



PRESIDENT'S MALARIA INITIATIVE



INDOOR RESIDUAL SPRAYING FOR MALARIA CONTROL

Mali End of Spray Round Report

Indoor Residual Spraying (IRS) for Malaria Control
Indefinite Quantity Contract (IQC) Task Order 1

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Acronyms

ACT	Artemisinin-based combination therapy
ASACO	Community health associations (associations de santé communautaires)
CSCOM	Community health centers (Centre de Santé Communautaire)
CILSS	Permanent Interstate Committee for Drought control in the Sahel (Comité Permanent Inter-Etats de Lutte contre la Sécheresse dans le Sahel)
CSREF	Health Reference Center (Centre de Santé de Référence)
DHPS	Directorate of Public Hygiene and Health
DNACPN	National Department of Sanitation, Pollution and Nuisance Control (Direction Nationale de l'Assainissement et du Contrôle des Pollutions et des Nuisances)
DNS	National Directorate of Health
EIA	Environmental impact assessment
EMP	Environmental management plan
GOM	Government of Mali
FAO	Food and Agriculture Organization.
IEC	Information, education and communication
IRS	Indoor residual spraying
IPTp	Intermittent preventive treatment for pregnant women.
LLIN	Lasting insecticide-treated bed net
PNLP	National Malaria Control Program (Programme National de Lutte Contre le Paludisme)
MRTC	Malaria Research Training Center
PPE	Personal protective equipment.
PMI	President's Malaria Initiative
RTI	Research Triangle Institute
RDTs	Rapid diagnostic tests
SACPN	Decontamination and Pollution Control Service (Service d'Assainissement de Contrôle de Pollution et des Nuisances)
SEA	Supplemental environmental assessment
SP	Sulfadoxine-pyrimethamine
DNS	National Direction of Health (Direction Nationale de la Santé)
SOW	Scope of work
TOT	Training of trainers
USAID	United States Agency for International Development
WHO	World Health Organization

Country Background

Introduction

Mali was identified by USAID as one of the third wave of countries to receive funding under the United States' (U.S.) President's Malaria Initiative (PMI). The U.S. Agency for International Development (USAID) and the National Malaria Control Program (Programme National de Lutte Contre le Paludisme [PNLP]) identified 2 epidemic prone districts (Koulikoro and Bla) for indoor residual spraying (IRS) activities. Bla district has a population of approximately 259,000 people and Koulikoro district has approximately 172,000 people. In 2007, USAID and the PNLP agreed to focus spraying activities in both districts with the intention of expanding IRS coverage to others areas in following spray operations.

RTI was tasked with providing strategic, technical, management and operations support for IRS activities in the above mentioned districts. RTI and the PNLP aimed to spray at least 70,000 households and protect approximately 431,000 people with lambda cyhalothrin, an insecticide approved by the World Health Organization (WHO). In addition, RTI was instructed to work in close collaboration with the Malaria Research and Training Center (MRTC) to support their entomological monitoring work as well as provide support to the PNLP to strengthen their epidemic preparedness and response capacity.

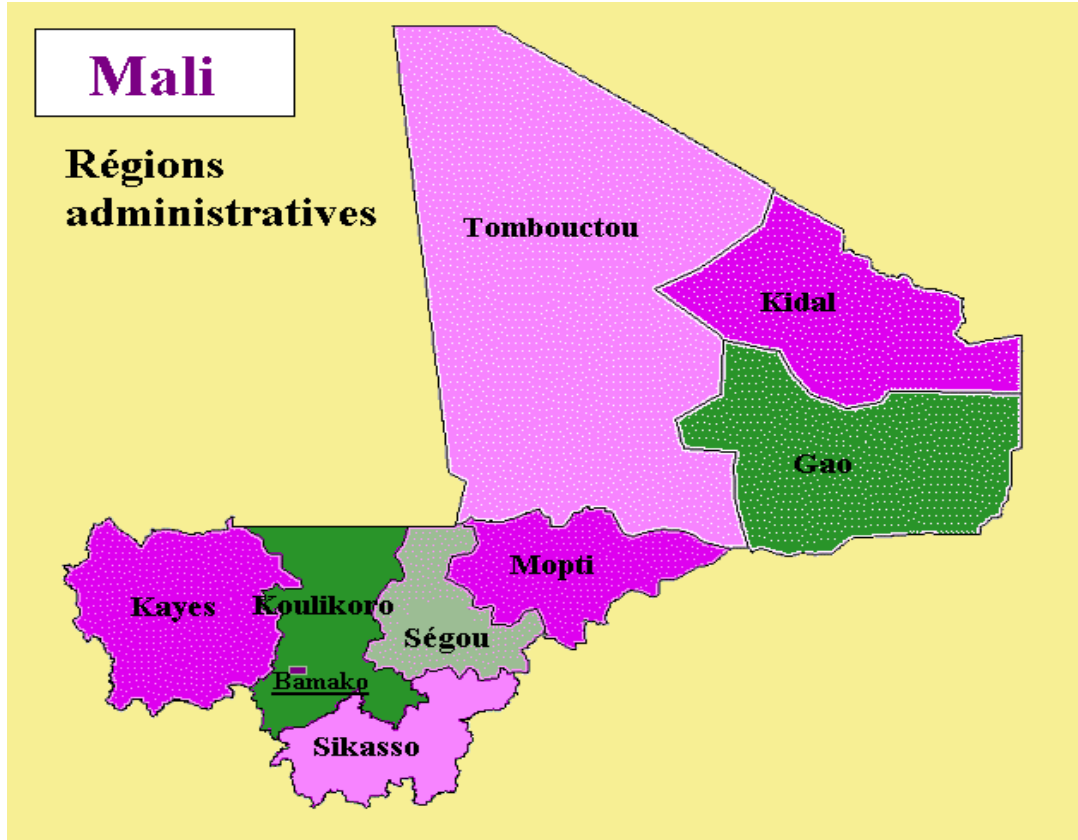
This report summarizes the IRS activities during the first spray round in Mali which lasted from July 16 to August 30, 2008 in the districts of Koulikoro and Bla.

