the beginning of that transmission season.

Registered private sector fumigation companies using mainly pyrethroids can play a major role in IRS for malaria control especially in private homes in urban areas and institutions.

Spraying cycle: This is the number of spray rounds per year. The seasonality and residual effect of the insecticide formulation on sprayable surfaces will determine the frequency of the spraying cycle. The insecticide selected for use should be effective during the period of time that transmission is likely to occur. Areas requiring continuous protection should be sprayed regularly. In Uganda there is continuous perennial transmission and the spraying will follow the rainy seasons, requiring at least two spray cycles (number of spray rounds per year).

Who to apply IRS:

Training on IRS techniques will be conducted at all levels of implementation. Only trained community volunteers will conduct the actual spraying under the supervision of district-based trainers/supervisors. Training on IRS will be done in a cascade manner from the national to the community level (refer to Annex 2).

How to apply IRS:

To apply a uniform dose of insecticide to all sprayable surfaces, compression sprayers, which meet WHO specifications, should be used. The sprayers should be fitted with nozzle tips producing the required swath and discharge rate, and pressure gauges or control flow valves graduated to deliver the required dosage and rate of application. The use of protective devices and safe working practices are essential to avoid or reduce the contamination of spray operators with insecticide.

Spray operators should be provided with protective devices which include: overalls, broad-brimmed hats, gloves and shoes or boots, light masks, goggles and visors during spraying. Supervisors or squad leaders should enforce safe behaviour and the appropriate use of protective devices.

Planning and preparation for spraying:

An effective residual spraying program is based on a plan of operations which defines the geographical area, the methods and procedures of spraying, duration of the program, personnel requirements, supplies, equipment and estimated cost as reflected in the Workplan (refer to Annex). Planning should include:

Geographical reconnaissance:

In order to perform spraying systematically and effectively with a satisfactory coverage, geographical reconnaissance should be undertaken for the selected areas to make available the following information:

- Map of the district with its boundaries
- Important ecological features, such as breeding sites in the area
- Distance and accessibility of the area
- Available routes to, and within, the area
- Total number of structures to be sprayed*
- Average size (surface area) of structure to be sprayed
- Total surface area of structure to be sprayed
- Types of structures
- Total population to be protected
- Social factors e.g. outdoor sleeping habits

The above information will assist in developing operation plans that define the geographical area, the method and procedures of house spraying, duration of the program, personnel required, supplies and estimated cost.

Operational Budgeting:

- Calculate the amount of insecticide needed and make available
- **Target period to begin and finish spraying in each area, and the whole spraying program of the season considering the insecticide to be used**
- Assess the status of logistics, such as spray pumps, spare parts, protective clothing, number of spray operators, transport, drivers, etc.
- Make available (recruit and train) the necessary manpower
- Assess the status of transport and plan to overcome shortages
- Calculate the financial expenditure and make available
- Prepare clear terms of reference for all staff that will be involved in the spraying program
- Inform, educate and mobilize authorities and communities
- Prepare reporting system and appropriate forms
- Prepare supervision programs and supervision checklist

Information, communication and education:

For a spraying program to be successful, the targeted population needs to be informed of the benefits of protection against malaria carrying mosquitoes afforded by residual house spraying. All possible channels of communication should be used to inform and educate the population on:

- The procedures and benefits of the program.
- Mode of action of insecticide and duration of activity on the sprayed surfaces
- Safety of the insecticide and effects on walls, ceilings and furniture
- That spray operators are responsible people who will handle and protect your property that the householder does not want to be sprayed.
- Participation of householders in preparing their houses for spraying and complying with instructions

- That the insecticide is not hazardous to humans, dogs, chickens, cats and other domestic animals provided the precautions outlined by the spray operator are followed

Ideally local spray operators should be employed or a local resident should accompany spray teams to secure community co-operation.
Supervision:

IRS requires direction, correction, assistance, assessment, stimulus, and appreciation from all concerned senior officials at regional and national level. This should be carried out routinely and consistently throughout the period of the program. Inspections should be done using approved forms/checklists to ensure uniformity, accuracy, and completeness. The objective is training not criticism.

Purpose of supervision:

Supervision and monitoring should be conducted at all levels for a smooth running of operations. The purpose of supervision is to ensure that IRS is applied appropriately and according to plan to achieve the desired effect of controlling malaria during each malaria transmission.

Supervisory tools:

- **These include forms, reports, records, graphs, and charts to monitor operations**
- Checklists to guide on what to observe

Monitoring and evaluation:

In malaria vector control, monitoring and evaluation should be a continuous process with the purpose of:

- Correcting actions through planning and re-planning
- Improving actions through enhancing efficiency, performance and quality
- Determining effectiveness and controlling costs
- Measuring accomplishments and needs versus time
- Disseminating knowledge and techniques
- Modifying program technology
- Justifying the program technically, socially, economically and politically
- Establishing priority for resource allocation and program activities

Monitoring and evaluation should be designed to provide information on:

Monitoring of process: document whether activities are carried out as planned to ensure accountability and to detect problems early

Evaluation of outcomes and impact: document expected results in terms of improved quality of delivery and coverage (targets), and of the desired changes in malaria morbidity and mortality (objectives)
Applied research: answer questions tied to specific problems that require more rigorous studies than tracking of indicators.
Periodic review: bring together all the information collected as a basis for planning. This includes assessment of broader program aspects such as the quality of the policy, effectiveness and efficiency of the interventions, sustainability and management
Timing: timing of the spray round in relation to the onset of malaria transmission season and the spray round in relation to the estimated duration.
Equipment: status and performance of spraying equipment checked regularly
Cost: Salaries, per diem, equipment, insecticides and transport costs should all be recorded in order to provide information for cost-effectiveness analysis

Indicators for operational monitoring and evaluation of IRS:

- Percentage of structures sprayed in relation to targets
- Refusal rate
- Quality of application
- Amount of insecticide and dosage used
- Persistence of insecticide on treated surfaces using bioassays
- Vector susceptibility status to insecticides used
- Anopheline indoor resting density by pyrethrum spray catches (PSC)
- Anopheline outdoor resting density by: natural shelters and artificial shelters
- Anopheline density in CDC light and animal traps
- Indoor and outdoor night biting densities
- 24-hour mortality among mosquito captures in exit window traps
- Sporozoite rates.

ROLES OF VARIOUS ACTORS:

CENTRAL ROLES:

Ministry of Health - responsible for:

- Policy, strategy and guidelines
- Resource mobilization and disbursement
- Monitoring and evaluation
- Quality assurance

Malaria Control Program and Line Departments

To plan, implement, manage, co-ordinate, monitor and evaluate all control activities:

- Developing standards and guidelines; and monitoring and evaluation tools
- Identification of training needs and implementation of training
- Pre-spray planning

- Program management
- Compilation of reports
- Monitoring, evaluation and quality control of IRS implementation
- Liaison with Vector Control/ITNs Working Group and other stakeholders
- Development of information, education and communication materials and messages
- Serve as a Public Relations Office
- Operational research

Line Ministries (including Ministry of Water and Environment, Ministry of Agriculture, Animal Industry and Fisheries, Ministry of Local Government, etc)

- Impact assessment
- Supervision and monitoring
- Resource mobilization
- Advocacy

Other Partners (Commercial sector, Civil Society Organizations, NGOs etc.)

- Importation and distribution of chemicals and supplies
- IEC/BCC campaigns
- Resource mobilization
- Logistical support
- Monitoring and evaluation

Development partners

- Resource mobilization
- Technical assistance (M & E, training, research, quality assurance, development of guidelines and standards, etc)

DISTRICT ROLES:

District Director of Health Services:

- To plan, implement, manage, co-ordinate, monitor and evaluate IRS activities.
- Recruitment and management of appropriate personnel
- Identifying training needs and implementing the training
- Reporting to district council and to the MOH
- Responsible for estimates for operational requirements and equipment
- Implementation of effective social mobilization and IEC

District Vector Control Officer:

- Responsible to the DDHS for the day-to-day running of IRS field activities
- Coordinating geographical reconnaissance and mapping of operational areas

- Participate in training of personnel and supervision of IRS operations
- Participate in entomological impact assessment.

Vector Control Officer at HSD

- Responsible/reports to the HSD in-charge
- Coordinates day-to-day implementation of IRS activities in the HSD
- Participates in supervision, monitoring and evaluation of IRS activities
- Compiles IRS field reports.

Sub county Supervisor (Health Inspector/Assistant):

- Responsible to HC III i/c of the subcounty where he/she is based
- Makes technical reports to the HC III i/c, Subcounty Council and the HSD Vector Control Officer
- Supervises spray teams in the subcounty and ensures quality of spraying activities
- Responsible for proper storage and distribution of insecticides and spray pumps
- Participates in the recruitment of spray operators
- Effects minor spray pump repairs and maintenance
- Works with existing community-based structures e.g. VHTs, PDCs, etc to maximize community mobilization and sensitization to ensure participation and ownership which will lead to the success of IRS operations.

Spray Team Leaders: Selected from among the spray operators during training

- Reports to the Subcounty Supervisor
- Supervises spray men
- Distributes insecticides and arranges for the security of insecticides and spray pumps
- Makes spraying reports including recording type and amount of insecticide used per house sprayed and other data as indicated in the Team Leader's Daily Record Form
- Enforces safety regulations and displine among spray operators

Spray Operators:

- Mixes the insecticide and sprays structures
- Labels sprayed structures
- Cleans spray equipment

N.B.: Spray operators will be temporarily employed from community to conduct IRS

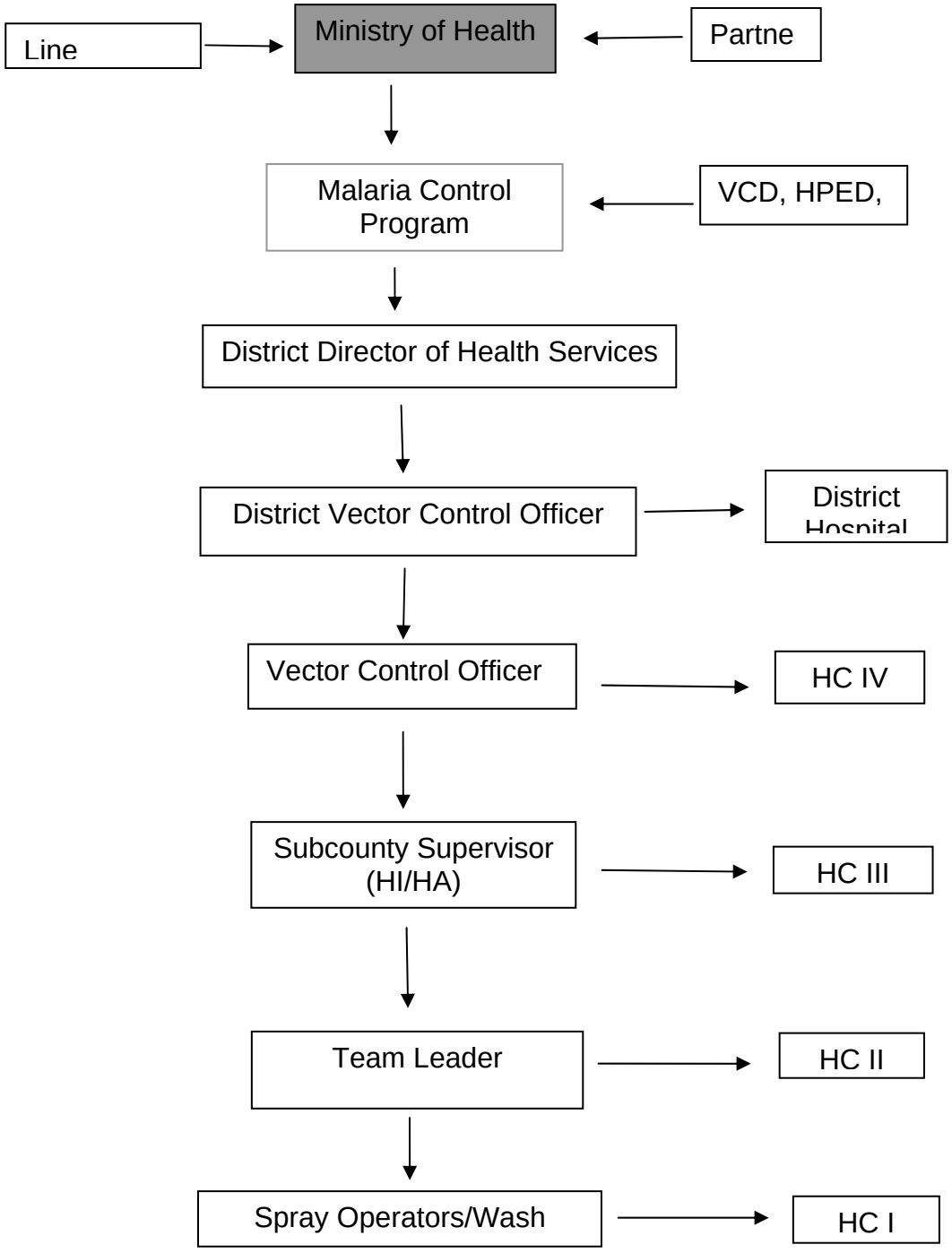
Wash person:

Washes all the protective wear used by the spray personnel

Mobilizer/Warner:

- Prepares communities in advance for IRS operations

ANNEX A: STRUCTURE OF THE IRS IMPLEMENTATION IN UGANDA



The structure will follow the existing health system.

ANNEX B: STRATEGY ON DDT USE FOR MALARIA VECTOR CONTROL IN UGANDA

1. Background:

Dichloro-Diphenyl-Trichloroethane (DDT) is an organochloride pesticide that was used heavily worldwide in the 1950 - 1960s mainly for agricultural purposes and less for public health. Public concerns about DDT persistence in the environment and its high bioaccumulation in fatty tissues led to the phasing out of DDT in many countries in the 1970s. The recently adopted (May 2001) Stockholm Convention on Persistent Organic Pollutants (POPs) aims to regulate and to restrict its use for vector control only according to WHO guidelines. In Africa alone, 11 countries have maintained the use of DDT for malaria vector control with remarkable success. These countries include Ethiopia, Madagascar, Mauritius, South Africa, Swaziland, Eritrea, Morocco, Sudan, Namibia, Zambia and Zimbabwe. Safety evaluations carried out by the World Health Organization (WHO) have uniformly and consistently concluded that DDT is safe when used according to WHO recommended guidelines for IRS.

In Uganda, IRS using DDT was last implemented in the early 1960s in the highland areas and this led to the near eradication of malaria in the area. A malaria epidemic in the mid 1960s around the Lake Bunyonyi basin in the current Kabale District was controlled through IRS using DDT. In line with international regulations, DDT is banned for agricultural purposes in Uganda but not for malaria vector control. The MOH is considering using DDT among other insecticides for malaria vector control. The present guidelines for indoor residual spraying with DDT for malaria vector control aims to provide basic information on effective and safe use of DDT for malaria vector control in the country. It is hoped that the use of these guidelines by health workers will contribute towards judicious usage of DDT for malaria vector control.

2. Justification for Guidelines on the use of DDT:

The use of DDT for malaria vector control has remained controversial over some years now.

Various reasons have been put forwards by advocates for and against DDT use for malaria vector control. However, despite this controversy, DDT is still recommended for disease vector control indoors under the Stockholm Convention when used according to the recommendations and guidelines of WHO. Because of this controversy, special guidelines on DDT use have been added to the general guidelines on IRS.

3. Objective of the DDT use Guidelines:

The overall objective of the guideline is to guide IRS implementers on the use of DDT for malaria vector control in Uganda so as to ensure rational, judicious and acceptable use of the chemical in the country.

4. Regulations to limit human & environment exposure to DDT:

4.1 Importation:

Procurement of DDT will be exclusively by the MOH to ensure effective control and accountability. MOH will identify suitable supplier(s) for quality DDT in line with the WHO specifications and the National Drug Authority (NDA) Importation Guidelines. The MOH will first and foremost obtain clearance from NEMA and NDA to import DDT and in addition, will provide NEMA and NDA with information on the formulation, WHO specification number of the manufacturer, concentration of active ingredient and quantity of DDT to be imported and its suppliers. NEMA and NDA will ensure that MOH takes responsibility and accountability for the DDT brought into the country.

4.2 Packaging and labeling:

DDT should be packed and labeled according to WHO and NDA specifications on public health pesticides. Packaging DDT into water-soluble sachets ensures that the sachets can be added directly to water filled tanks thereby reducing the hazard associated with handling and mixing in a separate container.

Labels should be in English and should indicate: contents, safety instructions, possible measures in case of swallowing or contamination, trade or brand name, ingredients, common name, type of formulation, name of manufacturer and address, manufacture and expiry dates, distributor or formulator, warning signs in symbols and words, direction for use, net weight in container, registration or license number.

4.3 DDT Distribution:

Multi-stage distribution routes between entry port and final destination of insecticide application must be limited to prevent pilferage. Regulatory mechanisms on mode of transportation to spraying area, inventory mechanisms before storage and at final destination must be put in place. The mode of transportation should be specified and dedicated for DDT only.

DDT will be solely distributed through MOH and its use strictly controlled by the Ministry to prevent any unauthorized access by the general public. MOH will ensure proper warehousing/storage, transportation and handling at all levels from central facilities to the place of application.

4.4 Storage of DDT:

DDT shall be stored in a lockable place that is inaccessible to unauthorized persons, domestic animals and birds. Warning signs should be placed on the entrances of the store. DDT shall be stored in their original containers with intact labels. Containers must be frequently examined for breakage or leaks. If damaged, transfer the insecticides into another container with exactly the same label. NEVER store DDT in food/beverage

store/containers where it may be mistaken for food. DDT and all other insecticides should be kept dry, away from fires, direct sunlight, heat and moisture in order to maintain their quality.

The storage place should be constructed of fire-resistant materials including a concrete floor (for easy cleaning, in case of spillage) and well ventilated. A Supplies Officer is necessary to ensure safekeeping of the DDT stocks. A checklist/record book and stock card on storage and issue of insecticide should be kept and available for inspection at all times. Periodic monitoring of DDT stocks will be conducted by a Multi-sectoral Monitoring and Evaluation team.