Background: Malaria in Mali

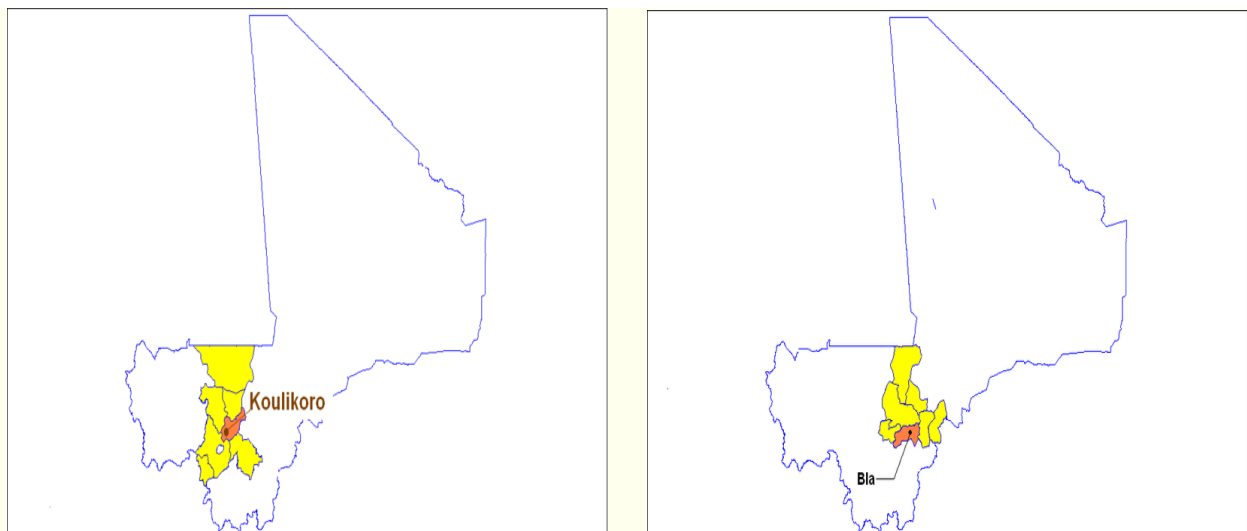
Malaria is an endemic disease that affects more than 90 percent of the total population in Mali and is the leading cause of morbidity and mortality among pregnant women and children under five years of age. The species of *Plasmodium* that cause malaria in humans are:

- *P. falciparum* (85 to 90 percent) accounts for the majority of malaria infections
- *P. malariae* (10 to 14 percent)
- *P. ovale* (1 percent) is the basis of the remaining infections
- *P. vivax* which is a rampant epidemic in the northern part of the country.

Figure 1. The subdivision of Mali in regions.



Figures 2 and 3. The districts of Koulikoro and Bla.



According to the 2006 statistics, 1,022,592 clinical cases were recorded in health centers, an incidence of 85.3 percent. Such cases are among the reasons why the Government of Mali (GOM) has searched for solutions to tackle problems related to malaria. PNLP developed a five-

year strategic plan (2007 to 2011) that builds on recent changes in the national malaria policy to include long-lasting insecticide-treated bed nets (LLINs), rapid diagnostic tests (RDTs), artemisinin-based combination therapy (ACT), and sulfadoxine-pyrimethamine (SP) for intermittent preventive treatment for pregnant women (IPTp). The overall goal of the GOM is to reduce malaria morbidity and mortality by 50% by the year 2011.

In order to support the GOM in its strategy of malaria control and to reinforce the protection of the populations against mosquito's bite, the GOM in collaboration with PMI chose IRS as one of strategies to fight against malaria. IRS is an integral part of the PNLP 2007 to 2011 strategic plan as vector control is one of the most effective means of malaria prevention. Bla and Koulikoro districts were selected by GOM for IRS on the basis of high malaria prevalence, high entomological inoculation rates, high vector densities, and high infant mortality rates reported in health facilities.

Summary Results

IRS operations began on July 16 and ended on August 30, 2008 in Bla and Koulikoro. In total, 107,279 households were sprayed by 330 spray operators and 420,580 people were protected in the two districts with a 90 percent coverage rate. Spray operators used 28,560 pesticide sachets to spray 252,236 rooms with an average of 12 rooms sprayed per sachet.

The proportion of refusals, which was 17 percent at the beginning of the operations, declined significantly and showed a clear improvement at the end of spray operations with only 8 percent of households refusing to have their houses sprayed. This reduction in refusals was due mostly to the effectiveness of communication between households; once sprayed households saw mosquitoes and other insects die after spray operations, they informed their neighbor who had originally refused IRS. Through testimonies, these households eventually requested that their houses be sprayed as well. A number of other factors contributed to the reduction of the refusal rate, including the continuous participation throughout the entire spray operations of head nurses of each community health center (Centre de Santé Communautaire [CSCOM]), chief doctors, community health associations (associations de santé communautaire [ASACO]), mayors, sub-prefects, broadcast journalists, and continuous information, education and communication (IEC) activities carried out by IEC mobilizers (*relais*) through door to door communication.

During IRS operations, data was collected on the utilization of mosquito nets in the districts being sprayed. Data collected by spray operators showed that 98 percent of households sprayed had at least one LLIN. The data also showed that among the targeted population, all children under 5 years and pregnant women slept under LLINs.

IRS Preparations

Environmental Assessment

RTI conducted a supplemental environmental assessment (SEA) in February 2008 to support USAID's environmental review as required under 22 CFR 218. The SEA discussed the following topics and was provided for review and approval to USAID.

- Pesticide use in Mali and the regulatory guidelines pertaining to its use, storage, disposal and chain of custody;
- Background documentation and statistics related to the geography, hydrology, agriculture, environment, demography, and health for Mali in general and for the two districts in particular; and
- Visits to some of the villages where IRS was conducted to determine the field conditions and to identify possible environmental risks and concerns. During this process, storage facilities were identified.

The SEA evaluated the possible residual impacts of the IRS program. Major components of the program implementation occurred prior to the start of IRS operations included:

- Procurement of insecticide, compression sprayers, and adequate amounts of personal protective equipment (PPE);
- Training which includes training of trainers (TOT), sprayers, mobilizers, supervisors, drivers, health workers, and IEC mobilizers;
- Geographical reconnaissance (mapping of IRS activities);
- IEC campaigns to raise public awareness and inform the population about the benefits of IRS and how to avoid contamination;
- Identification and preparation of warehouses and storage areas to meet environmental and Food and Agriculture Organization (FAO) rules and regulations;
- Construction of soak pits and progressive rinsing areas; and
- Additional human health and environmental safety components as described in the environmental management plan (EMP).

The SEA was prepared and submitted to USAID in April 2008.

An environmental impact assessment (EIA) was drafted in French and sent for approval to National Department of Sanitation, Pollution and Nuisance Control (Direction Nationale de l'Assainissement et du Contrôle des Pollutions et des Nuisances [DNACPN]). The EIA was submitted to DNACPN in May 2008 prior to the beginning of spray operations.

The SEA and EIA were prepared by RTI with continuous consultation and contributions from the National Directorate of Health, PNLP, Ministry of Environment (MOE), Ministry of Agriculture (MOA), The Institute of Geography, Regional Health Directorates, the Directorate of Agriculture, Phytosanitary, and Protection of Vegetation, MRTC, Directorate for the Protection of Plants, World Vision, and the Permanent Interstate Committee for Drought control in the Sahel (Comité Permanent Inter-Etats de Lutte contre la Sécheresse dans le Sahel [CILSS]). Spray operations began following the approval of the SEA and the EIA.

The chosen insecticide to be used during IRS operations was lambda cyhalothrin (ICON). Lambda cyhalothrin was selected by MRTC after conducting an entomological baseline survey in which a number of other insecticides were tested for their efficacy, effectiveness, and residual efficacy. Lambda cyhalothrin is a pyrethroid insecticide recommended for IRS use in malaria control programs by the WHO. Once the pesticide was chosen, RTI moved forward to procure it through competitive bidding. As the chosen pesticide was yet not registered in country, the MOA provided a waiver so that it could be brought in country and be used during IRS operations.

Logistic Needs Assessment

A joint team from RTI and PNLP visited the two targeted districts to determine the technical, financial, human resources, and operational needs to implement IRS. The team met with a number of partners and local officials including the Regional Health Directorate (Direction Régionale de la Santé [DRS]) of Segou and Koulikoro, MRTC, chief doctors of Bla and Koulikoro, USAID, the U.S. Centers for Disease Control and Prevention (CDC), and other partners and stakeholders. Meetings were also organized with local and district officials to collect information about the population at risk, field condition, infrastructure, storage facilities (security, availability of water, vehicles), and road conditions. The team had discussions with prefects, sub-prefects, mayors, governors, and regional and district health officers. The RTI team conducted numerous geographical reconnaissance and mapping trips in both districts with the help of community health workers. During these trips, the villages to be sprayed were identified and mapped, the distance and roads between villages was noted, the average size of household determined, and the type of household structure identified. Based on the reconnaissance, it was decided to spray villages that would be more difficult to reach to during the rainy season first.

Prior to the start of IRS operations, a competitive process was followed to select vehicles to transport spray operators, supervisors, and Ministry of Health (MOH) staff working on IRS operations. Forty five vehicles were retained for the operations.

Insecticide and PPE

Five thousand five hundred kilograms (kgs) of lambda cyhalothrin (ICON) was procured for the spray round. The insecticide estimation was based on the geographical reconnaissance and data provided by the MOH. WHO-approved Hudson X-Pert compression sprayers (S-Pert, Model 67462AD 4 Gallon) (Nozzles Tip T-JET 8001, Model) were procured for each spray operator with extras for emergency situations. PPE in accordance with WHO specifications was provided to each spray operator, team leader, washer, and driver. The following table provides a summary of PPE procured.

Figure 4. Commodities procured.

Description	Quantity
Compression Sprayers S-Pert, Model 67462AD 4 Gallon	500
Compress Sprayer Repair Kits for Item 1, Model	50
Compression Sprayer Nozzles Tip T-JET 8001, Model	500
Compression Sprayer Filters Nylon X-Pert, Model 152-356	550
Heavy Duty Gloves	3,000
Respirator Masks	20,000
One-Piece Coveralls	1,000
PVC Gumboots	550
Lightweight Helmet and Face Shield	550
Pregnancy Test Kits 8 x 25	180
Reflective Jackets – Green	65
Reflective Jackets - Red or Orange	30
Medical First Aid Kits - 10 Person/Kit	36
Lambda Cyalothrin ICON 10 CS	5,500 kg

Human Resources

The total number of houses to spray was estimated at 119,194. In total, it took 330 spray operators 45 days to spray all the identified households. Spray operators were supported by an operations team of 17 spray team leaders who doubled as spray operators, 35 team leaders who managed a group of 6 spray operators, 7 supervisors, 2 district coordinators, 2 data clerks, 2 logistics assistants and 2 finance assistants. A technical coordinator was hired to oversee the spray operation in the field.

Hygiene agents from the Hygiene Service (Service d’Hygiene) and environmentalists from the districts of Bla and Koulikoro provided additional supervision to ensure adequate team planning, safety, quality control, and environmental compliance. Specific scopes of work for supervisors were developed in collaboration with the MOH including PNLP, chief doctors, and MOE representatives. Spray operators were selected at the CSCOM level with assistance from chief nurses, village and traditional leaders, and ASACOs. The selection was based on literacy, physical and medical fitness, living in the community to be sprayed, and ability to easily carry 10 kg of spray equipment. Sex was not an eligibility criteria.

The IRS management structure was composed of:

- At the national level, a chief of party (COP), technical coordinator, finance officer, logistic officer, monitoring and evaluation (M&E) officer, and administrative assistant.
- Seasonal district level staff: two district coordinators, district logisticians, and data clerks, one environmental officer, one IEC officer, and one IEC assistant, 48 washers, 42 storekeepers, 42 security guards, and 14 service engineers.
- Spray teams: 330 spray operators, 17 team leaders, 35 team leaders and Supervisors (in health centers where the team leader also played the role of supervisor), and 7 supervisors.
- Supervision from MOH and MOE: one hygiene agent each from Koulikoro and Bla, two chief doctors, 42 chief nurses, two hygiene agents from DRS, and two representatives from local MOE.

Training

The aim of the training was to build the capacity of the host government at the national, district, and community level to implement a well organized IRS program. The training was organized in two parts, training of trainers (TOT) and training of spray operators.

TOT

Because IRS had not been conducted in Mali for many years, the purpose of this training was to strengthen the skills of the MOH and MOE by giving them a background on what IRS is, how it is done effectively, and the strict rules and regulations to follow during spray operations to avoid contamination or environmental degradation. RTI worked in close collaboration with PNL, DHPS, MRTC, and the Regional Department of Sanitation, Pollution and Nuisance Control (Direction Régionale de l'Assainissement et du Contrôle des Pollutions et des Nuisances [DRACPN]). The training lasted for 5 days and there were 35 participants.