4.5 Use of DDT:

Use of DDT will be regulated in accordance with the Stockholm Convention and WHO guidelines. DDT will **ONLY** be used for malaria vector control following the correct procedures of storage, applications/spraying and disposal that ensure safety to humans and the environment.

Handling:

- DDT will be mixed and used according to the label instructions. Notice should be taken of the warnings, precautions and special instructions.
- All measures will be taken to minimize spillage when mixing the insecticide.

Washing of protective wear:

- Protective wear will be washed on a routine basis. Any heavily contaminated wear should be removed immediately and washed the same day.
- All water used for washing of protective wear should be poured into a French drain
- Under no circumstances may clothes be washed in a river or any open water body.

The MOH will provide regular reports to NEMA on how the use of DDT is monitored and controlled. DDT shall **NEVER** be transferred to unauthorized users **EXCEPT** with express permission of NEMA, the national authority charged with this mandate in Uganda

4.6 Safe application of DDT:

Though a relatively safe insecticide, DDT like any other insecticide, is a toxic chemical that can harm people, animals and the environment if misused. DDT can be used with minimum or no risk to people or the environment if the following principles are followed:

- The insecticide **must** be applied carefully and correctly on to target surfaces following laid down guidelines and ensuring safety to humans, domestic animals and the environment.

- Before application, ensure that the DDT is not yet expired and sachets are intact.
- Ensure that appropriate equipment and protective wear are in place.
- All instructions for use, restrictions and precautions on the pesticide labels **mus**t be observed.
- DDT **must** be stored in a locked room, in original containers with labels intact, away from food and clothing, and out of the reach of animals and unauthorized people.
- Only properly trained personnel in dealing with insecticides in general should be engaged to ensure safe application of chemical to minimize impacts on humans and environment;
- DDT **must** be applied at correct dosages to avoid excessive residue.

NOTE that DDT use for Agricultural purposes has been banned in Uganda.

4.7 Considerations for safe DDT Application:

- Protective wear and equipment **must** be used.
- Application equipment should be checked regularly for leaks and faulty nozzles.
- Spray equipment should be calibrated before adding pesticides to ensure that equipment is releasing the correct amount of water.
- The correct spraying pressure and the right nozzle opening should be used at all times.
- Eating, drinking or smoking is prohibited during handling and spraying (until after washing of hands).
- In case of accidental spillage of insecticidal solution onto body, the area must be washed thoroughly with water.

4.8 Disposal of DDT:

Spray supervisors must ensure that right quantities of insecticides are prepared for each spraying round to avoid unnecessary leftovers. All excess insecticide left after spraying and any residuals must be collected and returned to supervisors together with all empty DDT containers for SAFE disposal. Never re-use empty DDT containers. The containers should be safely kept in a drum provided by the supplier who will in turn collect the drum to dispose the containers according to UNEP specifications. The MOH together with NDA will be responsible for arranging the disposal of unwanted and obsolete DDT according to the UNEP/WHO/FAO guidelines.

4.9 Surplus spray solution and rinse water management:

- Prepare just enough spray solution to treat the area to be sprayed.
- All spray solution in sprayers **must** be fully sprayed out at the end of the day's work. No solution should be kept until the next day as it poses a risk of accidental spillage and contamination and may corrode the equipment. The insecticide might not be suitable for spraying the next day as the suspensibility may be affected and the active ingredient may break down.

- Spray pumps **must** be thoroughly washed at the end of the day by rinsing with clean water (triple rinse). Rinse water must be poured into an appropriate container, tank, mixing drum or water trailer meant for this purpose and used the next day for making up the first spray solution. **Rinse water must not be disposed of into the environment.**
- At the end of the spray operation (season) the last batch of rinse water may be sprayed on the exterior of the structures being sprayed. This is expected to be minimal as it only represents one day's rinse water.
- The rinse water containers **must** be clearly marked with signs indicating that it contains "contaminated" water not fit for human or animal consumption. These containers should be kept away from animals, children and uninformed persons.

NOTE:

The Stockholm Convention stipulates that:

i. DDT shall be restricted to disease vector control only including malaria control, **when safe and cost-effective alternatives are not available.**
ii. Countries using or intending to use DDT must follow WHO guidelines;
iii. Countries that require to use DDT **must** notify UNEP and WHO

However, the Convention does not require that:

i. Countries requiring to use DDT should notify WHO and UNEP before spraying;
ii. Countries obtain WHO or UNEP's approval at any time for DDT use;
iii. Countries have a deadline by which they must stop using or producing DDT.

ANNEX C: INDOOR RESIDUAL HOUSE SPRAYING TRAINING MANUAL

[This training manual will be used in conjunction with the WHO Manual for Indoor Residual
Spraying document –WHO/CDS/WHOPES/GCDPP/2000.3 Rev 1]

1. Purpose of the Guide:

1. To develop a standardized teaching technique.
2. To develop standardized teaching materials.
3. To develop standardized operational technique
4. To develop a standardized reference guide.
5. To ensure the safe and correct application of residual insecticides when and where appropriate in order to reduce a vector population density and life span and the incidence of vector-borne diseases like malaria.

2. Training materials required:

- A 12 or 15-liter Hudson X-Pert® sprayer for each trainee.
- A bucket and strainer for each trainee.
- Tool kit for each team of six trainees that includes: medium (six inch) pliers, eight-inch adjustable wrench, screw drivers (Phillips and flathead).
- A source of potable clean water; sufficient water to fill each sprayer at least twice.
- Red and blue food coloring (used by trainer for spray pattern demonstration).
- A 2.9 meter, solid wall for spraying practice with lines drawn on it
- A watch with second hands or a stopwatch.
- A tape measure.
- A length of fencing or bailing wire about 50 cm (24 inches) long.

3. General training principles:

1. Step by step training following the recommendations listed in this guide will give the Spray Team members sufficient information for efficient spraying.
2. The entire training should be conducted within close proximity to a source of water and sprayers should be filled to their operational capacity at all times. This allows the trainee to become accustomed to handling and carrying the maximum weight of the sprayer.
3. The trainer should demonstrate the importance of maintaining adequate spray deposition pattern and rhythm during the final stage of the training. This can be done by spraying colored water on a white sheet or by spraying plain water on a dark, dry wall.

4. The trainer must emphasize the need for the operator to agitate the sprayer periodically during all stages of training to ensure that the insecticide applied remains in suspension.

4 Selection of spray operators:

Spray operators shall be recruited locally, i.e. from the target areas to be sprayed. This will enhance community cooperation and good coverage since local people know well their area. The local community leadership should be involved in the recruitment and subsequent supervision of spraying coverage in their areas. Recruitment should take into account gender issues. No one shall be discriminated on the basis of gender. However, pregnant women shall be excluded. All recruited spray operators should be medically fit, with no known hypersensitive reaction to insecticides and should be prepared to undergo occasional medical check ups.

5 Training of spray operators:

The training course is subdivided into several functional parts. The total estimated period for the practical training is seven days. Each section is not limited by time as the time to be devoted to each section depends exclusively on the readiness with which the trainees acquire the particular skill. However, two or three days should be dedicated to the practical portion of the training. The sections of the training will include:

1. Preparing the spray pump.
2. Handling and transporting the spray pump.
3. Spraying with water.
4. Sprayer pressurization.
5. Spray pattern (distance from nozzle tip to surface to be sprayed) and spray swaths.
6. Spray “rhythm.”
7. Care and cleaning of the sprayer.
8. First Test: knowledge of theory, methods and procedures.
9. Spraying in difficult situations.
10. Insecticide handling and safety.
11. Preparation of insecticide suspension.
12. Site preparation and communication skills.
13. Final Test: hands-on trouble-shooting and spraying demonstration.

6. Preparing the spray pump:

Before starting any spray operation, all the equipment must be thoroughly checked. Operating faulty sprayers may result in poor uneven application, under-treatment or over-treatment. The trainee must examine the sprayer visually to ensure that all parts are present, assembled correctly and are in good condition.

1. Sprayer body or tank
2. Shoulder strap

3. Inner Seal™ Lid
4. Pump and handle
5. Pressure gauge
6. Lance
7. In-line strainer
8. Hose
9. Nozzle - check that the correct type of nozzle is fitted and is not damaged or worn (8002E for materials other than pyrethroids; 8001E for pyrethroids)
10. Trigger assembly
11. Shut-off valve if one is present and footrest

With no pressure in the sprayer, the trainee should be able to:

1. Demonstrate how to handle a sprayer and prepare it to be carried.
2. Demonstrate how to fill the sprayer with liquid using a strainer even though suspension is not used.
3. Fill the sprayer with water up to its maximum liquid volume operational capacity
4. Explain why the sprayer must not be completely filled.
5. Demonstrate the removal and inspection of the in-line strainer.
6. Demonstrate the installation and replacement of the lance.
7. Demonstrate the installation and adjustment of the shoulder strap.
8. Demonstrate the installation and replacement of the nozzle tip, including carefully removing any debris causing an obstruction.

7. Handling and transporting the spray pumps

7.1 Handling:

Once the sprayer has been thoroughly checked and is ready for use, trainees should be able to correctly demonstrate the following:

- Lift the sprayer by the shoulder strap and positioning it on the trainee's shoulders. **NOTE**: Trainees must be reminded that neither the lid handle nor the plunger handle should be used to pick up or carry the sprayer, especially when the unit is full and ready for use.
- Shoulder position of the sprayer. The sprayer should be placed on the trainee's shoulder so that the pressure gauge is easily visible.
- Adjust the shoulder strap so the sprayer is carried comfortably.
- Shoulder selection. The sprayer should be carried over the opposite shoulder of the hand used to hold and operate the discharge assembly.
- Removing sprayer from shoulder. The trainee holds the sprayer by the shoulder strap and carefully places it on ground, other surface or shifts it to the other shoulder.
- Once the sprayer has been properly inspected and any deficiencies corrected, a piece of fencing wire should be fixed to the lance so that its tip is 45cm (18 inches) from the nozzle.

7.2 Transportation:

- The trainee lifts the sprayer by the shoulder strap and carefully places it on transport or other surface.
- The sprayer is gently placed upright on the transport.
- Adequate steps are taken to secure the sprayer to the transport.
- Adequate steps are taken to protect the pressure gauge and other sprayer components from damage during transit.

8. Spraying:

Upon arrival at the spray site and prior to conducting spray operations, the equipment must be thoroughly checked for possible damage generated during transit to the spray site. Examine the sprayer visually again to ensure that all parts are present, assembled correctly and are in good condition and working properly. The following checklist can prove useful; the trainee should be able to demonstrate the following:

8.1 Sprayer pressurization:

- The sprayer is placed on relatively flat ground.
- Both hands are placed on the plunger rod handle.
- The plunger is lowered slowly and evenly while maintaining a foot on the footrest.
- The operator checks for air leaks in the sprayer as its internal pressure rises.
- The sprayer is pressurized to 55psi.
- The sprayer is agitated to ensure the material is maintained in suspension. NOTE: The trainee should not hold the sprayer by the plunger handle or the pressure gauge.

Spraying:

Once the sprayer has been properly pressurized to the desired operating pressure and a 45cm (18 inches) piece of fencing wire is fixed to the lance, the trainee should be able to demonstrate the following:

- Operate the trigger to make sure that spray is generated.
- Calibrate the sprayer by discharging the contents of the sprayer into a calibrated cylinder for one minute and verify that the sprayer's output with an 8002 nozzle is 790ml.
- Repeat this procedure three times to ensure the accuracy of the procedure.
- Ensure that the nozzle tip is oriented so that the spray pattern produced is parallel to the ground.
- Ensure that the nozzle tip is maintained 45cm from the sprayed surface during the downward and upward motion of the spray wand.
- Ensure that a 75cm wide spray swath is maintained during the downward and upward motion of the spray wand.
- Ensure that a 5cm wide overlap is maintained between the downward and upward portions of the spray.

- Walk in the same direction of the hand holding the trigger: if right-handed, to the right; if left-handed, to the left.
- The sprayer is agitated periodically to ensure the material remains in suspension.

8.3 Spray "rhythm":

Spray rhythm is the speed at which a surface is sprayed in order to obtain adequate coverage and pattern. A wall should be sprayed at about 2.6 seconds of spray for every vertical, linear meter. In order to develop the right spray rhythm, the trainee must practice on the training wall spraying water following these steps:

- Properly position the spray operator to ensure adequate spray pattern and deposition are obtained.
- Extend the nozzle tip to the highest spot on the training wall and place it at the proper distance from the wall.
- Start spraying while counting out loud.
- The trainee brings the spray nozzle at the horizontal level about halfway down the vertical length of the wall when the trainee's count is somewhere around 2.5 seconds.
- The spray nozzle is at the lowest spot on the wall when the trainee reaches the count of five seconds.

8.4 Spraying in difficult situations:

A spray team member frequently finds himself/herself in a situation where an odd-shaped structure needs to be sprayed or where access to the surfaces to be treated is difficult. In these situations, the technician is required to make a series of decisions that can only be made with thorough training and practice obtained during the initial training session.

Is it possible to maintain a good spray pattern and rhythm using normal procedures and methods and maintaining safety standards?
YES: Proceed as usual.
NO: Adjust spray pattern and/or spray rhythm to provide the best coverage possible for the area to be sprayed.

9. Care and cleaning of the sprayer:

Care and cleaning of the sprayer is an important part of any spray operation. These activities can be completed in a field camp scenario or at the headquarters. If in a field setting, the sprayer would probably be transported to a camp with adequate facilities. If so, ensure adequate measures are taken to protect the sprayer during transit. Activities a trainee should be able to complete at the conclusion of any spray mission include:

- The sprayer is properly depressurized and any remaining material is properly disposed.
- The sprayer is filled to about a third of its capacity with clean water and pressurized to about 35psi.
- The sprayer is agitated to wash the inner surfaces of the sprayer.
- The sprayer contents are sprayed into a container for a minute or so.

- The sprayer is properly depressurized and any material remaining is properly disposed.
- The in-line strainer is removed and rinsed with clean water.
- The nozzle tip is removed and rinsed in clean water.
- The sprayer is reassembled and the hose disconnected from the sprayer body and allowed to drain.
- The exterior of the sprayer body is rinsed and cleaned.
- If in a FIELD CAMP scenario, the sprayer is left open, hung upside down and allowed to air-dry. NOTE: The trigger must be activated to allow any remaining material in the hose and lance to drain out.

10 Preparing the community and structure:

Trainees must understand that they are the de facto representatives of the NMCP and that the image they project has a direct bearing on the effectiveness of the program. Trainees should be able to:

1. Advise the residents the reasons why spraying is needed.
2. Explain to the residents the reasons why spraying is conducted.
3. Explain to the residents the necessary safety precautions needed to protect children, pets and other domestic animals from accidental contamination with the material applied.
4. Answer any reasonable question made by the resident in a courteous and professional way.
5. Inform the community on dates when spraying is to be conducted so that the people get their structures ready for spraying.
6. Community preparation of structures should include
    - Move all furniture to center of room and cover them to allow easy access of walls to be sprayed
    - Remove food stuff, water, cooking and eating utensils
    - Remove and tether all or cage all domestic animals and pets

11. Post-spray activities:

Trainees should be able to:

- Advise the residents of the structure sprayed to stay outside until the material sprayed has dried.
- Instruct the residents to sweep the residence's floor before allowing children or pets in it and keep the material collected away from their reach.
- Inform the residents of any future spray plans involving their neighborhood.

12 Factors influencing insecticide deposition:

1 INDEPENDENT (Constant factors not influenced by operator during application)

- Nozzle rating
- Final concentration

2. OPERATOR-DEPENDENT (Factors entirely dependent on operator's efficiency, attention to detail and training received)

- Sprayer pressure
- Distance from nozzle to target surface
- Application method/speed.

ANNEX D: WORK PLAN

PLAN OF ACTION FOR IRS IMPLEMENTATION IN UGANDA

Objective	Expected result	Activity	Tasks	Timeframe	Responsibility
To adopt IRS policy and guidelines	IRS policy, strategy & guidelines adopted	Hold shareholders' consultative meeting	1. Invite partners 2. Hold consensus meeting	June 2005	MCP
To obtain baseline data on DDT in Uganda	**EIA report available**	Conduct EIA	▪ Develop TORs for EIA ▪ Recruit a consultant ▪ Conduct EIA ▪ Produce a report	Start February - July 2005	MOH
To use DDT for IRS in Uganda	Policy, strategy & guidelines for DDT use for IRS developed	Develop policy, strategy & guidelines documents and disseminate to partners	▪ Develop policy, strategy and guidelines ▪ Circulate to stakeholders. ▪ Seek inputs and consensus on DDT use ▪ Develop national framework on IVM	Starting in June 2005	MoH
To mobilize resources for IRS	Resources for IRS made available	Mobilize human, logistics and financial resources	▪ Develop a proposal ▪ Lobby for resources form government & partners	Ongoing	MOH & Partners
To identify target areas for IRS	Target areas for IRS identified	Use laid down criteria to choose IRS target areas	▪ Develop criteria for identifying targeted areas for IRS & use the criteria to identify IRS target areas	September/ October 2004	MCP and districts
To collect baseline information	Baseline entomology, parasitology and sociology data	Obtain baseline data on entomology, parasitology and sociology	▪ Conduct entomology and epidemiological surveys ▪ Conduct KAP	July-August 2005	MCP and Contractors
To estimate IRS commodities	Required commodities for IRS quantified	Conduct IRS needs assessment & produce estimates	▪ Reconnaissance the target areas ▪ Estimate target structures ▪ Calculate required commodities	July 2005	MCP and Districts
To make available IRS commodities	IRS commodities available to districts	Procure required commodities	▪ Tender for commodities ▪ Award tender & purchase items ▪ Make commodities available to districts	Jan-May 2006	MoH and MoF and MCP
To recruit and train spray operators	Spray operators recruited and trained	Conduct TOTs and recruit spray operators	▪ Conduct TOTs ▪ Recruit operators ▪ Train operators ▪ Deploy operators	March-May 2006	MCP and districts, partners
To ensure quality and adequate spraying	Effective IRS implemented	Monitor program implementation through bioassays and supervision Conduct IEC	▪ Develop supervisory checklist ▪ Supervise operation ▪ Conduct bioassays	June-August 2006	MCP

Objective	Expected result	Activity	Tasks	Timeframe	Responsibility
To measure program performance	Program achievements determined	Evaluate program implementation	▪ Repeat entomology, parasitological and KAP survey Determine coverage	November-December 2006	MCP and partners

Annex 6: Regulations To Limit Human And Environment Exposure To DDT

THE REPUBLIC OF UGANDA

MINISTRY OF HEALTH

REGULATIONS TO LIMIT HUMAN AND ENVIRONMENT EXPOSURE TO DDT

MALARIA CONTROL PROGRAM

First Draft **November 2006**

Contents

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1 Introduction

The insecticide DDT has been very successfully used for many years in malaria control programs around the world. The success in using DDT to eradicate malaria in the past and to control malaria in some countries in East and Southern Africa have spurred Uganda to consider re-introducing DDT for malaria control. However, according to the Stockholm Convention, any country considering using DDT in an Indoor Residual Spraying (IRS) program to control malaria should ensure that the right regulatory mechanisms are in place. This document sets out the regulations Uganda will put in place to limit human and environment exposure to DDT.