Figure 5. Trainees trained in IRS.

Organization	Bla	Koulikoro	Bamako	Total
Hygiene technicians from CSREF	14	11	0	25
DNACPN	0	0	1	1
DRACPN	1	1	0	2
Decontamination and Pollution Control Service (Service d'Assainissement de Contrôle de Pollution et des Nuisances [SACPN])	1	1	0	2
National Health Directorate (Direction Nationale de la Santé [DNS])/DHPS	0	0	1	1
PNLP	0	0	2	2
MRTC	0	0	2	2
Total	16	13	6	35

Training of Spray Operators

The RTI team and the DRS organized the operator trainings concurrently in both districts. There were 5 training centers in each district. There were 213 spray operators including 30 team leaders and 11 supervisors in Bla and 142 operators, 9 team leaders, and 17 supervisors in Koulikoro trained.

Driver Training

In order to ensure safety at all levels during IRS operations, there were concurrent trainings done in Koulikoro and Bla for 32 drivers in IRS and the safe transport of pesticides and operators. Drivers were trained on individual protection measures, how to transport pesticides, and what to do in case of accidental exposure.

Storekeeper Training

A total of 32 secondary storekeepers were recruited and trained during the campaign on IRS, management of warehouses, individual precaution measures to be taken, and security needed in the management of secondary storages. The storekeepers also served as day guards.

Pesticide Poisoning Management Training

Two training sessions were organized and 42 of head nurses were trained. The first session was held in Bla (25 head nurses) and the second in Koulikoro (17 head nurses). Both sessions were conducted by Professor Aboubacar Maiga, a toxicology specialist and professor at the Bamako Faculty of Medicine.

Medical Testing

A general medical examination was conducted on all spray operators by the chief doctor of each district to assess their medical ability to perform IRS operations. In addition, all female spray operators including washers were tested for human chorionic gonadotropin levels to rule out pregnancy. None of the woman tested were pregnant and only those operators who were fit and had a medical certificate were chosen and later trained as spray operators.

IEC Activities and Community Involvement

Identification of IEC Mobilizers

The identification of IEC mobilizers was conducted by chief nurses under the supervision of the ASACOs. In total, 627 *relais* were identified for Koulikoro and 1,221 for Bla. The selected IEC mobilizers were already part of the MOH mobilizer group who had been trained in other malaria prevention. The identified mobilizers were trained in IRS as well as IEC.

Design and Production of IEC Materials

The IEC manuals, including the TOT manual and the handbook for IEC mobilizers, were developed by RTI working in close collaboration with the National Center for Information, Education, and Communication (Centre National d'Information, d'Education, et de Communication pour la Santé [CНИЕCS]) and PNLP. These manuals included information on IRS as well as the steps to be taken while training mobilizers and the messages that should be given to households before, during, and after IRS. The manuals were adapted to fit the IEC requirements of the MOH in Mali. Once the manuals were developed, they were approved during a workshop lead by CНИЕCS and attended by PNLP, WHO, USAID/Mali, and representatives from DRS of Segou and Koulikoro. Once the manuals were approved by the MOH, they were printed, distributed, and used for training.

Training of Trainers of IEC Mobilizers

Training of trainers took place concurrently in the 42 CSCOMs in Koulikoro and Bla for two days between April 27 and May 1, 2008. The TOT was done by the RTI IEC consultant in close collaboration with PNLP and CНИЕCS. Two representatives from each of the 17 CSCOMs in Koulikoro and the 25 in Bla were trained as trainers with a total of 42 head nurses trained. In turn, the trainers trained the 1,848 IEC mobilizers for two days in each district. These trainings were supervised by RTI, PNLP, and CНИЕCS.

IEC Implementation

IEC aims to inform the population about the benefits and precautions to be taken during IRS as well as other malaria control interventions. In Mali, there is a system of *relais* who were already in place and trained by other partner organizations in malaria control interventions. These *relais* were trained for the IRS operations because they had already a strong background in malaria control interventions.

The implementation plan for the IEC campaign was based on the information gathered by the RTI team during the operations, logistics and administrative assessments and discussions held with various stakeholders in Bamako and the districts of Bla and Koulikoro, and the leaders of villages to be sprayed.

A number of methods were used including meetings with village and religious leaders and other organizations and associations working in the targeted zones. Village gatherings were held and radio broadcasts were used. The bulk of the population received messages through door-to-door visits. During these visits, the mobilizers talked to the population about the benefits of IRS and the precautions to be taken before, during, and after IRS.

The following forms of media were used to pass messages to the beneficiary population:

- Community radio had the highest reach based on listenership survey.
- Printed media was essential for one on one communication.
- Public information campaigns at strategic places.
- TV had a high impact in some areas.
- Team branding benefitted from immediate recognition/acceptance by local authorities, religious associations, and youth and women’s associations.
- Feedback from watch groups, focus group discussions, and meetings was useful.

Figure 6. IEC illustrative Media.

Formal	Informal	Mass media	Group media	Interpersonal	Traditional & popular media
<ul style="list-style-type: none"> ▪ GOM structures at national and village level ▪ Health and agriculture extension networks ▪ Educational system ▪ Development projects 	<ul style="list-style-type: none"> ▪ NGOs ▪ Traditional authorities ▪ Religious groups ▪ Women’s and, youth clubs 	<ul style="list-style-type: none"> ▪ Radio ▪ TV ▪ Folders ▪ Posters ▪ Banners 	<ul style="list-style-type: none"> ▪ Video ▪ Meetings 	<ul style="list-style-type: none"> ▪ Home visits 	<ul style="list-style-type: none"> ▪ Theatre ▪ Comedians sketches

Coordination with Spray Operations

Geographical reconnaissance maps were elaborated by the RTI logistics officer and regional district officers and were used by mobilizers. These maps informed the mobilizers when and where spray operations were going to take place so that mobilizers could inform the targeted population 24 to 48 hours before their village was sprayed.

Implementation of IRS Activities

IRS operations were officially launched on July 1, 2008 in Tienfala (Koulikoro) and Touna (Bla). In Tienfala, the launch was chaired by the Minister of Health, Mr. Oumar Ibrahima Toure, and attended by the USAID Mission Director, the WHO country representative, the PNLP director, and other officials and partners. In Touna, the launching ceremony was led by the Principal Health Advisor to the MOH, Dr. Oumou Diakite, and the USAID/PMI representative, Mr. Sixte Zigirumugabe. It was attended by MOH officials from the national, regional, and local level.

Figure 7. The Minister of Health during the launching ceremony in Tienfala.



Although the IRS launch took place on July 1, 2008, the spray operations began on July 16, 2008 simultaneously in both districts (Koulikoro and Bla) due to the late arrival of PPE which had been stuck at the Addis Ababa airport. Spray operations ended on August 30, 2008.

During spray operations, each day was conducted in six stages.

- Roll call for attendance at 6:00 AM each morning.
- Spray operators ate their breakfast.

- Spray operators put on a clean set of their PPE.
- Spray operators signed out insecticide sachets for the day.
- Each team or sets of teams was transported to their scheduled site for the day.
- At the end of the day, the teams were transported back to the cleansing depot where they signed off an attendance list, returned empty and unused insecticide sachets, performed progressive rinsing, gave their PPE to washers, took a bath, and then returned to their respective homes.

As mentioned in the IEC section, mobilizers were 24 to 48 hours ahead of operators. Once a mobilizer passed through a house, he or she glued on the household door a PMI sticker which had a section for the mobilizer to sign his or her name. This signature showed the sprayers and supervisors that a mobilizer had passed through the household. The sticker was also signed by the spray operator after spraying a structure and by the supervisor after inspecting the quality of spraying. During spray operations, the information given by mobilizers was also reiterated by spray operators to households after spraying the rooms.

All spray operations were conducted in teams of 4 to 8 people and were coordinated and supervised by group leaders who regularly checked the quality of spraying, if the product was being mixed correctly, and if spraying was done according to the norms. Supervisors made sure that forms were filled out correctly and if errors were noticed, corrected them immediately and later notified to the district logistician. Forms were not always filled out correctly or completely and additional time was taken to correct the errors. For the next round, additional training will be conducted to emphasize the importance of filling out forms correctly and completely.

Storage of Commodities

Following WHO and FAO standards regarding the storage of dangerous products and materials, the Koulikoro and Bla warehouses were partitioned into storage spaces for PPE and storage spaces for insecticide. Fans were installed on ceilings to enable ventilation. Thermometers were placed in the warehouses and throughout operations the temperature was recorded three times daily. Fire extinguishers were placed at all strategic locations and personnel working daily in the central warehouse were trained on how to use the fire extinguishers.

All products and equipment in the central and district warehouses were stored on pallets to protect them from moisture and heat. Following compliance rules, pallets were placed 1 meter (3.28 feet) away from the wall to allow proper air circulation. To avoid contamination, the insecticide and contaminated solid waste were stored separately from PPE and spray equipment.

At the end of spray operations, all used PPE was cleaned and stored in the warehouses. Spray pumps were stored following spray operations standards.

Logistics Management

Transportation

During IRS operations, 44 buses with 12 to 18 person capacity were rented. Buses were distributed per spray site or CSCOM. During the 45 days of IRS activities, vehicles were deployed each morning for the transportation of spray operators from the CSCOM to the village where houses were to be sprayed. Service engineers worked side by side with spray operators to repair on the spot faulty compressor sprayers.

Washing Areas

The progressive rinsing areas as well as the 41 soak pits were built according to environmental standards in all the CSCOMs. The following instructions were given to spray operators during the training and throughout IRS operations and supervisors made sure that these instructions were followed correctly to provide for safest and most responsible clean-up possible.

At the end of each work day, the quantity of water used to rinse out sprayers can be re-used at the beginning of the next day's work to save water and reduce the potential for pollution from contaminated rinse water. This best practice for rinse water re-use is called progressive rinse. With this rinse method, seven drums of approximately 200 liters (L) each are placed in a line and every other container is filled with water. During cleanup, the remnants of a pump charge from the field are emptied into the containers in a chronological order. The following day, spray pumps are filled with liquid from containers in the same sequential order: container one, container three, and container five. Any remaining liquid in the fifth and seventh containers is quite dilute and can be disposed in the soak pit.

Figure 8. Operators demonstrate progressive rinsing.



The IRS spray operation was conducted following the guidelines contained in the SEA and EIA approved by USAID and the GOM. Compliance with the regulations of both the GOM and

USAID was confirmed during the inspection which was done in July 2008 by the RTI environmental specialist based in the regional office in Nairobi.

A number of forms were used to track the daily movement and control of equipment from the central warehouses of Koulikoro and Bla to the 42 storage facilities. The storage facilities were equipped with incoming and outgoing log books. A central log book was updated to keep track at the central warehouse to detect any possible dysfunctions in the system and correct them immediately. PPE (suits, helmets, boots, gloves, and masks) and insecticide sachets were distributed to the districts. The 57,600 sachets of insecticide were each coded, allowing tracking throughout the entire process. The coding included the following information:

- The first letter of the district to be sprayed.
- The crate number in which the sachet was located.
- The box number in which the sachet was originally stored (all boxes were numbered)
- A number assigned as soon as the sachet was removed from the box (the number of sachets per box was clearly marked).

Figure 9. Distribution of insecticide and PPE.

Item	Total	Koulikoro warehouse	Bla warehouse
Icon 10 CS sachets	57,600	28,200	29,400
Boots	548	325	223
Overalls	997	374	623
Face mask	20,030	9,710	10,320
Pairs of gloves	3,012	1,530	1,482
Helmets	550	266	284
First aid kit	44	19	25
Pregnancy test	180	82	98
Red bright jacket	30	15	15
Green bright jacket	60	24	36
Support visors	550	266	284
Visors	560	270	290
Pumps	500	223	277
Filters	500	299	196
Repair kits (tools)	50	20	30
Nozzles	500	302	167

At the end of the spray operations, a team was put in place to manage and properly store the unused insecticide sachets, PPE, and solid and liquid wastes in the central warehouses of Bla and Koulikoro. Ninety seven percent of the PPE and other equipment was stored after being thoroughly cleaned at the central warehouses. Due to inaccessibility from poor road conditions during the rainy season, 3 percent of the PPE was stored at secondary storage centers at the CSCOM level.