2 Importation:

Procurement of DDT will be exclusively by the MOH to ensure effective control and accountability. MOH will liaise with WHO to identify suitable supplier(s) for quality DDT in line with the WHO specifications and the National Drug Authority (NDA) Importation Guidelines. The MOH will first and foremost obtain clearance from NEMA and NDA to import DDT and in addition, will provide NEMA and NDA with information on the formulation, WHO specification number of the manufacturer, concentration of active ingredient and quantity of DDT to be imported and its suppliers. NEMA and NDA will ensure that MOH takes responsibility and accountability for the DDT brought into the country.

3 Packaging and labeling:

DDT should be packed and labeled according to WHO and NDA specifications on public health pesticides. DDT should be packaged in sachets to ensure that the insecticide can be added directly to water filled tanks thereby reducing the hazard associated with handling and mixing in a separate container.

Labels should be in English and should indicate: contents, safety instructions, possible measures in case of swallowing or contamination, trade or brand name, ingredients, common name, type of formulation, name of manufacturer and address, manufacture and expiry dates, distributor or formulator, warning signs in symbols and words, direction for use, net weight in container, registration or license number.

4 Transportation of DDT

The transportation of DDT from the point of manufacture to the stores of MOH in Uganda should be the responsibility of the supplier. Government has overall responsibility for the safe transportation of DDT from the stores in Uganda, up to the point of use (spraying). Thus, where the supplier delivers the DDT up to Kampala, or even to an up-country destination, the Government of Uganda, through the contract, must require the supplier to ensure that human beings and the general environment are not contaminated during transportation. Therefore, MOH will have a transportation monitoring plan, including a record on DDT sources, suppliers, transportation and

delivery schedules, training and supervision of transporters' staff, especially pertaining to emergency preparedness, response and first aid.

Whether transportation from the port is by rail or by trucks, the supplier will ensure that the containers are intact and are made of such tough and sealed materials that even if there was a traffic accident en route, the DDT cannot spill and contaminate the environment. Therefore, MOH or their appointed agents, will follow the movement of DDT from the point of manufacture, to the port of landing, and then to the point of use and disposal, so that all the imported DDT can be accounted for, to the last gram. The need for tough containers must be included in the contract of the supplier. The transporters, especially the drivers and their assistants, must be educated about the safe handling of the containers in order to prevent spillage. They should also be educated about emergency response measures, such as cordoning off the truck and calling for urgent help, should an accident occur. All transporters of DDT must train their employees in first aid, and must avail them with the first aid equipment. The employers will supervise the drivers and assistants to ensure that the emergency preparedness and first aid measures are understood and are in place all the time.

5 DDT distribution:

Multi-stage distribution routes between entry port and final destination of insecticide application must be limited to prevent pilferage. Regulatory mechanisms on mode of transportation to spraying area, inventory mechanisms before storage and at final destination will be put in place. The mode of transportation should be specified and dedicated for DDT only.
DDT will be solely distributed through MOH and its use strictly controlled by the Ministry to prevent any unauthorized access by the general public. MOH will ensure proper warehousing/storage, transportation and handling at all levels from central facilities to the place of application.

6 Storage of DDT

MOH will arrange for importation of DDT in only the amounts required to cover areas selected for spraying. The districts selected for spraying will then arrange with MOH to requisition for DDT in the amounts estimated to just cover the households in that particular district. There will be a record of DDT coming into the store, given out, returned if unused after spraying, and a record of spillage if any. Any spillage in the store will have to be reported, giving cause, whether it could have been avoided, and preventive measures to be followed in the future.

The stores to be used for DDT in Uganda will be certified by MOH in collaboration with NEMA and NDA. The stores will be exclusively used for DDT and spraying equipment. The stores will be in good physical repair, well aerated and the containers of DDT will be placed on wooden pallets.

DDT shall be stored in a lockable place that is inaccessible to unauthorized persons, domestic animals and birds. Warning signs will be placed on the entrances of the store. DDT shall be stored in their original containers with intact labels. Containers will be frequently examined for breakage or leaks. If damaged, insecticides will be transferred into another container with exactly the same label. DDT is NEVER to be stored in food/beverage store/containers where it may be mistaken for food. DDT and all other insecticides will be kept dry, away from fires, direct sunlight, heat and moisture in order to maintain their quality.

The storage place will be constructed of fire-resistant materials including a concrete floor (for easy cleaning, in case of spillage) and well ventilated. A Supplies Officer/ Storekeeper is necessary to ensure safekeeping of the DDT stocks. A checklist/record book and stock card on storage and issue of insecticide will be kept and available for inspection at all times. Periodic monitoring of DDT stocks will be conducted by a Multi-Sectoral Monitoring and Evaluation Task force.

7 DDT application

The spraying of DDT for IRS will be monitored from the point of issuing of insecticide to the point of application using compression sprayers which must be in good repair. Spray staff will be issued with personal protective equipment before deployment.

Spray Teams will be assigned a number of target houses. They will be issued with the exact number of sachets, which must be all used, and empty sachets returned to account for usage. The Supervisor will also be required to ensure that the targeted houses have been sprayed and a record card signed by Team Leader.

In order to allay the fears of possible environmental contamination the IRS program will ensure that DDT is sprayed on walls of residential houses. All agricultural produce in the houses must be protected from DDT contamination. This will require removal of such produce from immediate precincts of the spray. There will be need for regular sampling of the produce to trace possible contamination.

In the above perspective, all the spray staff will be required to wear appropriate personal protective equipment (PPE) supplied by Ministry of Health. The Supervisors will ensure that all the spray staff members under their jurisdiction have the equipment, have been adequately trained to use them correctly, and are supervised to ensure appropriate and efficient use whenever spraying is carried out. The PPE will include at least boots, long sleeved overall, gloves, a plastic apron, a half face mask with organic vapor filter cartridge, goggles, or a visor shield, and a helmet. The spray staff will be availed facilities where to clean and keep the PPE after each spray session. They will also be availed with bathing facilities after the spraying session. Due to logistical consideration in Uganda this operational base may be at Subcounty or Health Centre III. There will be a record of the PPE provided and of the supervision procedures on a daily basis.

7.1 Handling:

- DDT will be mixed and used according to the label instructions. Notice should be taken of the warnings, precautions and special instructions.
- All measures will be taken to minimize spillage when mixing the insecticide.

7.2 Washing of protective wear:

- Protective wear will be washed on a routine basis with soap. Any heavily contaminated wear should be removed immediately and washed the same day.
- All water used for washing of protective wear should be poured into a pit latrine
- Under no circumstances may clothes be washed in a river or any open water body.

7.3 Safe application of DDT:

Though a relatively safe insecticide, DDT like any other insecticide, is a toxic chemical that can harm people, animals and the environment if misused. DDT can be used with minimum or no risk to people or the environment if the following principles are followed:

- The insecticide **must** be applied carefully and correctly on to target surfaces following laid down guidelines and ensuring safety to humans, domestic animals and the environment.
- Before application, ensure that the DDT is not yet expired and sachets are intact.
- Ensure that appropriate equipment and protective wear are in place.
- All instructions for use, restrictions and precautions on the pesticide labels **mus**t be observed.
- DDT **must** be stored in a locked room, in original containers with labels intact, away from food and clothing, and out of the reach of animals and unauthorized people.
- Only properly trained personnel in dealing with insecticides in general will be engaged to ensure safe application of chemical to minimize impacts on humans and environment;
- DDT **must** be applied at the correct dosage to avoid excessive residue.

NOTE that DDT use for Agricultural purposes has been banned worldwide including Uganda.

7.4 Considerations for safe DDT Application:

- Protective wear and equipment **must** be used.
- Application equipment should be checked regularly for leaks and faulty nozzles.
- Spray equipment should be calibrated before adding pesticides to ensure that equipment is releasing the correct amount of water.
- The correct spraying pressure and the right nozzle opening should be used at all times.

- Eating, drinking or smoking is prohibited during handling and spraying (until after washing of hands).
- In case of accidental spillage of insecticidal solution onto body, the area must be washed thoroughly with water.

7.5 Disposal of DDT:

Spray Supervisors must ensure that the right quantities of insecticides are prepared for each spraying round to avoid unnecessary leftovers. All excess insecticide left after spraying and any residuals must be collected and returned to supervisors together with all empty DDT containers for SAFE disposal. Never use empty DDT sachets. The sachets should be safely kept in a drum provided by the supplier who will in turn collect the drum to dispose the sachets according to UNEP specifications. The MOH together with NDA will be responsible for arranging the disposal of unwanted and obsolete DDT according to the UNEP/WHO/FAO guidelines.

7.6 Surplus spray solution and rinse water management

- Prepare just enough spray solution to treat the area to be sprayed.
- All spray solution in sprayers **must** be fully sprayed out at the end of the day's work. No solution should be kept until the next day as it poses a risk of accidental spillage and contamination and may corrode the equipment. The insecticide might not be suitable for spraying the next day as the suspensibility may be affected and the active ingredient may break down.
- Spray pumps **must** be thoroughly washed at the end of the day by rinsing with clean water (triple rinse). Rinse water must be poured into an appropriate container, tank, mixing drum or water trailer meant for this purpose and used the next day for making up the first spray solution. **Rinse water must not be disposed of into the environment.**
- At the end of the spray operation (season) the last batch of rinse water may be sprayed on the interior of the structures being sprayed. This is expected to be minimal as it only represents one day's rinse water.
- The rinse water containers **must** be clearly marked with signs indicating that it contains "contaminated" water not fit for human or animal consumption. These containers should be kept away from animals, children and uninformed persons.

8 DDT Spray Monitoring and Evaluation

Before the spray season the spray staff will have their blood and urine tested for the levels of DDT and its metabolites and for pregnancy in case of women. Because the laboratory tests are expensive, and because the procedure of spraying is standard and the exposures are likely to be similar between spray staff, only a representative sample of spray staff may be tested per sub-county. The alternative or complementary testing may be by fixing adsorbent pads on the body of the spray staff and then dressing appropriately using PPE. After a spray session or day the pad is taken to the laboratory for analysis of

the level of DDT reaching the body through the PPE. Again because of the costs and logistics only a limited sample of spray staff need be tested per sub-county.

A sample of produce in houses sprayed and samples of soil near houses, which have been sprayed, should be sent to the laboratory to determine the level of DDT contamination immediately after each spraying season. The level of DDT residues should be compared to similar sample from areas where IRS is not taking place.

DDT efficacy can be measured by the reduction in the mosquito population densities in houses that have been sprayed. Therefore mosquito population densities will be estimated in a sample of houses before the seasons' spraying exercise begins. The same sampled houses will have the mosquito population taken after the spraying. Geographical Positioning System (GPS) will be used to facilitate mapping of sprayed areas and the monitoring for possible resistance of mosquitoes to DDT. The exercise will be coordinated by the Entomologist at the Ministry of Health in conjunction with the District Vector Control staff, who will keep records of the findings, and disseminate them as required.

Pre- and post IRS prevalence surveys will be conducted. Incidences of malaria infection in sample health facilities with good and reliable data will also be monitored to establish the impact of the IRS using DDT. The statistics will be scored to draw comparison with past situations in order to establish the effectiveness and impact of using DDT.

Use of DDT will be regulated in accordance with the Stockholm Convention and WHO guidelines. DDT will **ONLY** be used for malaria vector control following the correct procedures of storage, applications/spraying and disposal that ensure safety to humans and the environment.

The MOH will provide regular reports to NEMA on the use of DDT. Monitoring of DDT use will be conducted by the Multi-sectoral Task Force. DDT shall **NEVER** be transferred to unauthorized users **EXCEPT** with express permission of NEMA, the national authority charged with this mandate in Uganda

9. Offenses and Penalties

The National Drug Policy and Authority Statute No. 13 of 1993, Part IX Section 61 (1) a, d and e, sets out the penalties and punishments to be meted out to persons contravening the provisions of this Statute as follows: such people will be liable ----
(a) to a fine not exceeding one million shillings;
(d) to imprisonment not exceeding one year; or
(e) to any two of the above punishments.

The Ministry of Health feels that the same penalties and punishments should apply to those found illegally in possession and/or using DDT. This is aimed at avoiding misuse of DDT by unauthorized persons and/or unauthorized purposes and its potential impact on agricultural products and exports.

10. The Stockholm Convention

The Convention stipulates that:

iv. DDT shall be restricted to disease vector control only including malaria control, **when safe and cost-effective alternatives are not available.**
v. Countries using or intending to use DDT must follow WHO guidelines;
vi. Countries that require to use DDT **must** notify UNEP and WHO

However, the Convention does not require that:

iv. Countries requiring to use DDT should notify WHO and UNEP before spraying;
v. Countries obtain WHO or UNEP's approval at any time for DDT use;
vi. Countries have a deadline by which they must stop using or producing DDT.

Annex 7: Profile for DDT

CAS Registry Number 50-29-3

Summary

a. Chemical History

Dichlorodiphenyltrichloroethane (DDT) is a broad range pesticide used since the late 1930s on agricultural crops and to control disease-carrying insects, such as those that spread malaria and typhus. In 1955, a global campaign to eradicate malaria was adopted based on the use of DDT, and endemic malaria in developed countries, subtropical Asia, and Latin America was eradiated by 1967. However, few African countries participated, and the campaign ended in 1969 due to lack of support and developing mosquito resistance to DDT (Rogan and Chen, 2005). DDT was banned in the United States and other industrialized countries in the early 1970s, largely due to its persistence in the environment. However, DDT is still in use today in sub-Saharan African countries to control malaria (ATSDR, 2002). DDT is not generally thought to be toxic to humans; however, recent data have indicated that exposure to DDT in amounts necessary for malaria control may cause preterm birth and early weaning (Rogan and Chen, 2005). Acute exposure to high levels of DDT by any route causes neurological effects, including excitability, headache, nausea, vomiting, and dizziness (ATSDR, 2002).

Data on Mexican workers who use DDT show very high levels of DDT in adipose (fat) tissues and serum (Rogan and Chen, 2005). Children are also at risk for increased exposure to DDT and its metabolites via consumption of breast milk and cow's milk. DDT exhibits its toxic effects in humans on the nervous system and liver (ATSDR, 2002).

b. Description of Data Quality and Quantity

EPA and ATSDR have developed quantitative human heath benchmarks (EPA's chronic RfD and oral and inhalation CSFs and ATSDR's acute and intermediate oral MRLs). Several comprehensive reviews on the toxicity of DDT are available and recommended:

- Toxicological Profile for DDT, DDE, and DDD (ATSDR, 2002)
- IRIS summary review (U.S. EPA, 2005a)
- A recent review article by Rogan and Chen (2005).

Other relevant resources include

- Specifications for Pesticides Used in Public Health (WHO, 1999)
- Environmental Health Criteria 9: DDT and its Derivatives (IPCS,1979)

– Pesticide Information Profile for DDT (EXTOXNET, 2003)
– The Pesticide Action Network (PAN) Pesticide Database (PAN, 2005).

Summary Table

Duration	Route	Benchmark Value	Units	Endpoint	Reference
Acute	Inhalation	0.0005	mg/kg/day	Adopt acute oral MRL as acute inhalation; assume no portal of entry effects	
Intermediate	Inhalation	0.0005	mg/kg/day	Adopt intermediate oral MRL as intermediate inhalation; assume no portal of entry effects	
Chronic	Inhalation	0.0005	mg/kg/day	Adopt chronic RfD as chronic inhalation; assume no portal of entry effects	
Cancer	Inhalation	0.034	per mg/kg/day	Inhalation CSF (calculated from oral data) for benign and malignant liver tumors in rats and mice	U.S. EPA (1997)
Acute	Oral	0.0005	mg/kg/day	Acute oral MRL based on neurodevelopmental effects in mice	ATSDR (2002)
Intermediate	Oral	0.0005	mg/kg/day	Intermediate oral MRL based on liver effects in rats	ATSDR (2002)
Chronic	Oral	0.0005	mg/kg/day	Chronic oral RfD based on liver effects in rats	U.S. EPA (2005a)
Cancer	Oral	0.034	per mg/kg/day	Oral CSF for benign and malignant liver tumors in rats and mice	U.S. EPA (2005a)
Acute	Dermal	0.0005	mg/kg/day	Adopt acute oral MRL as acute dermal; assume no first pass effects and 100% oral absorption	
Intermediate	Dermal	0.0005	mg/kg/day	Adopt intermediate oral MRL as intermediate dermal; assume no first pass effects and 100% oral absorption	
Chronic	Dermal	0.0005	mg/kg/day	Adopt chronic RfD as chronic dermal; assume no first pass effects and 100% oral absorption	

Cancer	Dermal	0.034	per mg/kg/day	Adopt oral CSF as chronic dermal; assume no first pass effects and 100% oral absorption

For oral exposure, the acute oral MRL of 0.0005 mg/kg/day was derived for DDT based on the LOAEL for neurodevelopmental effects in mice perinatally exposed to DDT (ATSDR, 2002). The intermediate oral MRL of 0.0005 mg/kg/day was derived for DDT based on the NOAEL for liver effects in rats exposed to DDT in the diet (ATSDR, 2002). A chronic RfD of 0.0005 mg/kg/day was derived for DDT based on liver lesions in male and female rats exposed to DDT in the diet for 27 weeks. An oral CSF of 3.4E-1 per mg/kg/day was also derived based on benign and malignant liver tumors in male and female rats and mice chronically exposed to DDT in the diet (U.S. EPA, 2005a).