In regards to waste management, all liquid and solid wastes were stored separately in barrels. RTI is working in close collaboration with the African Program on Pesticide Stocks (Programme Africain relatif aux Stocks de Pesticides [PASP]) which deals with the management of toxic waste. RTI has stored waste in accordance with WHO, FAO, and PASP rules and is working with PASP to have the waste recaptured.

Supervision

Supervision improved the quality of operators' work while also ensuring capacity building. The responsibilities of supervisors were to:

- Ensure that all PPE, pesticide, and first aid kits were stored as per the guidelines which were taught during training;
- Assess if IRS rules are being fully implemented;
- Ensure the effectiveness of the IRS team across all health areas of Koulikoro and Bla districts;
- Ensure proper filling of forms in accordance with IRS directives;
- Inform the RTI team in case of side effects;
- Work with communities during IRS operations in the dissemination of information relating to the IRS;
- Check the status of soak pits, wash and bath areas; and
- Check the status of warehouses and secondary storages.

Composition of Supervision Teams

To ensure oversight of IRS, the IRS Task Force established 4 levels of supervision: the national level, the regional level, the district level and the local level. At the national level, two field visits were conducted by the group at the beginning and at the end of spray operations. The national team consisted of 8 representatives from PNL, MOE, MOA, MRT, CNI, the Division of Hygiene and Public Health, and RTI International.

At the regional level, two field visits were conducted by the group at the beginning and at the end of spray operations. The regional team consisted of 3 representatives from the DRS, the Regional Directorate of Environment and Sanitation, and the Regional Directorate of Social Development and Solidarity Economy.

At the district level, the team consisted of representatives from district health centers, the Ministry of Social Development, the MOE, and hygiene agents at the local level.

The district supervisors were chosen from the highest performers during the TOT and the best trainers during the training of spray operators. The team worked in close collaboration with RTI during spray operations. Spray sites were divided between supervisors and were alternated so that all supervisors worked in all sites and therefore knew the strengths and weaknesses of each spray center. On a daily basis, RTI staff along with supervisors made sure spray operators left the spray center at the scheduled time each morning and at the end of a spray day followed all the environmental rules. At the end of the spray day, they also verified that spray cards were properly filled out before being turned in to data clerks to be keyed into the database that was categorized by PMI indicators.

At the end of each day, the supervision team from the district and local level held meetings to discuss what worked or did not work and document the outcomes and actions to be taken the following days to correct errors.

At the local level, the team consisted of the head nurse and the ASACO committee. This team worked daily during IRS operations to oversee activities in their respective CSCOM. There were some constraints and difficulties with this group as some of the sites were not easily accessible during spray operations. Additionally, the head nurses were not motivated as they were not paid daily because the chief doctor had instructed them to include IRS in their daily routine (head nurses work full time at the health centers; it was recommended by PNLP, USAID/Mali, and DRS that they not work fully on IRS because the sick would not be cared for).

Monitoring and Evaluation

An M&E system was put in place to gather data that was being collected in the field. A number of forms were used during spray operations to evaluate work carried out in the field:

- Spray operator forms
- Team leader form which summarized up to 6 operator forms
- Supervisor form which summarized two or three team leader forms.

Prior to the start of spray operations, trainers and spray operators were trained in data collection and how to fill out the daily forms. Three levels of control were putting into place: team leaders checked daily forms filled out by spray operators; group leaders checked forms filled out by team leaders; and supervisors checked all three forms.

There were a number of challenges during the collection of information, including gathering and dissemination of information from the different spray sites to the central level due to the lack of means of communication or poor infrastructure conditions. A number of lessons have been learned to improve the M&E system for the next spray round.

The following graphs show the number of structures sprayed weekly throughout the IRS spray operations.

Figure 10. Structures sprayed in the district of Bla.

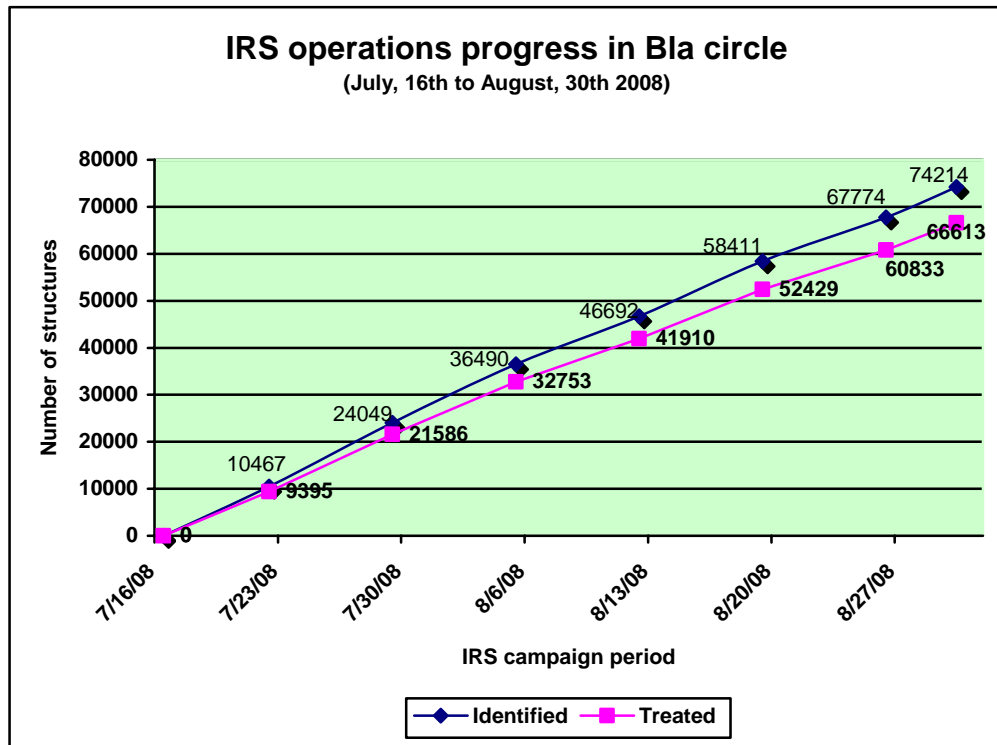
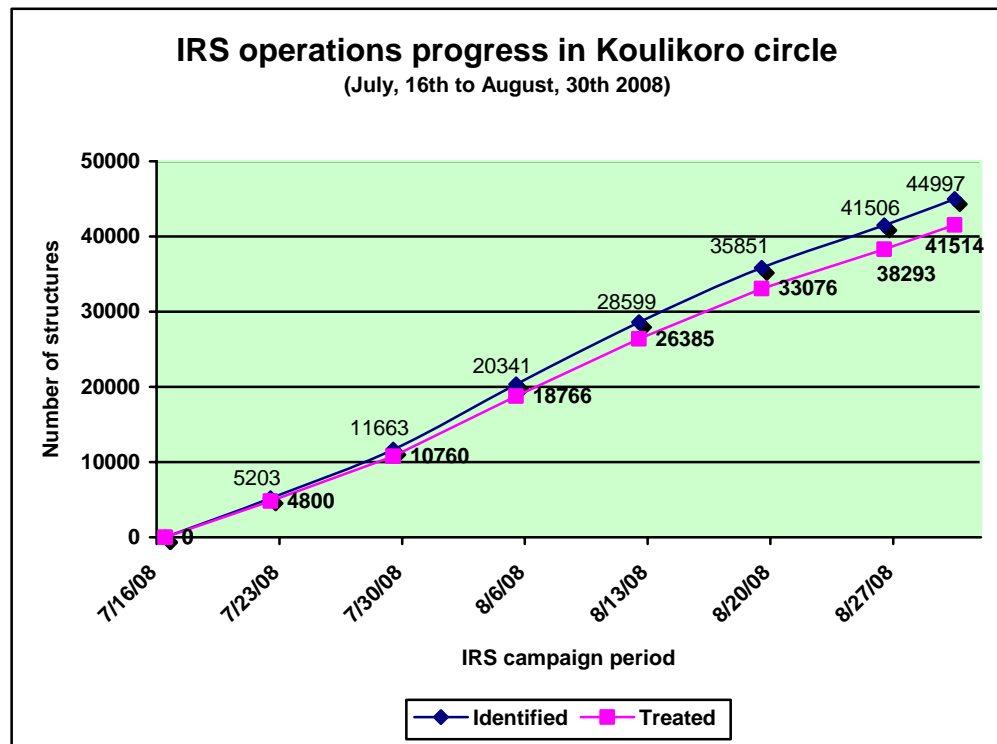