For inhalation exposure, no noncancer toxicity factors were derived for DDT because adequate experimental data do not exist for this route (ATSDR, 2002; U.S. EPA, 2005a). An inhalation unit risk of 9.75E-5 per $\mu g/m^3$ and an inhalation cancer slope factor of 3.4E-1 per mg/kg/day were calculated from oral data for benign and malignant liver tumors in male and female rats and mice chronically exposed to DDT in the diet (U.S. EPA, 2005a).

For dermal exposure, no dermal toxicity factors have been derived because EPA and ATSDR have not yet identified a method suitable for this route of exposure. However, EPA has developed a simplified paradigm for making route-to-route extrapolations for systemic effects via percutaneous absorption in which complete oral absorption is assumed, thereby eliminating the need to adjust the oral toxicity value (U.S. EPA, 2004). This approach may result in underestimating risk. No adjustment was made and oral toxicity values were used for the dermal assessment.

c. Background

CASRN:	50-29-3
Synonyms:	(p-chlorophenyl)ethane; dichlorodiphenyl trichloroethane; DDT; 1,1'-(2,2,2-trichloroethylidene)bis(4-chlorobenzene); α-α-bis(p-chlorophenyl)-β, β, β –trichloroethane (ATSDR, 2002)
Chemical Group:	organochlorine (ATSDR, 2002)
Registered Trade Names:	Genitox, Anofex, Detoxan, Neocid, Gesarol, Pentachlorin, Dicophane, Chlorophenothane (ATSDR, 2002) Cesarex, p,p'-DDT, Dichlorodiphenyltrichloroethane, Dinocide, Didimac, Digmar, ENT 1506, Guesapon, Guesarol,

Gexarex, Gyron, Hildit, Ixodex, Kopsol, Neocid, OMS 16, Micro DDT 75, Rukseam, R50 and Zerdane (EXTOXNET, 2003).

d. Usage

DDT is a broad spectrum insecticide that was once widely used. In World War II, it was used extensively to control insect-borne diseases such as malaria and typhus. In the early 1970s, it was banned in the United States and most industrial countries due to its persistence in the environment. Today it is used only in sub-Saharan Africa and in emergency cases to control malaria (ATSDR, 2002).

e. Formulations and Concentrations

Technical grade DDT is generally used as an insecticide. It is made up of three isomers of DDT, including p,p'-DDT (up to 85 percent), o,p'-DDT (15 percent), and o,o-DDT (trace amounts) (ATSDR, 2002). DDT is available as an aerosol, a dustable powder, an emulsifiable concentrate, in granules, or as wettable powders (EXTOXNET, 2003). DDT that is used for indoor residual spraying is usually a wettable powder that has 75 percent active ingredient. WHO (1999) indicated that the content of p,p'-DDT in the DDT formulation should be declared and contain the following:

- Technical grade DDT: no less than 700 g/kg p,p'-DDT
- Dustable powder: over 25–100 g/kg p,p'-DDT with a permitted tolerance of +/- 10% of the declared content
- Wettable powder: 100–250 g/kg p,p'-DDT with a permitted tolerance of +/- 6% of the declared content, or 250–500 g/kg p,p'-DDT with a permitted tolerance of +/- 5% of the declared content, or greater than 500 g/kg with a permitted tolerance of +/- 25 g/kg.

f. Shelf Life

DDT has a long shelf life. It is resistant to destruction by light or oxidation (HSDB, 2005).

g. Degradation Products

DDT breaks down very slowly by dehydrohalogenation into DDE [1,1-dichloro-2,2-bis(p-dichlorodiphenyl)ethylene] and DDE [1,1-dichloro-2,2-bis(p-chlorophenyl)ethane]. In animal systems, these metabolites are stored in body fat and either leave the body slowly if exposure decreases, remain constant in the tissues, or increase with continued exposures (ATSDR, 2002). Stored DDE and DDD are slowly transformed to DDA [bis(dichlorodiphenyl) acetic acid] by other metabolites. DDA and its metabolites are then excreted in the urine (EXTOXNET, 2003).

h. Environmental Behavior

Fate and Transport in Terrestrial Systems

DDT and its metabolites are highly persistent and bioaccumulate in the environment (ATSDR, 2002). The persistence of DDT in the environment is mainly due to its being soluble in fat and virtually insoluble in water (IPCS, 1979). DDT is released into the air as a result of spraying operations in countries where it is still being used. DDT and its metabolites may also enter the air when they evaporate from contaminated soil and water. They may then be deposited back onto land and surface waters. This cycle of volatilization and deposition may be repeated numerous times resulting in the movement of DDT in the atmosphere. As a result, DDT and its metabolites have been found in air, sediment, and snow, and accumulated in biota in the Arctic and Antarctic regions. As a result of this ability to undergo long-range global transport, the actual lifetime of DDT and its metabolites is substantially longer than indicated by their estimated half-lives. In the atmosphere, DDT and its metabolites occur as a vapor or are attached to particulates in the air. As a vapor, DDT and its metabolites are broken down by sunlight. DDT is also broken down slowly by microorganisms (ATSDR, 2002).

In most soils, DDT is practically immobile due to its strong affinity to soil, especially organic soil matter (EXTOXNET, 2003). Because DDT and its metabolites (DDD and DDE) stick strongly to the soil, they remain mostly in the surface layers of soil. Soil with DDT bound to it may enter waterways via runoff (ATSDR, 2002). Other routes of loss and breakdown of DDT in soil include volatilization, photolysis, and aerobic and anaerobic biodegradation. Loss from volatilization depends on how much DDT was applied, the amount of organic material in the soil, proximity to the soil-air interface, and the amount of sunlight (EXTOXNET, 2003). Very little DDT will seep into groundwater. The persistence of DDT is soil varies with the type of soil, temperature, and soil mositure (ATSDR, 2002). The typical half-life of DDT in soil ranges from 2 years to 15 years (EXTOXNET, 2003). DDT and its metabolites last for a shorter time in soils that contain more microorganisms, wet soils, and warmer soils (ATSDR, 2002). Because DDT persists in the soil, bioaccumulation in plants has been observed, especially in the root.

Fate and Transport in Aquatic Systems

The two main ways that DDT may be released into surface waters are by direct application for the control of mosquito-borne malaria and by runoff from sprayed areas. Atmospheric transport and drift represent lesser scenarios (EXTOXNET, 2003). DDT is a highly persistent compound with low volatility and low solubility in water, leading to great potential to bioaccumulate in the environment. DDT binds to particles in surface water, settles, and then deposits in the sediment (ATSDR, 2002). Studies have shown that DDT dose not readily break down in

estuary sediments. Additionally, DDT has been widely detected in ambient surface water samples in the United States. The reported half-life of DDT in lake and river water is 56 and 28 days, respectively; the half-life in river water is shorter because river water usually has more organic soil matter (EXTOXNET, 2003). The main fate processes in the aquatic environment are volatilization, photodegradation, absorption to water-borne particles, and sedimentation, with the dominant fate process being volatilization. In surface waters, DDT is transformed via biotransformation and photolysis (ATSDR, 2002). DDT is also readily taken up by and accumulates in aquatic organisms (EXTOXNET, 2003).

i. Human Health Effects

Acute Exposure

Effects/Symptoms

DDT has been used in large populations for more than 60 years with little acute toxicity except from accidental exposures (Rogan and Chen, 2005). DDT impairs the conduction of nerve impulses. In humans, this can cause effects ranging from mild altered sensations to tremors, convulsions, and respiratory depression (ATSDR, 2002). Additional effects observed in humans following acute DDT exposure include headaches; nausea; vomiting; diarrhea; numbness; paresthesia; increased liver enzyme activity; irritation of the eyes, nose, or throat; altered gait; and malaise or excitability (EXTOXNET, 2003; PAN, 2005).

The toxicity of DDT varies with formulation and the exposure pathway. In humans, the oral route is thought to be the most significant. Fatalities have been documented following ingestion of commercial preparations that also contain substances other than DDT (ATSDR, 2002). Children appear to be more susceptible to the fatal effects of DDT than adults (EXTOXNET, 2003). Dermal and inhalation exposures to DDT are more likely in humans if the compound is in solution form (dermal) or aerosol form (inhalation). Exposure through dermal contact is more likely when DDT is in an oily solution than when it is in a wettable powder form, which is the formulation used most often in indoor residual spraying (ATSDR, 2002).

In animals, the toxicity DDT and its analogues have been studied extensively. Acute exposure to high doses of DDT can cause death, with the toxicity dependent upon the formulation. Acute oral LD_{50} values range from 150 to 200 mg/kg in mice, 113 to 800 mg/kg in rats, and 500 to 750 mg/kg in dogs (EXTOXNET, 2003). Deaths were usually a result of respiratory arrest (ATSDR, 2002). DDT is most known for its neurotoxic effects in animals. Similar to its effects in humans, DDT causes hyperactivity, tremor, and seizures in animals. Acute exposure to low doses of DDT can cause subtle neurodevelopmental effects in neonatal mice (EXTOXNET, 2003). Liver effects such as increased liver weights, induction of liver enzymes, and hepatic-cell hypertrophy and necrosis

have also been observed (Rogan and Chen, 2005). Because of the hormone altering action of DDT isomers, reproductive and developmental effects have also been seen in laboratory animals. Acute exposure to DDT and its metabolites in food may have negative effects on reproduction (ATSDR, 2002). DDT is very slightly toxic to laboratory animals via acute dermal exposure. LD_{50} values range from 2,500 to 3,000 mg/kg in rats, 1,000 mg/kg in guinea pigs, and 300 mg/kg in rabbits. Acute inhalation exposure of animals to DDT does not result in significant absorption in the lungs (EXTOXNET, 2003).

Treatment

Exposure to DDT may be measured through laboratory tests. DDT and its metabolites (DDE and DDD) may be detected in the blood/plasma, semen, urine, liver, kidney, fatty tissue, skin lipids, breastmilk, and lymphatic tissues (ATSDR, 2002). DDT exposure should be treated with anticonvulsants (benzodiazepines), oxygen, and cardiopulmonary monitoring. Epinephrine, other adrenergic amines, atropine, and orally administered fats are all contraindicated (PAN, 2005; Reigart and Roberts, 1999).

j. Chronic Exposure

Noncancer Endpoints

Most chronic exposure human data come from studies of workers who are exposed to DDT in manufacturing facilities or as spray applicators and from epidemiological studies. These studies indicate that chronic oral exposure to small amounts of DDT does not produce toxic effects in humans. However, DDT and its metabolite DDE may alter hormonally mediated endpoints such as lactation duration, maintenance of pregnancy, and fertility. Increased chances of premature birth, infants that are small for their gestational age, and height abnormalities in children have also been associated with high DDE levels in the blood (ATSDR, 2002). DDT and its metabolites affect male reproductive parameters such as semen volume, sperm count, testosterone ratios, and sperm DNA damage (Rogan and Chen, 2005).

In animals, liver effects have been seen following chronic exposure to moderate levels of DDT (ATSDR, 2002). The main effect was localized liver damage. Additional chronic effects in animals include nervous system (tremors, central nervous system cellular chemistry changes, loss of equilibrium), kidneys (adrenal gland and kidney damage), and immune system (reduced antibody formation, reduced immune cells). Those effects were seen at levels much higher than than expected human exposure levels (EXTOXNET, 2003).

Cancer Endpoints

IARC has classified DDT in group 2B; a probable human carcinogen (IARC, 1991). EPA has also determined that DDT is a probable human carcinogen (U.S.

EPA, 2005a). The available epidemiological evidence regarding carcinogenicity in humans is inconclusive. A slight increase in risk from lung cancer was observed in workers at two DDT production facilities. No other cancer incidences were found in sufficient numbers for analysis. Inconsistent results have been found when comparing serum DDT/DDE levels in people with and without cancer (IARC, 1991). One study indicated a potential link between chronic, high dose DDT exposure and pancreatic cancer in chemical workers but the reliability of the study is questionable. The association between p,p'-DDE and breast cancer has been studied extensively, but studies have failed to show an association (Rogan and Chen, 2005). Studies have indicated that DDT and its metabolites are not mutagenic (ATSDR, 2002). In animals, DDT has been shown to cause liver and lung cancers (ATSDR, 2002).

k. Toxicokinetics

DDT is absorbed via inhalation, the gastrointestinal tract, and dermally. In humans, oral exposure to DDT is considered the most significant. Orally, DDT is absorbed from the gastrointestinal tract into the lymphatic system. There is also some absorption into the portal blood. Distribution of DDT to all body tissues then occurs from the lymphatic system and blood. In the tissues, DDT is stored in proportion to the lipid (fat) content of the tissue (ATSDR, 2002). DDT is initially metabolized into DDE and DDD, however these are ultimately transformed into DDA (EXTOXNET, 2003). DDA and its metabolites are eventually excreted in the urine. DDT may also be excreted via feces, semen, and breastmilk (ATSDR, 2002).

l. Ecological Effects

Acute Exposure

DDT is only slightly toxic to birds. Acute oral LD_{50} values in various bird species include the following: Japanese quail (841 mg/kg), pheasant (1,334 mg/kg), and mallard (2,240 mg/kg). Most avian exposures are a result of the food chain and consumption of aquatic (e.g., fish) or terrestrial (e.g., earthworms or other birds) species that have an accumulated body burden of DDT. However, earthworms are not susceptible to the acute toxic effects of DDT. Additionally, DDT is not toxic to bees. DDT may, however, be toxic to bats as DDT may be released from fat stores during migration (EXTOXNET, 2003).

DDT is highly toxic to many aquatic species. On average, acute exposure to DDT is only slightly toxic to amphibians and phytoplankton; moderately toxic to annelida, mollusks, and zooplankton; highly to very highly toxic to fish; and very highly toxic to crustaceans (PAN, 2005). In fish, the 96-hour LC_{50} values range from 1.5 µg/L in northern pike to 21.5 µg/L in fathead minnows. DDT is very highly toxic to stoneflies, midges, crayfish, sow bugs, and other aquatic

invertebrate with 96-hour LC_{50} values ranging from 0.18 to 7.0 µg/L. In aquatic invertebrates, DDT adult stages are less susceptible than developmental stages (EXTOXNET, 2003).

Chronic Toxicity

Chronic exposure to DDT has been linked to reproductive effects in birds. Eggshell thinning and embryo death are two of the main concerns especially in birds of prey. The mechanism of eggshell thinning is thought to be from the major metabolite DDE. Additionally, the reproductive behavior of birds may also be subtlety altered by DDT and DDE exposure. In laboratory studies, changes in courtship behavior, delays in pairing and egg laying, and decreases in egg weight have been observed in some bird species, though it is not clear what these effects mean for the survival of wild bird species. A synergism may exist between DDT metabolites and organophosphate pesticides to produce greater neurotoxicity and increased deaths (EXTOXNET, 2003).

Chronic exposure to DDT may occur in fish and aquatic species through bioaccumulation. This occurs from the uptake of DDT in sediments and water, with smaller fish taking up higher amounts of DDT. It has been estimated that the half-time elimination of DDT for rainbow trout is 160 days. Bioaccumulation can occur at very low environmental concentrations and the bioconcentration factor for DDT is 1,000 to 1,000,000, depending on the aquatic species (EXTOXNET, 2003).

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Annex 8: Exposure Treatment Guidelines

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Organochlorines

DDT is the only insecticide of the organochlorine chemical group that is still recommended for indoor residual spraying (IRS). Previously used organochlorines belonged to the cyclodiene sub-class, which included dieldrin and HCH. Dieldrin was abandoned because of its high acute toxicity to humans. Eventually, the whole subgroup became unusable because a mechanism common to all cyclodienes caused the rapid development of resistance.

DDT

DDT is an organochlorine insecticide with low volatility and very low solubility in water, but which is soluble in fats and organic solvents. DDT is highly persistent and has a long residual effect on most sprayed surfaces. The long persistence in the environment and its high bioaccumulation in fatty tissues have contributed to the dispersal of DDT residues everywhere (including arctic ice) from the agricultural use of DDT in the 1950s and 1960s. This bioaccumulation has resulted in highly toxic effects at the top of food chains, particularly in sharks, eagles, and falcons.

The main danger of environmental contamination from using DDT as an indoor residual spray comes from diverting the insecticide from malaria control to agricultural use. A similar danger would occur if containers were inadequately disposed of or pumps indiscriminately washed in surface waters. These risks could be prevented by proper education and strict supervision.

Toxicology

Absorption route: Absorbed from the gastrointestinal tract and by inhalation. DDT in oily solution may also be absorbed through intact skin. This is not applicable to the WP formulations used for malaria control.

Mode of action: DDT is a central nervous system stimulant that produces hyperactivity and tremor; convulsions may occur but are less common than with other organochlorine insecticides.

[*] US Agency for International Development. Draft 4. Integrated Vector Management Programs for Malaria Vector Control: Programmatic Environmental Assessment. March 2006. Prepared by RTI International. Contract GHS-I-01-03-00028-000-1. Prepared for Bureau for Global Health, USAID.

Symptoms of poisoning

Acute poisoning by DDT is very rare, particularly when used for indoor residual spraying. Nevertheless, it could potentially occur if there is gross mishandling. Early symptoms may include paresthesia (tingling) of the tongue, lips, and parts of the face, which in severe cases extends to the extremities. The patient may have a sense of apprehension and disturbance of equilibrium, dizziness, confusion, and a characteristic tremor.

Emergency Treatment

Emergency treatment for organochlorine pesticide exposure includes removing the contaminated clothing, washing the affected skin with clean water and soap, and flushing the affected area with large quantities of clean water. Keep the patient calm and in quiet, shaded conditions and seek medical assistance. Do not give the patient oils and fats.

Treatment by Medical Professional

Observation. Persons exposed to high levels of organochlorine pesticides by any route should be observed for sensory disturbances, incoordination, speech slurring, mental aberrations, and involuntary motor activity that would warn of imminent convulsions.

Convulsions. If convulsions occur, place the victim in the left lateral decubitus position with the head down. Move away furniture or other solid objects that could be a source of injury. If jaw movements are violent, place padded tongue blades between the teeth to protect the tongue. Whenever possible, remove dentures and other removable dental work. Aspirate oral and pharyngeal secretion, and when possible, insert an oropharyngeal airway to maintain an open passage unobstructed by the tongue. Minimize noise and any manipulation of the patient that may trigger seizure activity.

Dosage of Diazepam:

- *Adults*: 5-10 mg IV and repeat every 5-10 minutes to maximum of 30 mg.
- *Children*: 0.2 to 0.5 mg/kg every 5 minutes to maximum of 10 mg in children over 5 years, and maximum of 5 mg in children under 5 years.

Although lorazepam is widely accepted as a treatment of choice for status epilepticus, there are no reports of its use for organochlorine intoxication. Some cases have required aggressive management that included the addition of phenobarbital and induction entobarbital coma.

Seizures in patients caused by organochlorine toxicity are likely to be prolonged and difficult to control. Status epilepticus is common. For this reason, patients with seizures that do not respond immediately to anticonvulsants should be transferred as soon as possible to a trauma center and will generally require

intensive care admission until seizures are controlled and neurologic status is improved. Initial therapy with benzodiazepines should be instituted.

Oxygen. Administer oxygen by mask. Maintain pulmonary gas exchange by mechanically assisted ventilation whenever respiration is depressed.

Skin decontamination. Thoroughly decontaminate the skin.

Gastrointestinal decontamination. If organochlorine has been ingested in a quantity sufficient to cause poisoning and the patient presents symptoms within an hour, consider gastric decontamination procedures. If the patient presents more than an hour after ingestion, activated charcoal may still be beneficial. If the victim is convulsing, it is almost always necessary first to control the seizures before attempting gastric decontamination. Activated charcoal administration has been advocated in such poisonings, but there is little human or experimental evidence to support it.

Respiratory failure. Particularly in poisonings by large doses of organochlorine, monitor pulmonary ventilation carefully to forestall respiratory failure. Assist pulmonary ventilation mechanically with oxygen whenever respiration is depressed. Because these compounds are often formulated in a hydrocarbon vehicle, hydrocarbon aspiration may occur with ingestion of these agents. The hydrocarbon aspiration should be managed in accordance with accepted medical practice as a case of acute respiratory distress syndrome, which will usually require intensive care management.

Cardiac monitoring. In severely poisoned patients, monitor cardiac status by continuous ECG recording to detect arrhythmia.

Contraindications. Do not give epinephrine, other adrenergic amines, or atropine unless absolutely necessary because of the enhanced myocardial irritability induced by chlorinated hydrocarbons, which predisposes to ventricular fibrillation. Do not give animal or vegetable oils or fats by mouth. They enhance gastrointestinal absorption of the lipophilic organochlorines.

Phenobarbital. To control seizures and myoclonic movements that sometimes persist for several days following acute poisoning by the more slowly excreted organochlorines, phenobarbital given orally is likely to be effective. Dosage should be based on manifestations in the individual case and on information contained in the package insert.

Cholestryamine resin. Cholestryamine resin accelerates the biliary-fecal excretion of the more slowly eliminated organochlorine compounds. It is usually administered in 4 g doses, 4 times a day, before meals and at bedtime. The usual dose for children is 240 mg/kg/24 hours, divided Q 8 hours. The dose may be mixed with a pulpy fruit or liquid. It should never be given in its dry form and

must always be administered with water, other liquids, or a pulpy fruit. Prolonged treatment (several weeks or months) may be necessary.

Convalescence. During convalescence, enhance carbohydrate, protein, and vitamin intake by diet or parenteral therapy.

General Principles in the Management of Acute Pesticide Poisonings

Skin Decontamination

Decontamination must proceed concurrently with whatever resuscitative and antidotal measures are necessary to preserve life. Shower patient with soap and water, and shampoo hair to remove chemicals from skin and hair. If there are any indications of weakness, ataxia, or other neurologic impairment, remove the victim's clothing, have the victim lie down, and give the victim a complete bath and shampoo using copious amounts of soap and water. Check for pesticide sequestered under fingernails or in skin folds and wash these areas.

Flush contaminating chemicals from eyes with copious amounts of clean water for 10-15 minutes. If eye irritation is present after decontamination, ophthalmologic consultation is appropriate.

Persons attending the victim should avoid direct contact with heavily contaminated clothing and vomitus. Contaminated clothing should be promptly removed, bagged, and laundered before returning to the patient. Shoes and other leather items cannot usually be decontaminated and should be discarded. Note that pesticides can contaminate the inside surfaces of gloves, boots, and headgear. Decontamination should especially be considered for emergency personnel (such as ambulance drivers) at the site of a spill or contamination. Wear rubber gloves while washing pesticide from skin and hair of patient. Latex and other surgical or precautionary gloves usually do not provide adequate protection from pesticide contamination.

Airway Protection

Ensure that a clear airway exists. Suction any oral secretions using a large bore suction device if necessary. Intubate the trachea if the patient has respiratory depression or if the patient appears obtunded or otherwise neurologically impaired. Administer oxygen as necessary to maintain adequate tissue oxygenation. In severe poisonings, mechanically supporting pulmonary ventilation for several days may be necessary.

Note on Specific Pesticides: There are several special considerations with regard to certain pesticides. In **organophosphate** and **carbamate** poisoning, adequate tissue oxygenation is essential prior to administering atropine.

Gastrointestinal Decontamination

A joint position statement has recently been released by the American Academy of Clinical Toxicology and the European Association of Poisons Centres and Clinical Toxicologists on various methods of gastrointestinal decontamination. A summary of the position statement accompanies the description of each procedure.

1. **Gastric Lavage.** If the patient presents within 60 minutes of ingestion, lavage may be **considered**. Insert an orogastric tube and follow with fluid, usually normal saline. Aspirate back the fluid in an attempt to remove any toxicant. If the patient is neurologically impaired, airway protection with a cuffed endotracheal tube is indicated prior to gastric lavage. Lavage performed more than 60 minutes after ingestion has not proven to be beneficial and runs the risk of inducing bleeding, perforation, or scarring due to additional trauma to already traumatized tissues. It is almost always necessary first to control seizures before attempting gastric lavage or any other method of GI decontamination. Studies of poison recovery have been performed mainly with solid material such as pills. There are no controlled studies of pesticide recovery by these methods. Reported recovery of material at 60 minutes in several studies was 8 percent to 32 percent. There is further evidence that lavage may propel the material into the small bowel, thus increasing absorption.

Note on Specific Pesticides: Lavage is contraindicated in hydrocarbon ingestion, a common vehicle in many pesticide formulations.

Position Statement: Gastric lavage should not be routinely used in the management of poisons. Lavage is indicated only when a patient has ingested a potentially life-threatening amount of poison and the procedure can be done within 60 minutes of ingestion. Even then, clinical benefit has not been confirmed in controlled studies.

2. **Activated Charcoal Adsorption**. Activated charcoal is an effective absorbent for many poisonings. Volunteer studies suggest that it will reduce the amount of poison absorbed if given within 60 minutes. There are insufficient data to support or exclude its use if time from ingestion is prolonged, although some poisons that are less soluble may be adsorbed beyond 60 minutes. Clinical trials with charcoal have been done with poisons other than pesticides. There is some evidence that paraquat is well adsorbed by activated charcoal. Charcoal has been anecdotally successful with other pesticides.

Dosage of Activated Charcoal:

- ***Adults and children over 12 years:*** **25-100 g in 300-800 mL water.**
- ***Children under 12 years:*** **25-50 g per dose.**
- ***Infants and toddlers under 20 kg*****: 1 g per kg body weight.**

Many activated charcoal formulations come premixed with sorbitol. Avoid giving more than one dose of sorbitol as a cathartic in infants and children due to the risk of rapid shifts of intravascular fluid. Encourage the victim to swallow the adsorbent even though spontaneous vomiting continues. Antiemetic therapy may help control vomiting in adults or older children. As an alternative, activated charcoal may be administered through an orogastric tube or diluted with water and administered slowly through a nasogastric tube. Repeated administration of charcoal or other absorbent every 2-4 hours may be beneficial in both children and adults, but use of a cathartic such as sorbitol should be avoided after the first dose. Repeated doses of activated charcoal should not be administered if the gut is atonic. The use of charcoal without airway protection is contraindicated in the neurologically impaired patient.

Note on Specific Pesticides: The use of charcoal without airway protection should be used with caution in poisons such as organophosphates, carbamates, and organochlorines if they are prepared in a hydrocarbon solution.

Position Statement: Single-dose activated charcoal should not be used routinely in the management of poisoned patients. Charcoal appears to be most effective within 60 minutes of ingestion and may be considered for use for this time period. Although it may be considered 60 minutes after ingestion, there is insufficient evidence to support or deny its use for this time period. Despite improved binding of poisons within 60 minutes, only one study suggests that there is improved clinical outcome. Activated charcoal is contraindicated in an unprotected airway, a GI tract not anatomically intact, and when charcoal therapy may increase the risk of **aspiration** of a hydrocarbon-based pesticide.

Seizures: Lorazepam is increasingly being recognized as the drug of choice for status epilepticus, although there are few reports of its use with certain pesticides. Emergency personnel must be prepared to assist ventilation with lorazepam and any other medication used to control seizures. See dosage table below. For organochlorine compounds, use of lorazepam has not been reported in the literature. Diazepam is often used for this, and is still used in other pesticide poisonings.

Dosage of Diazepam:

- ***Adults*: 5-10 mg IV and repeat every 5-10 minutes to maximum of 30 mg.**
- ***Children*: 0.2 to 0.5 mg/kg every 5 minutes to maximum of 10 mg in children over 5 years, and maximum of 5 mg in children under 5 years.**

Dosage of Lorazepam:

- **Adults: 2-4 mg/dose given IV over 2-5 minutes. Repeat if necessary to a maximum of 8 mg in a 12 hour period.**
- **Adolescents: Same as adult dose, except maximum dose is 4 mg.**
- **Children under 12 years: 0.05-0.10 mg/kg IV over 2-5 minutes. Repeat if necessary .05 mg/kg 10-15 minutes after first dose, with a maximum dose of 4 mg.**

Caution: Be prepared to assist pulmonary ventilation mechanically if respiration is depressed, to intubate the trachea if laryngospasm occurs, and to counteract hypotensive reactions.

Phenobarbital is an additional treatment option for seizure control. Dosage for **infants, children, and adults** is 15-20 mg/kg as an IV loading dose. An additional 5 mg/kg IV may be given every 15-30 minutes to a maximum of 30 mg/kg. The drug should be pushed no faster than 1 mg/kg/minute.

For seizure management, most patients respond well to usual management consisting of benzodiazepines, or phenytoin and phenobarbital.

Annex 9: Environment of Uganda

(Extracted from the website of the Ministry of Environment)

Country Overview

Uganda is a land-locked country sitting astride the Equator, characterised by a number of major transboundary natural resources (lakes, rivers and mountains).

From the 39 districts, which were in existence in 1994, there are now 70 confirmed, with other districts proposed but not implemented as of 2005. While the increase in the number of districts will mean greater devolvement of central government functions including that of environment and natural resources management, the move will increase the cost of administration. The new districts will need to appoint environment and natural resources management officers (lands, forestry, environment and wetlands) as defined in the new structures recommended by the Public Service. The new districts will also be candidates for the environment action plan process.

The extensive habitat variations as a result of the intersection of phytochoria, the location on the Equator, and the wide range of altitudinal variations, extensive drainage systems and relatively fertile soils, give the country a mosaic of vegetation, modified climates and extensive wetlands. When climate is considered with agriculture and altitude, one can identify two highland agricultural zones and seven zones with different agroclimatic potentials and environmental impacts associated with production.

There are 46 indigenous tribes with varying production and consumption patterns and hence varying influences on the environment. The population is growing rapidly at a national average of 3.4% per annum. This growth rate masks differences among the districts, ranging from over 9% for Kotido District to less than 1% for Kabale. The national population is relatively young. Population under 18 years of age makes up 56% of the total population. The mean household size is 4.8 persons - 4.2 persons in urban areas and 4.9 in rural settings.

Governance in Uganda is linked to the progressive devolution - as opposed to deconcentration - of power from the centre to the local governments through the process of decentralisation.

Since 1994, the economy of Uganda has registered an impressive growth rate. Over the period 1994 to 2005, growth of the economy measured by increases in the gross domestic product has averaged over 5% per annum. Headcount poverty levels decreased from 56% of the total population in 1992 to 35% by 2000 and then rose to 38% by 2004. The northern region is the most disadvantaged region of Uganda with headcount poverty of about 70% as a result of nearly 20-years of civil war and cattle rustling. Furthermore, while the growth of the economy is impressive, there are worries of inequitable sharing of the benefits. There are indications that the gap between the poor and the rich is now

wider. In terms of structure, the share of the non-monetary segment of gross domestic product has continued to decline from1994 and in the fiscal year 2003/4 it accounted for 20.4% of the total compared to the monetary component at 79.6%, an indication of a modernising economy.

Put another way, the country's natural capital is being ‘mined' without sufficient compensatory formation of physical and human capital.

Since 1991, growth in industrial output has averaged over 10% per annum. Most of the industrial activity is based on agricultural commodities and natural resources products. The growth in industrial production is accompanied by increased levels of air, water and soil pollution. The pollution effects are being mitigated somewhat using the environmental assessment process and cleaner production procedures.

The road network is improving and the environmental effects of road construction and maintenance are mitigated using the EIA guidelines for the Roads Sub-Sector and several guidelines to address other cross-cutting concerns.

Finally, employment in Uganda is still largely agriculture-based. However, as other sectors of the economy grow, agriculture's share of total employment is expected to decline.

ATMOSPHERIC RESOURCES

Climate is an important resource. Climate change and climate variability, both impose adverse impacts on livelihoods, especially of the rural poor. Global research indicates that biodiversity is particularly sensitive to climate change.

Uganda is impacted adversely by increases and fluctuations in the earth's temperature. Increased frequencies of floods and droughts are manifestations of climate change. The erratic onset and cessation of rains as a result of climate variability makes it difficult for farmers to plan when to plant crops. There have been instances of frequent crop failures of late. Hence, to reduce vulnerability to the deleterious effects of climate change and climate variability, adaptation plans including early warning systems need to be put in place.

TERRESTRIAL RESOURCES

Land resources and agriculture

Land is a limiting factor of production. Access to land is increasingly becoming difficult, especially for the poorer segments of society. Land degradation, especially through soil erosion is the single largest contributor to the annual cost of environmental degradation. Loss of soil nutrients is the reason the country's adjusted net savings are negative, in the absence of other compensatory factors.

With respect to agriculture, the country's dominant development pathways are: expansion of cereals production; expansion of banana-coffee production; non-farm development; expansion of horticulture; expansion of cotton; and stable coffee production. Each of these development pathways has implications for the environment, which will have to be addressed whichever pathways are followed.

Forestry resources

The loss of forest cover in the gazetted areas has been reducing and total cover is stabilising. Unfortunately, forests in protected areas make up only 30% of the national forest cover. The remaining 70% are on private and customary lands where deforestation rates are high as a result of conversion of forest areas and bushland into agricultural and pastoral land. Furthermore, the country's harvestible timber resources are almost exhausted. Hence, to increase forest cover and ensure increased supply of timber, the Sawlog Production Grant Scheme and other licensing measures including charging economic rents for timber are in place. To ensure that rural communities living adjacent to forest reserves receive equitable benefits, collaborative forest management is being promoted. In recognition of the scarcity of land and goods and services provided by trees, agroforestry systems are also being promoted as integral aspects of farming practices.

Rangeland resources and livestock production

Rangelands, mostly found in the ‘cattle corridor' occupy 107 000 km 2 or 44% of the country's land area. In some places, the conditions of the rangelands are deplorable - overgrazed, and through wind and soil erosion, bare. The rangelands are also located in arid and semi-arid areas, themselves fragile ecosystems. In the extreme, pasture and water scarcities are contributing to frequent conflicts between cultivators and pastoralists in the first place, and among pastoralists themselves.

The number of cattle, goats and sheep is on the increase and hence there is need to pay attention to the carrying capacities of Uganda 's rangelands. There is anecdotal evidence that in some locales the carrying capacities of the rangelands are being exceeded. Quantitative studies of rangeland conditions are lacking and ought to be addressed. Carrying capacities of various rangelands have also not been established.

On the other hand, here are intensive piggery and poultry operations. Large-scale piggery and poultry operations can generate significant pollution problems. From 1999 to 2003, the numbers of pigs and birds have reduced somewhat for a variety of reasons.

Wildlife resources

Wildlife constitutes an important resource base for the country – as a source of food and material, recreation, tourism, nature study and scientific research. Wildlife resources occur in protected and un-protected areas. By 1994, wildlife populations whether inside or outside protected areas represented a small fraction of what they were in the 1960s, with some species such as both the black and the white rhino becoming extinct. By 2004,

the populations of wildlife in protected areas had stabilized, and some even increased, although marginally so. Outside protected areas, the decline in wildlife populations continues unabated as a result of increased off-take, the blocking of migratory routes and habitat conversions, among others. The Uganda Wildlife Authority is piloting the conservation of wildlife populations outside protected areas through measures such as the operationalisation of the different classes of Wildlife Use Rights provided for in the Wildlife Act. Also, communities adjacent to wildlife protected areas are being encouraged to appreciate the prescence of wildlife through benefit (including revenue) sharing.

Mineral resources

Reading from geological formations, there is a significant mineral potential in the country. However, the exact locations of commercially-exploitable deposits in most cases are unknown. Of the ones that are known, on a base case scenario, the value of mineral production is expected to rise from the 2003 figure of $12 million to over $100 million/year; while on a best case scenario basis the value is expected to increase to over $200 million/year. However, the realisation of these projections is contingent upon availing sufficient capital to the mining sector.

When increased mineral production is realised, it will bring with it higher levels of pollution which will have to be mitigated, through among others, the use of the EIA Guidelines for the Mining Sector and regular supervision of mining operations.

AQUATIC RESOURCES

Wetlands

Wetlands cover about 13% of the area of Uganda and provide a number of direct and indirect values to the people of the country. Up to late 1980s, wetlands were generally considered ‘wastelands' to be reclaimed for agriculture in rural areas, and ‘drained' as an anti-malarial measure in urban settings. By 1994, the need for conservation was realized and the process of formulating an appropriate policy of wetlands.