Figure 11. Structures sprayed in the district of Koulikoro.



Results

IRS spray data was collected and sent to the USAID Mission and to all partners every two days. A data summary was sent weekly. Due to infrastructure challenges, some spray sites were not accessible and therefore data was not collected in those sites frequently, whereas in other sites data was collected daily.

The spray operations lasted for 45 days and 107,279 households were sprayed by 330 operators in both districts.

As shown in Figure 12, nearly 9 in 10 structures were sprayed in the district of Bla (89 percent) and slightly more in Koulikoro (92 percent). Of the identified 119,194 structures, 107,638 were sprayed, an equivalent of 90 percent, surpassing the 85 percent PMI objective for Mali IRS. The sprayed structures had 252,236 rooms (160,294 rooms in Bla and 91,942 in Koulikoro).

Figure 12. Structures sprayed and population covered.

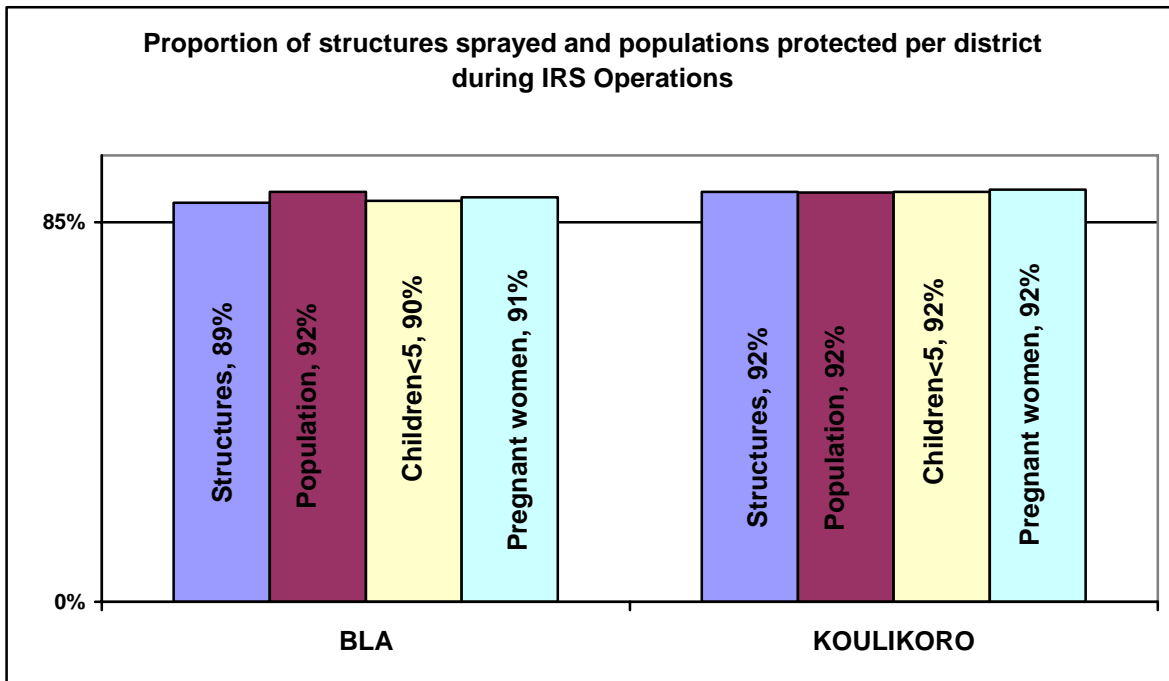


Figure 13. Population protected by IRS.