By 2001, wetlands were regarded as ‘granaries of water'. From being a project in 1994, wetlands had by 2005 obtained an institutional home within government structure. Wetlands are now better known and better characterised with detailed information up to the district level. The 56 districts existing by 2004 all had District Wetland Action Plans. Some communities in a few districts have gone ahead and prepared Community Wetlands Action Plans. The management of wetlands is governed by a 10-year Wetlands Sector Strategic Plan which qualified for funding under the Poverty Action Fund. Despite such an impressive achievement, the implementation of the various action plans is constrained by lack of resources.

Furthermore, despite a wide array of achievements, wetlands degradation is still evident – some for basic survival needs of the poor, others as a saving measure where land

purchase prices are high, and yet others are the result of ignorance about ownership and legal boundaries of wetlands. Perhaps the most important reason for continued wetland degradation is weak enforcement of the applicable environmental laws and fairly low levels of awareness among policy makers and rural communities.

Water

Uganda has significant quantities of water resource. From both hydrological and social water scarcity considerations, at the moment Uganda is not water stressed. Howeverindications are that, by 2025, increasing demands for human, livestock, wildlife, irrigation and industrial water will pose a reason to worry. Uganda is ranked in a group of countries that must plan and secure more than twice the amount of water they used as of 1998 in order to meet reasonable future requirements.

The quality of the water from available sources is another area of concern principally as a result of pollution – residential, industrial and agricultural land discharges into the open waterbodies. To some extent the buffering capacity of wetlands is making a contribution towards reductions in pollution, but this will continue only if the integrity of the wetlands can be sustained.

Fisheries

The fisheries resource of Uganda has been an important source of high quality solid animal protein. On average Ugandans were consuming about 13kg/person/year by 1994. As of 2005,

this consumption was estimated to have declined to about 10kg/person/year, mainly as a result of increasing scarcity and cost. Exports of fish and fish products are also on the increase. The twin effect of increases in domestic consumption as a result of population growth and higher levels of export demand has pushed capture fisheries close to its long-run sustainable supply and is threatening to exceed it. There is evidence of localised over-fishing in certain waterbodies. Two lakes (Victoria and Kyoga) and two species (Nile Perch and Tilapia) account for over 80% of annual harvest, implying a high level of selectivity. On the other hand, the Nile Perch, a carnivore, is having a devastating effect on the fish biodiversity of lakes Victoria and Kyoga.

A new fisheries policy is in place and seeks to address among others enhanced aquaculture development by adding 100 000 tonnes per year to the one of capture fisheries of about 330000 tonnes so as to raise the combined long-run sustainable supply to 430 000 tonnes at least. The development of aquaculture at this magnitude will call for a combination of commercial and artisanal productions. Both modes of production have the potential to generate significant adverse environmental impacts which need to be mitigated. Due to the uniqueness of acquaculture, specific environmental impact assessment guidelines may have to be developed for this activity.

CROSS-SECTORAL RESOURCES

Energy

The dominant source of energy in Uganda is biomass and this is expected to remain so in the foreseeable future inspite of plans to increase hydropower energy production. However, the share of clean energy in total consumption is gradually increasing, in part as a result of programs like the Energy for Rural Transformation. Production of energy has also been The State of Environment Report for Uganda , 2004/05 liberalised, attracting an increasing interest among private investors. The adverse environmental effects of clean energy production are mitigated through the EIA Guidelines for Uganda 1997 and the EIA Guidelines for the Energy Sector .

Biomass energy will continue to be an important source of energy, especially for the rural poor, who constitute the majority of Ugandans. In some districts, the scarcity of biomass is already beginning to have impacts on the quality of food prepared. Households are opting for easy to cook but often less nutritious foods. There is need to encourage agroforestry practices so that households can raise their own biomass energy requirements in conjunction with farming practices.

There are efforts to diversify clean energy sources through the promotion of new renewable energy such as solar and biogas. Unfortunately, the investments required are still at levels which the rural poor cannot afford. Geothermal energy on the other hand, has potential for increased electricity production. There are at least two promising sites awaiting development.

Biodiversity

Uganda is endowed with a very rich and varied biodiversity due to its bio-geographical setting, varied altitudinal range and extensive drainage systems. The extensive biodiversity supports rural livelihoods and contribute to commercial economic activities. The contribution of Uganda 's biodiversity resources, organisms or parts thereof, populations or other biotic component of ecosystems with actual or potential value for humanity has been estimated at $1000 million per year, balanced against economic costs of $ 202 million plus losses to other economic activities of about $49 million per year.

While Uganda continues to lose some of its rich biodiversity, the rate of loss has been reduced in recent times. The loss of biodiversity in protected areas has to a great extent been stopped and the trend reversed between 1990 and 2005. The loss of biodiversity is largely the result of habitat conversion and introduction of alien species.

Apac and Oyam

There are lake and river edges, wetlands and a variety of habitat types in Apac and Oyam districts. From a simple analysis of the National Biomass Study published by the Ministry of Water, Lands and Environment (2003), we can see that the Apac District (2003) has 11,462 hectares of wetlands and 35,533 hectares of water. Apac also has 105

hectares of local forest reserves, 11,373 hectares of Central Forest Reserves (protected area), and 6 hectares of a national park that is shared with Masindi district (protected). Maruzi Central Forest Reserve (6,101 hectares) is the largest in the district with only 5% (or 309 hectares) having been deforested. Located in the southern portion of Maruzi county, this is probably the most important protected area in the DDT pilot area. Ground checking each of these areas prior to commencing IRS is very important since central forest reserves have largely been depleted of woody biomass (and other biodiversity) and have been magnets of colonization.

Annex 10: Comparative Cost Analysis Regarding the Potential Use of DDT for Indoor Residual Spraying in Apac and Oyam Districts, Uganda

Context and Purpose

As part of the President's Malaria Initiative (PMI), the U.S. Agency for International Development (USAID) is supporting the use of indoor residual spraying (IRS) for Uganda's national malaria control strategy. The National Malaria Control Program (NMCP), part of the Ministry of Health, intends to expand the use of IRS in Uganda and to use dichloro-diphenyl-trichloroethane (DDT) as the residual insecticide in selected districts that experience perennial malaria transmission. Because DDT applied to the interior walls of houses has been shown to be effective in killing *anopheline* mosquitoes for up to 12 months, the NMCP expects that using DDT will result in substantial cost-savings by avoiding the need to conduct two IRS rounds each year, as would be required if an insecticide with a shorter effective period were used. However, there are additional costs associated with the use of DDT, e.g., for shipping, security, environmental monitoring, and waste disposal.

The purpose of this analysis is to determine whether the NMCP's expectation of net savings from use of DDT is reasonable, given best estimates of the costs associated with use of DDT and its alternatives for IRS. This analysis does not evaluate potential economic losses that could result from the use of DDT (e.g., from a reduction in export of agricultural commodities shown to contain DDT residues at concentrations unacceptable to importers), nor does it attempt to compare such potential losses to the likely economic benefits that may be expected from a reduction in malaria cases and deaths.

Scope of the Analysis

USAID has contracted RTI International to provide financial, technical, and operational support for use of IRS in countries receiving assistance from the President's Malaria Initiative (PMI). The Uganda NMCP has requested that RTI conduct a trial of IRS using DDT in an area of Uganda that experiences perennial transmission, and has selected Apac and Oyam Districts for the trial in 2008. This analysis compares the costs of using DDT for IRS operations in Apac and Oyam with the cost of using lambda-cyhalothrin, as is currently the practice in the PMI-supported IRS program. The analysis considers two alternative formulations of lambda-cyhalothrin.

Key Exclusions

This analysis is limited to an evaluation of costs applicable to Apac and Oyam Districts in 2008; it does not attempt to evaluate the costs that would be incurred in a general, nationwide use of DDT for IRS. Apac and Oyam are the only districts in Uganda for

which DDT use is being considered in 2008. USAID policy requires an annual review and approval of a Supplemental Environmental Assessment for use of DDT. Thus, if the trial use of DDT is successful and the government wishes to consider a broader introduction of DDT for IRS, it will be timely to compare the cost of using DDT with that of using alternative chemicals when this SEA is revised for future years.

This analysis only looks at the cost to USAID in its support for the pilot of DDT in Uganda. It does not attempt to estimate costs that will necessarily be incurred by the Ministry of Health and other Government of Uganda agencies over the next several years if it decides to substantially increase the use of DDT and take direct responsibility for implementing IRS with DDT. During the trial in Apac and Oyam Districts, RTI will implement the necessary environmental controls and audits to ensure compliance with the Safer Use Action Plan (SUAP). If the Government decides to expand the use of DDT, it will incur additional costs not addressed in this analysis, e.g., to complete the registration of DDT, establish training and compliance with chain-of-custody requirements, and establish capabilities for environmental monitoring and vector surveillance. In addition, basic infrastructure and security (e.g., storage and ablution facilities, evaporation tanks) as well as technical capacities for core vector control functions (eco-epidemiological evaluations, including vector surveillance and monitoring, pesticide bioassays, planning, and M&E) will need to be developed.

Key Assumptions

- Using DDT, one round of IRS per year will be sufficient to substantially reduce the anopheline vector population and malaria transmission in the treated area. Using lambda-cyhalothrin or any other WHOPES-approved residual insecticide, two rounds of IRS would be required to achieve a comparable result.
- For 2008 in Apac and Oyam, RTI will retain direct control over DDT throughout the chain of custody and will have direct responsibility for implementing all environmental compliance measures. The MOH will provide formal authorization for RTI to use DDT in Apac and Oyam Districts under the special permission granted by NEMA, at no administrative cost to RTI or USAID.
- Although DDT is not fully registered in Uganda, the MOH's policy decision to support use of DDT for malaria control, combined with NEMA's conditional approval, are legally sufficient to authorize the use of DDT for public health purposes in 2008.

Methodology

The analysis employs an ingredients approach, listing each type of cost anticipated, estimating the number of units required, and determining costs by using unit costs derived from recently completed IRS programs or procurement data obtained during such programs.

Analysis

Estimated cost of achieving effective malaria control for one year using IRS with lambda-cyhalothrin (ICON WP) in Apac and Oyam Districts

- The cost of recent IRS programs RTI has implemented in southern Uganda was approximately $16.45 per household treated.

- Government authorities estimate the current population of Apac and Oyam at 490,688. Recent surveys determined the average household size is 4.8 people. Thus, there are approximately 102,227 households in Apac and Oyaam.

- Thus, the estimated cost of one spray round is $16.45 * 102,227 = $1,681,634.

- Two spray rounds would be required to achieve effective control for one year using lambda-cyhalothrin in the WP formulation. The estimated cost of two rounds is $1,681,634 * 2 = $3,363,268, or $32.90 per household.

Estimated cost of achieving effective malaria control for one year using IRS with lambda-cyhalothrin (ICON CS) in Apac and Oyam Districts

- Based on recent purchases completed or in process by RTI International, the current price of ICON-CS is equivalent to the price of ICON-WP. Thus, the estimated cost of one spray round is $1,681,634.

- The CS formulation of lambda-cyhalothrin has been shown to have a longer period of effect than the WP formulation on mud walls, currently estimated at 7-9 months. Assuming that all of the houses in Apac and Oyam Districts are constructed with mud walls, and that the preliminary estimates of the duration of effect for CS prove reliable, it would be possible to achieve control of the malaria vector population with IRS rounds scheduled every 8 months, or three rounds over a two-year period.

- Thus, the estimated annual cost of using ICON-CS to control the malaria vector population in Apac and Oyam Districts is $1,681,634 * 3/2 = $2,522,451, or $24.67 per household .

Estimated cost of achieving effective malaria control for one year using IRS with DDT in Apac and Oyam Districts.

Part 1: Estimated cost of DDT and routine IRS operations not specific to DDT.

- The cost of lambda-cyhalothrin used in recent IRS programs in Uganda is $5.76 per household, or approximately 35% of the total cost. Thus, the cost of all routine operations, without including the insecticide, is $10.69 per household.

- With 102,227 households in Apac and Oyam, the cost of all routine IRS operations, exclusive of the insecticide cost, is 102,226 * $10.69, or $1,092,806.

- We assume, on average, it will be possible to spray two households for each sachet of DDT. In a recent procurement, RTI purchased DDT for use in a PMI country for $3.60 per sachet, plus an additional $0.91 per sachet for shipment by air freight, for a total cost of $4.51 per sachet. For 102,227 households, we anticipate needing 51,114 sachets. Thus, the cost of DDT for the proposed program in Apac and Oyam is estimated as 51,114 * $4.51, or $230,524.

- Thus, the estimated cost of purchasing DDT and conducting routine IRS operations for one round in Apac and Oyam Districts is $1,092,806 + $230,524 = $1,323,328.

Part 2: Cost of additional measures specific to the use of DDT.

- *Evaporation tanks.* Rinse water containing DDT cannot be disposed in a pit latrine; rather, it must be placed in an evaporation tank, from which solid phase DDT can be collected after the water has evaporated. One tank is required at each IRS operational "site" (the location at which compression sprayers are stored and from which spray operators deploy each day). Apac and Oyam Districts contain 83 parishes, and we assume it will be reasonable to establish one operational site to service a radius of about 15 to 20km, for a total of 18 operational sites. In a similar and concurrent program in Mozambique, it was possible recently to have evaporation tanks constructed for $150 each. For a Uganda pilot program, at least two chambers of 2x3x2 meters would be needed, as well as a cemented wash bay area linked to the chambers leading to the evaporation tank. An estimate of $500 per service point will be used. The total number of IRS service points would be about 18 (9 points per district). Each site servicing a radius of about 15-20 km. that will give about 9 sites per district

  18 sites * $500 = $9000.

- *Environmental Monitoring*. RTI is preparing an environmental monitoring plan specific to the use of DDT in Apac and Oyam Districts; the following is included for illustrative purposes.

  Soil – collect soil samples at communal gathering places in 5% of villages (57), assume 3 gathering places per village, collect 2 samples from each sampling location, repeated 3 times (before IRS, just after IRS, + 6 months). Cost of collection is $20/sample, cost of analysis is $150/sample. Overall cost is 57*3*2*3*$170 = $174,420

  Export Commodities – collect and analyze 10 samples each of 5 exported agricultural crops and fish, repeated 3 times (before IRS, just after IRS, and + 6 months). Cost of collection is $10/sample, cost of analysis is $150/sample. Overall cost is 10*5*3*$160 = $24,000

Soil, Sediment, and Biological Samples in Sensitive Habitats – collect and analyze 20 samples each of soil, sediments, and one biological tissue from each of two species known to accumulate or bio-concentrate DDT, performed before IRS to establish background concentrations. Additional samples will not be collected during or after IRS unless a substantial release is documented and has occurred in a manner and location that would indicate the potential for transport to the sensitive habitat. Cost of collection is $25 per sample, cost of analysis is $175 per sample. Overall cost is 80 * $200 = $16,000

Total Cost: $174,420 + $24,000 + $16,000 = $214,420

Note: The environmental monitoring plan being prepared for implementation in Apac and Oyam Districts also includes sampling and analysis of airborne particles and vapor to evaluate the potential for contamination of crops stored indoors in houses sprayed with DDT. However, such samples are collected only for evaluation and modeling purposes and would not be included in a routine environmental monitoring program. The cost of collecting and analyzing air samples is therefore not included here.

- *Recovery and disposal of DDT packaging.* Because Uganda does not have an incinerator that is capable of completely and safely destroying DDT-contaminated waste materials, the vendor will be required to include in their proposed offer the cost of recovering, shipping, and safely disposing spent packaging and unused product. A DDT vendor recently provided a quotation for this service, at an average cost of $0.23 per sachet.

  51,114 sachets * $0.23 = $11,756

- *Market Inspectors.* IRS spray operators and warehouse personnel are sometimes tempted to pilfer the insecticide stocks, repackage the insecticide, and sell it to a vendor or directly to residents at a market. In some programs, this practice has been recognized as a significant source of insecticide diversion, or "leakage." Such leakage is especially problematic with DDT. One way of preventing or limiting such diversion is to conduct active surveillance at markets and other community gathering places. This cost estimate is based on hiring 6 inspectors for Apac and Oyam Districts and employing them for 3 months, at a cost of approximately 20,000 Uganda shillings ($12) per day, plus transport. The total cost is as indicated below:

  6 inspectors @ $12/day * 72 days = $5184
  3 drivers, vehicles and fuel @ $20/day * 72 days = $4320

- *Media Relations.* Because of the increased interest shown by news media when DDT is involved, it is helpful to hire a full-time media specialist as part of the project team and to disseminate accurate information via radio and other means.

Media Specialist at $30/day * 96 days = $2880
Transport & per diem $25/day * 96 days = $2400
Radio spots: 1008 (3 stations, 3 spots/day for 16 weeks) at $10 = $10,080
Press kits: 200 @ $5 each = $1,000

- *IRS Spray Card.* Given recent reports on the potential health effects of DDT exposure in women who are exposed at a young age, the spray cards used to record data on each treated household should be redesigned to capture information on the age of female residents. This will require a minimal cost for word processing and reproduction.
  $1500

- *Total estimated cost for additional measures specific to the use of DDT*

Evaporation Tanks	9,000
Environmental Monitoring	214,420
Disposal of DDT Packaging	11,756
Market Inspectors	9,504
Media Relations	16,360
IRS Spray Card	1,500
TOTAL	262,540

Part 3: Total Estimated Cost of Using IRS with DDT in Apac and Oyam Districts in 2008

- The total estimated cost of using DDT in Apac and Oyam is the sum of Parts 1 and 2 above:
  $1,323,328 + $262,540 = $1,585,868

- The average cost is $15.51 per household.
  $1,585,868 / 102,227 households = $15.51

Cost Comparison: IRS using DDT vs. IRS using lambda-cyhalothrin WP or CS

The estimated annual cost of maintaining effective control of the malaria vector population with IRS in Apac and Oyam Districts is $32.90 per household using lambda-cyhalothrin in the WP formulation; $24.67 per household using lambda-cyhalothrin in the CS formulation; and $15.47 per household with DDT. The estimated cost of using DDT is slightly less expensive than lambda-cyhalothrin even for a single round, after accounting for the additional costs that are specific to DDT use. Additional, substantial cost savings are realized because of the longer effective period for DDT once applied, obviating the need for a second round of spraying each year.

This result is consistent with published studies on the topic. In an article published in 2004, Conteh et. al found that the costs of IRS per person protected, as implemented in southern Mozambique, were as follows:

Spraying, monitoring, and surveillance and project management costs in "Zone 1"

DDT	1 round	$2.94
ICON	1 round	$3.19
FICAM	2 rounds	$5.21
Propoxur	2 rounds	$6.62

Excerpted from Table 6 in Conteh, Sharp, Streat, Barrto and Konar, 2004. The cost and cost-effectiveness of malaria vector control by residual insecticide house-spraying in southern Mozambique: a rural and urban analysis. Tropical Medicine and International Health, v. 9:1, 125-132.

In the cited study, the cost of spraying with lambda-cyhalothrin (ICON) was 8.5% higher than spraying with DDT for a single round; in the analysis for Apac and Oyam, the estimated differential is 7.5%. In both analyses, chemicals requiring 2 rounds of IRS have substantially greater costs.

Annex 11. Statement of Public Support for DDT-Based IRS program from Apac District

STATEMENT FROM PARTICIPANTS IN THE APAC DISTRIC VALIDATION AND CONSENSUS BUILDING WORKSHOP ON OUTCOMES OF THE PUBLIC HEARING ON DDT-BASED INDOOR RESIDUAL SPRAYING PROGRAM IN UGANDA.

Preamble:

We, the participants in the Validation and Consensus Building Workshop on Outcomes of the Public hearing on DDT-based Indoor Residual Spraying Program in Uganda held at Apac on 5th November 2007, representing the residents and community of Apac District, take this opportunity to express our gratitude to the Government of Uganda through the Ministry of Health and Research Triangle Institute International, for organizing the Workshop. The people of Apac are fully aware of the destructive effects of malaria because of the daily heavy toll it inflicts on the population resulting in death of infants, children and adults and substantial loss of household capacity to produce food for the families or for income generation.

We, the participants, on behalf of the people and community of Apac:

- Recognizing current and past government initiatives to eradicate extreme poverty and hunger and uplift people's livelihood,
- Aware of government's efforts to reduce infant and child mortality and improve the overall health status of the people to improve their productivity,
- Appreciating national and international efforts to combat debilitating diseases such as HIV/AIDS, malaria and other diseases inflicting our population,
- Encouraged by government's efforts to ensure environmental safety and sustainability for our future generations,
- Noting the central role of key institutions such as Ministry of Health, Ministry of Water and Environment, Ministry of Agriculture, Animal Industry and Fisheries, National Environment Management Authority, Research Triangle Institute International (RTI) and other stakeholders including support agencies in the success of the malaria control initiative in the district.

Do, hereby:

- Commend government's efforts to support the indoor residual spraying (IRS) malaria control program in advancing the quality of life of the people in Apac District,

- Assure government and IRS program executing and implementing agencies and institutions, particularly Ministry of Health and Research Triangle Institute International, of our support for the program,

- Endorse IRS programs generally and the DDT-based IRS program in particular with emphasis on attention to social, economic, and environmental safety considerations and other environmental measures for community development,

- Urge government to take urgent measures to realize the objectives of the IRS program in Apac District,

- Stress the importance of joint and complementary institutional and community responsibility in realizing the objectives of the malaria control program, and in this regard, encourage the resident communities of Apac to support the use of DDT as effective means of fighting the malaria scourge in the district,

- Request government to promote similar measures for other debilitating diseases in the district such as tuberculosis and neglected non-communicable diseases that hitherto have had little attention,

- Encourage government to promote traditional medicine and indigenous knowledge that have hitherto been used by the community to complement current malaria control efforts in the district,

- Thank the government for selecting Apac District as initial beneficiary of the DDT-based Presidential Malaria Initiative (PMI) IRS program initiative.

We, on behalf of residents and community of Apac District, append our signatures at Apac this date of 5th November 2007.

Annex 12. Statement of Public Support for DDT-Based IRS Program from Kanungu District

STATEMENT FROM PARTICIPANTS IN THE KANUNGU DISTRIC VALIDATION AND CONSENSUS BUILDING WORKSHOP ON OUTCOMES OF THE PUBLIC HEARING ON DDT-BASED INDOOR RESIDUAL SPRAYING PROGRAM IN UGANDA.

We, the participants in the Validation and Consensus Building Workshop on Outcomes of the Public hearing on DDT-based Indoor Residual Spraying Program in Uganda representing the residents and community of Kanungu District wish to take this opportunity to express our gratitude to Government of Uganda through the Ministry of Health and Research Triangle Institute (RTI) International for organizing the Workshop. The people of Kanungu, having benefited previously from DDT treatment against the malaria vector, are fully aware of the destructive effects of malaria because of the heavy toll it inflicted on the migrant population of the then Kigezi district, resulting in death of infants, children and adults and substantial loss of household capacity to produce food for the families or for income generation.

We, the participants, on behalf of the people and community of Kanungu:

- Recognising current and past government initiatives to eradicate extreme poverty and hunger and uplift people's livelihood

- Aware of government's efforts to reduce infant and child mortality and improve the overall health status of the people to improve their productivity,

- Appreciating national and international efforts to combat debilitating diseases such as HIV/AIDS, malaria and other diseases inflicting our population,

- Encouraged by government's efforts to ensure environmental safety and sustainability for our future generations,

- Noting the central role of key institutions such as Ministry of Health, Ministry of Water and Environment, Ministry of Agriculture, Animal Industry and Fisheries, National Environment Management Authority, Research Triangle Institute International and other support agencies in the success of the malaria control initiative in the district,

Do, hereby:

- Commend government's efforts to support IRS malaria control program in advancing the quality of life of the people in the district'

- Assure government and IRS program executing and implementing agencies particularly Ministry of Health and Research Triangle International of our support for the program,

- Endorse IRS programs generally and the DDT-based IRS program in particular with emphasis on attention to social, economic, and environmental safety considerations community development,

- Urge government to take urgent measures to realise the objectives of the IRS program in Kanungu District,

- Stress the importance of joint and complementary institutional and community responsibility in realizing the objectives of the malaria control program in the district,

- Request government to promote similar measures for other debilitating diseases in the district such as tuberculosis and neglected non-communicable diseases that hitherto have had little attention,

- Encourage government to promote traditional medicine and indigenous knowledge to complement current malaria control efforts in the district,

- Thank the government for selecting Kanungu to be among the initial beneficiaries of the IRS program.

Signed on this date **9th November 2007** on behalf of Residents and Community of Kanungu District: (*Note:scanned signatures removed in this version due to size*)

Annex 13. Public Comment Background Documents

Annex 13A. Approval of EIS on Use of DDT for Indoor Residual Spraying for Malaria Control in Uganda

Annex.13B. Outcomes of the Public hearing on DDT-Based Indoor Residual Spraying (IRS) Program – Issues, Recommendations and Next Steps.

Annex.13C. Issues for Consideration by the Discussion Groups at Apac and Kanungu Validation and Consensus Building Workshops on Outcomes of the Public Hearing on DDT-Based IRS Program in Uganda

Annex 13A. Approval of EIS on Use of DDT for Indoor Residual Spraying for Malaria Control in Uganda

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NEMA REGISTRY 16 JAN 2007

NEMA/9.14.2

11th January 2007

All LC V Chairpersons

APPROVAL OF EIS ON USE OF DDT FOR IN-DOOR R IDUAL SPRAYING FOR MALARIA CONTROL IN UGANDA

As you may be aware, NEMA has approved the environmental aspects for the re-introduction of DDT for in door residual spraying to malaria control on 23rd December 2006.

However, the approval is subject to conditions which should be strictly taken into account when implementing the component involving the use of DDT such as obtaining approval from other authorities such as World Health Organization and the Secretariat of the Stockholm Convention on Persistent Organic Pollutants (POPs).

(1) The conditions include establishment of a professional and competent multi-sectoral/multidisciplinary monitoring committee to oversee the implementation of the environmental concerns of DDT re-introduction. This committee should include among others NEMA, Ministries of Health; Agriculture, Animal Industry and Fisheries; Tourism, Trade and Industry; NGOs and any other stake holders.

(2) An effective Public Awareness program is to be carried out through various Media to prepare the population for the DDT re-introduction, which shall include community mobilization for the management of dust that may be

DDT contaminated, as well as enable the population take precautionary measures relating to removal of the house hold items that may be contaminated during the exercise.

3. Other important aspects put into consideration are those relating to importation of DDT. It is to be done in accordance with the WHO specifications and National Drug Authority guidelines.

4. DDT will be transported by the Ministry of Health Officials, stored in safe and lockable places and it will be ensured that application is in line with the Stockholm and Rotterdam Conventions and disposed off in a manner consistent with NEMA waste management regulations of 1999.

5. It will also be ensured that any other unforeseen and undesired impact to environment at the time of undertaking are avoided and mitigated.

6. Therefore, this is to inform you of the decision in order to solicit the district's support in ensuring that set conditions are adhered to for the good of our country.

Aryamanya-Mugisha Henry
EXECUTIVE DIRECTOR

Cc All Resident District Commissioners

Cc All Chief Administrative Officers

Cc All District Environmental Officers

(A) General Conditions

(a) Prior to the re-introduction of DDT, obtain the necessary approvals from the Secretariat of the Stockholm Convention and the World Health Organization in line with Annex B Part II of the Convention;

(b) the importation and application of DDT should be carried out prudently and in line with the World Health Organization recommendations and guidelines;

(c) establish a professional and competent multisectoral/multidisciplinary monitoring Committee to oversee implementation of the environmental concerns of DDT re-introduction. This Committee should include, among others, NEMA, Ministry of Agriculture, Animal Industry and Fisheries, Ministry of Tourism, Trade and Industry, Ministry of Water and Environment, the private sector, NGOs and any other stakeholders as shall be deemed necessary and agreed upon;

(d) implement the Environmental Monitoring and Management Plan as contained in the EIS and ensure submission of monitoring reports every four months to this Authority as required under Section 78 of the Act;

(B) Awareness Programme

2. (a) ensure that an effective awareness programme is carried out through various media and any other possible means to prepare the population for the DDT re-introduction and in any case not later than, three months before the IRS exercise begins. This shall include awareness and community mobilization for the management of dust that is swept from the homesteads that may contain traces of DDT and pause a risk of contaminating the outdoor environment;

(b) ensure that enough awareness is created in the community regarding the spraying programme and methods to enable the residents take all necessary precautions including removal from their houses all items that could be contaminated during the spraying exercise;

(C) Importation of DDT

3. (a) The importation of DDT should be carried out in accordance with the World Health Organization (WHO) specifications and requirements and shall strictly follow the National Drug Authority guidelines;

(b) not withstanding the above, the DDT chemical should be packed and labeled according to WHO specifications and the labels should be clearly visible with standard symbols of dangerous chemicals;

(D) Transportation

4. (a) ensure that DDT will be solely distributed by the Ministry of Health from the central facilities to the areas of application to prevent any unauthorized access by the general public;

(b) put in place a comprehensive contingency plan to handle any accidental spillages and associated clean-up operations;

(E) Storage

5. (a) ensure that DDT is stored properly according to standard guidelines. In particular the chemical shall be stored in places constructed of fire-resistant materials including a concrete floor, well ventilated stores and in its original container with the labels intact;

(b) the storage places should be lockable, inaccessible to unauthorized persons; and away from fires, direct sunlight, heat and moisture.

(F) Application

6. (a) ensure that use of DDT will be regulated in accordance with the Stockholm and Rotterdam Conventions;

(b) application should be exclusively carried out by trained personnel and under strict supervision;

(c) workers should be provided with adequate protective gear;

(d) ensure that DDT is used only for indoor residual spraying on walls and roofs of homes and in small quantities, in line WHO guidelines;

(E) DISPOSAL

7. (a) ensure that all the waste including empty DDT containers will be safely kept in drums provided by the supplier, who shall in turn, collect the drums and dispose the containers in accordance with the National Environment (Waste Management) Regulations, 1999;

(b) not withstanding the above, ensure that the wastewater from the wash and rinse operations of the containers used in application is not disposed of into the environment;

(c) ensure that any expired/spoilt DDT is disposed off in accordance with NDA Guidelines and the National Environment (Waste Management) Regulations, 1999;

8. In accordance with Section 22 (4) of the National Environment Act, Cap 153, fulfill any other requirements to ensure that any other undesirable environmental impacts that may a rise due to implementing this project but were not contemplated by the time of undertaking this environmental impact assessment are avoided and mitigated.

I look forward to continued collaboration.

Aryamanya-Mugisha, Henry
EXECUTIVE DIRECTOR

c.c: The Rt Hon. Prime Minister
Prime Minister's Office
KAMPALA

c.c: The Hon. Minister of Health
Ministry of Health
KAMPALA

c.c: The Hon. Minister,
Ministry of Water and Environment
KAMPALA

c.c: The Hon. Minister,
Ministry of Tourism, Trade and Industry,
KAMPALA

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c.c: The Hon. Minister of State for Environment,
Ministry of Water and Environment,
KAMPALA

c.c: The Principal Private Secretary,
To H.E. The President,
State House, Nakasero
KAMPALA

c.c: The Principal Private Secretary,
To H.E. The Vice President,
Vice President's Office
KAMPALA

c.c: The Permanent Secretary,
Ministry of Water and Environment,
KAMPALA

c.c: The Permanent Secretary,
Ministry of Agriculture, Animal Industry and Fisheries
ENTEBBE

c.c: The Permanent Secretary,
Ministry of Tourism, Trade and Industry,
KAMPALA

c.c: The Permanent Secretary
Ministry of Foreign Affairs
KAMPALA

c.c: The Director General Health Services,
Ministry of Health
KAMPALA

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Annex 13B. Outcomes of the Public hearing on DDT-Based Indoor Residual Spraying (IRS) Program – Issues, Recommendations and Next Steps

OUTCOMES OF THE PUBLIC HEARING ON DDT-BASED INDOOR RESIDUAL SPRAYING (IRS) PROGRAM

Issues, Recommendations and Next Steps

Background Document**

1.0. Context

1.1. Malaria is one of the acute diseases responsible for high mortality percentages among Ugandans. It is endemic in 95% of the country and kills 320 persons each day. It is the leading cause of morbidity (death of below infant lives) and mortality in Uganda. It accounts for approximately 14% hospital inpatient deaths and up to 35% hospital admissions. For the under-five year olds, malaria accounts for up to 70% of out-patient cases, over 50% of admissions and fatality rate of anything between 8-25%. About 50% of deaths among children under five years old are attributed to malaria. While malaria disorder can be treated, it is believed that malaria vector control provides a better effective method of reducing malaria infection and epidemic incidences that appear to have increased in Uganda in recent years.

1.2. The impact of malaria is not just a health concern. Its debilitating health effects affect productivity of individuals, households and communities and the overall national growth and output. Its effects have direct impact on productive sectors such AS agriculture and industry. Malaria prevalence reduces productivity (loss of over 50% man-hours) of the workforce with resultant reduction in outputs, whose effects threaten not only national food security and agricultural exports, if the agricultural sector is considered, but also industrial outputs, as well as domestic and international trade. The effects of malaria are far-reaching such that there should be no compromise in seeking every retaliatory measure to suppress the malaria disease burden on Ugandan population. It is against this background, and as part of the Poverty Eradication Action Plan (PEAP) as well as Uganda's commitment to attain the Millennium Development Goals that the health sector adopted a strategy and planning framework for malaria control in Uganda.

1.3. Malaria case management and control are a health sector responsibility. The strategies for undertaking these responsibilities are set in the National Malaria Control Strategic Plan (2005/6-2009/10) integrated in the Health Sector Strategic Plan (HSSP) of the Ministry of Health. They include vector control through the
provision of long lasting

** Background Document prepared by Professor Z.M.Nyiira, Consultant for Research Triangle International (RTI) for the Open Public Forum and District Consultative and Validation Workshops on DDT-Based Indoor Residual Spraying (IRS) Program held in Kampala, Apac and Kanungu, from 5-13 November 2007

Insecticide-treated nets (LLITNs) and indoor residual insecticide spraying. By the end of government 2006/07 operational year, 1.8m nets had been distributed in at least two sub-counties in each district in the country, and, success in reducing malaria was recorded with PMI IRS pilot projects in Kabale, Kanungu and Kitgum using short residual pyrethrin, *lambda-cyhalothrin WP* also known as ICON. During the same period, after exhaustive debates involving a wide range of environmentalists, agro-produce exporters and the general public, and having considered lower comparative costs and long term benefits, government adopted and endorsed the use of DDT for malaria control in the country. Pilot indoor residual insecticide spraying using DDT will commence in January 2008.

1.4. Other government institutions, though with responsibilities not directly related to management and control of malaria, have interest and supporting roles in malaria vector control programs. They play a significant role in implementation of IRS programs, to monitor and advise the responsible ministry, and to ensure safe use of pesticides in malaria vector control. The key institutions include Ministry of Agriculture, Animal Industry and Fisheries, Ministry of Water and Environment, Ministry of Tourism, Trade and Industry, Uganda Wildlife Authority and Uganda Bureau of Standards. These institutions will be expected to commit themselves to assume key roles in implementation of the DDT-based IRS program in the assessment and monitoring aspects including involvement in community education and pesticide residue analyses.

1.5. NEMA gave its approval for Ministry of Health to use of DDT in IRS on 22nd December 2006 after the Environmental Impact Assessment (EIA). The general and specific conditions under which the approval was made related to the importation, transportation, storage, application and disposal of DDT, as well as the need for environmental monitoring and management portfolio and regular submission of monitoring reports by an inter-sectoral multi-disciplinary monitoring committee comprising NEMA, Ministry of Agriculture, Animal Industry and Fisheries, Ministry of Tourism, Trade and Industry, Ministry of Water and Environment, the Private Sector, NGOs and other essential stakeholders established for the purpose of overseeing implementation of environmental concerns of DDT introduction.

1.6. Supplementary Environment Assessment (SEA) was undertaken. It includes issues that touch on development of a Safer Use Action Plan for the implementation of best practices with regard to DDT-based IRS operations in Uganda. The Safer Action Plan – embraces safety *(policy, management, administrative, environmental and human health safeguards)*, effectiveness *(performance impact on target object)* and affordability *(capacity to obtain and sustain)*. The goal is to provide an enabling framework for actions that minimize and monitor impacts on human and animal health, trade and environment within the best practices resonant with the Stockholm Convention on Persistent Organic Pollutants (POP). The issues and concerns that emerged from the Public Hearing and the SEA demanded attention in the process (not a one time attention) of implementing the National Malaria Control Program, of which part is the DDT-based IRS program. Significant progress has already been made, including the development of guidelines by NEMA and MoH covering the general and specific conditions under which the use of DDT was approved, readiness of government to push through the essential activities to fully comply with DDT-based investment plan. RTI has in place a framework that not only explains the technical approach to

planning, design and monitoring of environmental monitoring for environmental monitoring of DDT Indoor Residual Spraying in Uganda but also serves as an educational framework for awareness raising on DDT environmental effects which were hitherto left to speculation.

1.7. The Safer Usage Action Plan (SUAP) recommendations addressed the issues and concerns, almost wholly safety issues, linked to the Vector Control Program in general and IRS in particular and the concerns of compliance with the provisions of the Stockholm Convention on Persistent Organic Pollutants (POPs) as well as specific guidelines and recommendations of the WHO on general use of DDT that the World health Organisation (WHO) listed for potential use in public health particularly for IRS.

1.8. The public hearing NEMA organized, was useful in representing issues and concerns of the public as much as it fulfilled a necessary condition for approval of DDT-based IRS. Above and in addition to understanding the relevant issues and concerns, it became necessary to seek consensus and additional inputs, if any, from the same public on measures proposed to address them.

1.9. The objective of these rounds of public fora is a response to the proposal of the SEA to hold direct and small group consultations to, among other things, consider issues and outcomes of the public hearing and other issues that require attention in the process of implementing DDT-based IRS program, validate the measures suggested to address the concerns, and recommend additional approaches and modalities to address present and future concerns related to the program.

2.0. Outcomes of the Public Hearing

The public hearing was convened on 23 November 2006 by NEMA to obtain views on DDT-based IRS program that government approved as part of the policy to fight malaria impact on Ugandan population.

2.1. Issues and Stakeholder Concerns

The issues and concerns that emerged from the public hearing and those expressed by the stakeholders generally are grouped in 8 categories namely:

2.1.1. Concerns of General Nature

These are concerns regarding management systems and general governance of the proposed DDT-based IRS program. They refer to requisite conditions that were to be in place to ensure the success of the program including the conditions NEMA addressed to MoH. They also include, among others, government readiness to push through DDT-based IRS activities, value-for-investment issues, and development of guidelines for registration, procurement, transportation, storage, use and disposal of IRS pesticides generally, and DDT in particular. At the public hearing, stakeholders were assured, that administrative and management issues and concerns were to be properly handled by the Ministries concerned and Research Triangle Institute (RTI) International.

2.1.2. Agricultural Concerns:

Issues and concerns in this category focused on pesticide leakage into agricultural primary production systems possible diversion of IRS pesticides, in this case DDT, for use in agricultural and livestock production systems. Observations made emphasized need for Ministry of Agricultural should be closely involved in the process of IRS programs to monitor pesticide use and any residues of IRS program pesticides in field crops of program target communities.

2.1.3. Produce Export Concerns:

The major concern in this category was possible contamination of agricultural produce and livestock products for domestic and export markets. Stakeholders stressed the need for safe packaging and storage of the pesticides in polythene material as well as safe post-harvest storage practices for agricultural produce and livestock products. They suggested close working relationship between Ministries of Health and Agriculture to effect necessary education and literacy to target communities and adoption of by-laws that were to regulate use and storage of pesticides and agricultural produce.

2.1.4. Human Health Concerns:

Concerns on human health were mainly contamination of food and water for drinking. Safe and separate storage of the pesticide away from stored or prepared food or water reserved for drinking were proposed to avoid the danger of contamination.

2.1.5. Animal Health Concerns:

Similar to human health concerns, issues in this category revolved around pollution of livestock (small and large stocks) and wildlife (fish, birds and wild animals). Safe disposal of pesticides and need for formulation of comprehensive quality assurance framework to monitor drift of pesticides into livestock and wildlife management environment were emphasized as measures to minimize danger to animal health.

2.1.6. Environmental Contamination Concerns:

Stakeholders expressed concern over possible leakage of DDT to soil and springs. It was observed that this concern applies not only to DDT but also to all pesticides as well as other chemicals applied in agriculture, manufacturing enterprises and in public health. Participants in public hearing advised that the IRS program takes special care to observe regulations pertaining to storage and disposal of chemicals and establishes a special protocol for monitoring any possible IRS chemical leakage to the environment particularly soil and water springs.

2.1.7. Methodological and Logistical Concerns:

The major issue in this category was whether environmental impact assessment should be conducted as a one-time-activity or continuously in real time circumstances. The proposal was for this matter to be addressed in accordance to existing regulations.

2.1.8. Governance Concerns:

Issues of governance were addressed and left to government (particularly MoH) to handle as appropriate but emphasis was laid on effectiveness and efficiency that the stakeholders felt were deficient. Need for training and awareness creation on safer use of DDT in IRS were emphasized.

2.2. Recommendations Suggested for Addressing the Issues and Concerns

(a) Governance, Management and Administrative Concerns

Governance, administrative and management issues and concerns should be handled by the Ministries concerned and RTI.

(b) Agricultural Concerns:

The Ministry of Agriculture, Animal Industry should be closely involved in monitoring pesticide use and any residues of IRS program pesticides in field crops of target communities.

(c) Produce Export Concerns:

Recommendations stressed safe packaging and storage of the pesticides in polythene material as well as safe post-harvest storage practices for agricultural produce and livestock products. Close working relationship between Ministries of Health and Agriculture was recommended to effect necessary education and literacy to target communities and to ensure the use of by-laws in regulating use and storage of pesticides and agricultural produce.

(d) Human Health Concerns:

Safe and separate storage of the pesticide away from stored or prepared food or water reserved for drinking were recommended.

(e) Animal Health Concerns:

Similar to human health concerns, recommendations emphasized safe disposal of pesticides and need for formulation of comprehensive quality assurance framework to monitor drift of pesticides into livestock and wildlife management environment.

(f) Environmental Contamination Concerns:

Participants recommended strict observance of regulations pertaining to storage and disposal of chemicals and establishment of a special protocol for monitoring any possible IRS chemical leakage to the environment particularly soil and water springs.

(g) Training and Awareness Creation

Training and retraining and awareness creation on safer use of DDT in IRS were recommended.

(h) Quality Assurance

Multi-sectoral monitoring task force was proposed to act as watchtower and ensure quality assurance.

(i) Information Feedback

It was recommended, that the implementing ministry adopts a mechanism of informing stakeholders about the status of implementation of the recommendations.

2.3. Additional Approaches and Modalities Suggested

Despite the multi-sectoral oversight task force proposed at the public hearing, an additional modality that participants may wish to consider and recommend is the establishment of a community pear review mechanism that could comprise an oversight committee and a community quality assurance inspector to monitor the process of implementation. This, however, will imply additional cost that may not be accommodated by the project. Alternatively, given cost considerations, the multi-sectoral oversight committee that NEMA proposed as one of the conditions for approval, could be mandated to represent community interests.

3.0. Next Steps

The next steps focused on validation of the recommendations, and development of a plan of action defining roles of relevant institutions in implementation of the IRS program.
Some of the desired actions have already been implemented and new ideas may have also been implemented since the public hearing. Hence, the need to update recommendations and modalities for addressing DDT-Based IRS program.

4.0. Action Requested

Participants in the validation and consensus building meetings and the open public forum will consider the issues and concerns, adopt or improve on the proposed measures to address them and recommend any other approaches and measures to address current and future concerns related to DDT-based IRS.

Annex 13C. Issues for Consideration by the Discussion Groups at Apac and Kanungu Validation and Consensus Building Workshops on Outcomes of the Public Hearing on DDT-Based IRS Program in Uganda

VALIDATION AND CONSENSUS BUILDING WORKSHOP ON OUTCOMES OF THE PUBLIC HEARING ON DDT-BASED IRS PROGRAM IN UGANDA

Background Document and Issues for Consideration by the Discussion Groups

1.0. Introduction:

1.1. After carefully weighing out its advantages and safety issues relating to various environmental aspects, government adopted DDT as a useful insecticides for indoor spraying mosquito control program. Formal and informal debates have taken place to rationalize DDT- related safety issues. Ministry of Health and National Environment Management Authority have taken precautions, and are putting in place measures to address identified public and institutional safety issues and concerns that apply to primary crop and livestock (including fish) production, natural resources (wildlife, water bodies, soil and air), human and general animal health, generic environment generally and secondary level or post harvest treatment of agricultural and livestock products, as well as market concerns. The proposals and recommendations on how the concerns will be addressed have been presented in the paper titled: ***"Outcome of Public Hearing: Issues, Recommendations and Next Steps"***. Provisions have been made for continuous monitoring and assessment of the impact of indoor residual spraying pesticides generally, and DDT in particular, to ensure safety of the stakeholders chain in delivery of the malaria control program. Albeit, there will continuously emerge new issues and concerns in the process of program implementation. Important at this moment, is the need to exhaust the issues that need attention, before and in the process of implementation of the DDT-based indoor residual spraying program. This is the basis of the exercise and questions that follow which participants are requested to consider and to which they are requested to provide answers.

1.2. Each group will handle similar exercise. Since individual and group perceptions differ, and that different circumstances require different approaches, response to issues and answers to questions are bound to differ. This, in itself, is expected to contribute to diversity of approaches, and modalities in addressing issues and concerns of indoor pesticide spraying for mosquito control.

2.0. Tasks for Groups

2.1. The tasks of each group as follows:

- Participants will divide themselves into three (1, 2, 3) groups
- Each group will chose its chairman and rapporteur
- The group will make a 10-15 minutes presentation
- Each group will submit to the organizing Secretariat a written report/summary of their discussion.

2.2. Issues for Group Discussions:

The following are the issues for each group discussion and for report presentation by the groups:

(1) Review the issues and concerns as well as recommendations and proposals for addressing them. These emerged from the public hearing that NEMA convened on 23 November 2006. Are there improvements you personally or the group wish to propose? Indicate the proposed improvements.

(2) Identify additional issues or concerns on indoor application of DDT for mosquito control that were not covered in the public hearing.

(3) For each issue or concern identified propose/suggest/recommend methods/approaches of addressing the issue/concern. Identify the actors and elaborate how the full participation and collaboration of the actors across institutions can be encouraged/achieved. Is there a role for external (such as international or regional or non governmental) institutions?

(4) Government has two approaches to eradicating malaria. The first is to treat patients afflicted by the disease. The other is to kill mosquitoes using insecticide treated nets or spraying residential habitats. Are there additional options/approaches your group wish to suggest?

(5) Are there elements which should be included or excluded in the DDT-based indoor residual spraying program for mosquito control? Do you see the program as important to contributing to national development priorities and in what way?

(6) What advice would you give to MoH as the program executing agency and RTI as the implementing institution to enhance the efficiency and effectiveness of DDT-based IRS program?

(7) Any additional comments/thoughts are welcome.

Annex 14. Program for Apac District Stakeholders Validation and Consensus Building Workshop (Participants List attached to Statement)

Program for Apac District Stakeholders Validation and Consensus Building Workshop, 5th November 2007

8.30am-9.00am	:	Arrival and Registration (Registration at the Workshop Desk)
9.00am-10.30am	:	Opening Session *Chairman: Dr. Robert Omin, (District Councilor and Secretary for Finance)*
10.30am-11.00am	Tea Break	
11.00am-01.00pm	:	Presentations:

Outcomes of the Public Hearing Forum: Issues, Recommendations and Next Steps *(Professor Z.M.Nyiira)*

IRS Strategy and Policy Perspectives *(Dr. J. Rwakimari)*

RTI and the Implementation Modalities of IRS *(Dr. John Bahana)*

Open Discussion
Group Formation

0.00pm-0.2.00pm	:	Lunch Session
02.00pm-03.00pm	:	Group Meetings
03.00pm-04.00pm	:	Presentation of Group Reports Consolidation of Issues and Recommendations

		Communique from Participants
04.30pm-04.30pm	:	Vote of Thanks
		Closure

Apac Workshop Participant Categories

Political leaders	:	9
Local Administration representatives	:	4
Religious leaders	:	2
NGO representatives	:	11
Press	:	2

Annex 15. Program for Kanungu District Stakeholders Validation and Consensus Building Workshop (Participants List attached to Statement)

Program for Kanungu District Stakeholders Validation and Consensus Building Workshop, 9th November 2007

8.30am-9.30am	:	Travel to Kanungu District Headquarters
9.30am-12.30am	:	Participation in and Presentation of IRS program to Kanungu District Council Meeting
12.30pm-02.00pm	:	Lunch Break
02.00pm-04.00pm	:	Validation and Consensus Building Workshop Proceedings *Chairman: Hon. Chris Baryomunsi, MP*

Outcomes of the Public Hearing Forum: Issues, Recommendations and Next Steps *(Professor Z.M.Nyiira)*

IRS Strategy and Policy Perspectives *(Dr. J. Rwakimari)*

RTI and the Implementation Modalities of IRS (Dr. John Bahana)

Open Discussion

Consolidation of Issues and Recommendations

Communique from Participants

04.30pm-04.30pm : Vote of Thanks
Closure

Kanungu Workshop Participant Categories

Members of Parliament	:	1
Political leaders	:	35
Religious leaders	:	10
Public service employees	:	36
NGO representatives	:	13
Local community members	:	2
Journalists/ Press	:	3

Sample of questions raised during the workshop

- *We have heard of accumulation of DDT in human tissue and its effect on human systems. What do you say about that?*
- *We are informed that DDT is safe and that it can be drank without killing anybody. Will the doctor (Dr. Rwakimari) take a cup at the launching day?*
- *We have not heard mention of DDT in agriculture in the presentations:*
- *Why do we use protective gear if DDT is not dangerous?*
- *Why was DDT banned on crops?*
- *Why spray the mosquitoes only indoor and not outside as well as it is done in India?*
- *If is safe as told why is it necessary to re-export US unused DDT?*
- *Why was DDT chosen among all the recommended chemicals?*

Annex 16. Open Public Validation and Consensus Building Forum Program and List of Attendance

OPEN PUBLIC VALIDATION AND CONSENSUS BUILIDNG FORUM ON OUTCOMES OF THE PUBLIC HEARING ON DDT-BASED INDOOR RESIDUAL SPRAYING (IRS) PROGRAM IN UGANDA, 13th November 2007, HOTEL EQUATORIA, KAMPALA, UGANDA

PROGRAM

08.30am-09.00am Desk)	:	Arrival and Registration (registration at the Forum
09.00am-09.20am	:	Opening Session *Chairman: Professor J. H.Pen Mogi Nyeko* *Vice Chancellor, Gulu University*
09.20am-10.30am	*:*	*Presentation Session* *Chairman: Professor J. H.Pen Mogi Nyeko* *Vice Chancellor, Gulu University* Forum Objectives and Outcomes of the Public Hearing on DDT-based IRS Program *(Professor Z.M.Nyiira)* Policy perspectives and Progress Toward Program Implementation *(D. J. Rwakimari)* RTI and Environmental Compliance Policies and Programs *(Dr. John Bahana)*
10.3am-11.00am	:	Tea Break and Free Forum Interaction
11.00am-01.00pm	:	Consideration of Issues, Concerns and Recommendations from the Public Hearing General Public Discussion
01.00pm-01.30pm	:	Conclusions and Closure

01.30-02-30pm : Departure

Open Public Forum Participant Categories

Civil Organisations	:	7
Community Development Agencies	:	2
Environmental NGOs	:	2
Commercial and Industrial Organisations	:	2
Private Chemical Quality Monitoring Consultants	:	2
Quality and Standards Bureau	:	1
Ministry of Agriculture, Animal Industry and Fisheries	:	1
University Institutions	:	2
Ministry of Health	:	6
Ministry of Environment Water Sector	:	2
World Health Organisation	:	1

Annex 17. People Consulted Outside the Workshops

Individual Persons Consulted

Fourways Fish Exporters, Luzira

Mr. Thobani (Chairman and CEO)
Mr. Tobi Nyabongo (Fish Exporting Supervisor)

Uganda Fish Processors and Exporters Association

Mrs. Ovia Katiti Matovu (Managing Director and Chief Executive Officer)
Ms. Lilian Nyandago (Field Assistant)

Agricultural Produce Exporters (Produce Commodity Exchange)

Mr. Godfrey Epodoi (Coordinator)

Uganda Grain Exporters Association

Mr. J. Magnay (CEO)

Uganda Export Promotion Council

Ms. C. Kata (Executive Director)

Ministry of Agriculture, Animal Industry and Fisheries

Mr. Kimeyombi, Commissioner, Crop Protection

Members of Parliament

Hon. Betty Amongin, MP, Apac District
Hon. David Obot MP, Apac district
Hon. Patrick Amuriat, Mp, Kumi District

Electoral Commission

Sister Magoba (Deputy Chairperson, Electoral Commission)

National Environment Management Authority (NEMA)

Mr. Waiswa, Ayazika Arnold, EIA Coordinator

Ministry of Health

Dr. Francis Runumi Mwesige (Commissioner for Planning)
Dr. Robert Basaza (Principal Planning Officer)
Dr. J. Rwakimari (Malaria Control Project Manager)

Apac District Local Government

Mr. Nicolas Opio Bunga Chairm, District Council
Mr. Bob Okai, Vice Chairman, District Council
Dr. Robert Omin, District Council Secretary for Finance
Mr. Kenneth Kibirige, Ag. RDC
Mr. Stanley Adrabo CAO
Mr. Patrick Olila Deputy CAO
Mr. R.P.Odongo, Ag. District Health Officer

Makerere University

Professor Kiremire (Department of Chemistry)

European Union

Ms. Estella Aryada (Operations Officer, EU)

Ministry of Industry

Dr. Ben Manyindo (Deputy Director, UNBS)

Private Sector Foundation

Ms R. M. Emaasit (Program Officer)