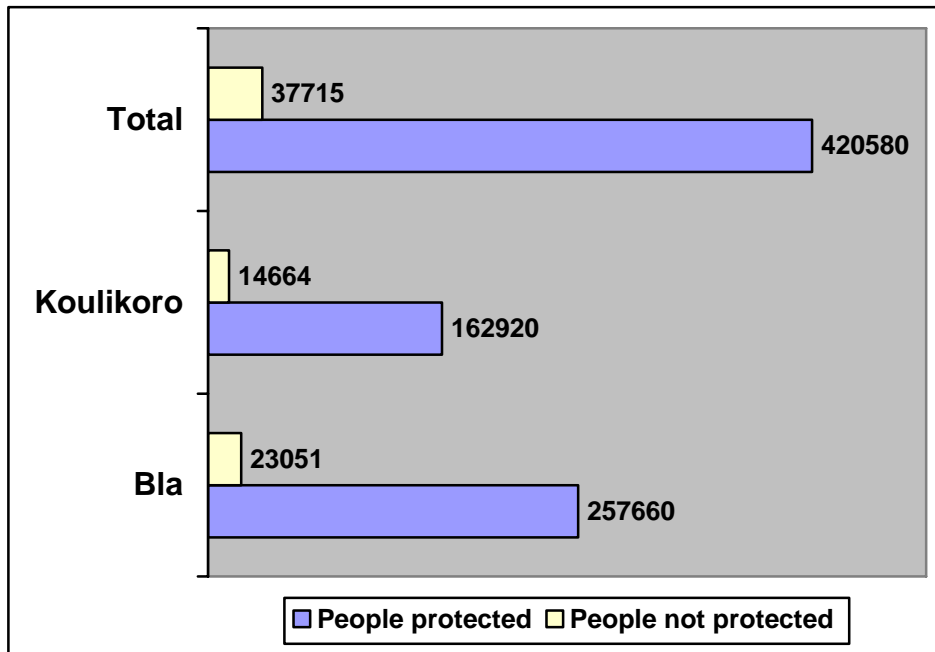
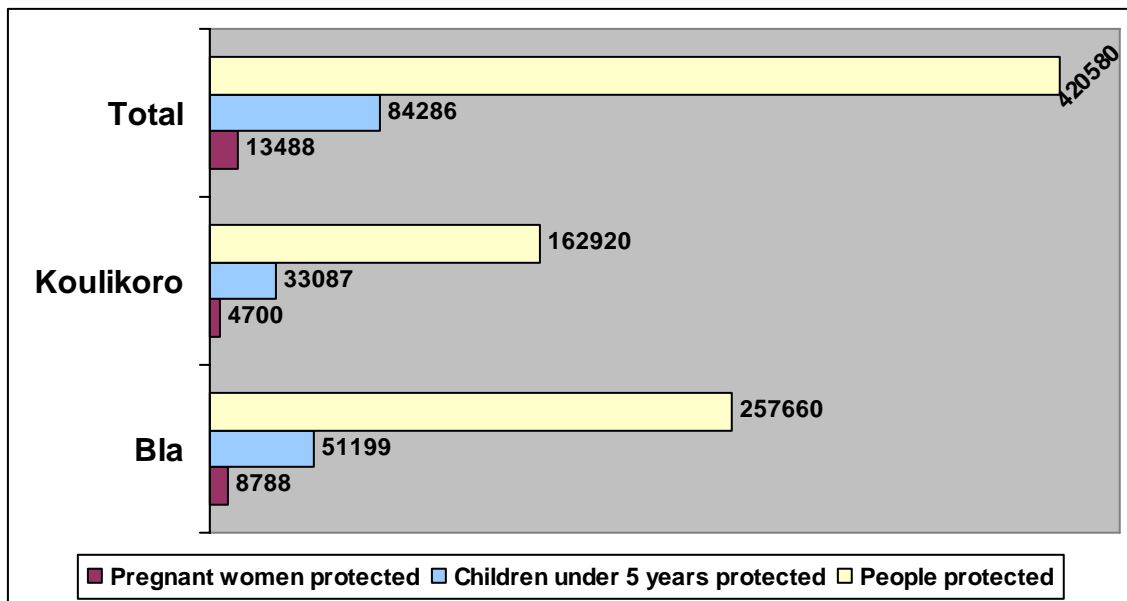


Figure 14. Number of pregnant women and children under 5 protected by IRS.



The following table shows a summary of the structures and the population protect by district in each targeted district.

Figure 15. IRS indicators for first round of IRS.

Indicators	District		
	Bla	Koulikoro	Total
<i>Coverage</i>			
Structures visited	74,214	44,980	119,194
Structures sprayed	66,342	41,296	107,638
Percentage	89.4%	91.8%	90.3%
People in structures visited	280,711	177,584	458,295
People covered	257,660	162,920	420,580
Percentage	91.8%	91.7%	91.8%
Children under 5 years in structures visited	57,038	36,034	93,072
Children under 5 years covered	51,199	33,087	84,286
Percentage	89.8%	91.8%	90.6%
Pregnant women in structures visited	9,703	5,091	14,794
Pregnant women covered	8,788	4,700	13,488
Percentage	90.6%	92.3%	91.2%
<i>Household acceptance rate</i>			
Total of structures	74,214	44,980	119,194
Structures sprayed	66,342	41,296	107,638
Structures not sprayed	7,872	3,684	11,556
Percentage of acceptance	89.4%	91.8%	90.3%
<i>Insecticide usage</i>			
Received	17,880	10,680	28,560
Used	13,046	7,827	20,873
Returned	4,834	2,853	7,687
<i>Mosquito net usage</i>			
Ordinary	36,448	21,490	57,938
LLIN	62,776	43,883	106,659
Percentage of households with at least one LLIN	97.5	97.6	97.3
Percentage of population in households with at least one LLIN	24.4	27.9	25.4

Acceptance

This first IRS campaign was conducted during the rainy season which coincided with the agriculture season. In Mali, this season is a time when the population spends all day in the agriculture fields. Therefore, it was challenging to conduct IRS as the targeted population needed to be present before, during, and after IRS operations to remove all their household items prior to spraying.

Despite the rainy season, households visited accepted IRS, followed all instructions given to them during IEC, and were enthusiastic to have their households sprayed. During IEC, the targeted population was told to have water available in case spray operators needed to mix a new sachet of insecticide. All sprayed households had available an average of 11 liters of clean water, clearly demonstrating that the targeted population accepted IRS operations and also followed IEC messages.

Of the households targeted, 11 percent were not sprayed in Bla and 8 percent were not sprayed in Koulikoro. The most common reasons for not spraying a house were absence of occupants and rains which prevented the spray operators from reaching the targeted households due to poor infrastructure conditions. Houses which were not sprayed during the first visit were revisited a second and sometimes a third time. Health nurses were also informed of houses which were not sprayed during the first visit so that could visit members of these households to arrange for their houses to be sprayed during the next visit.

Insecticide Usage

Figure 16 shows that 17,880 sachets were used in Bla during IRS operations and 10,680 in Koulikoro. All the unused sachets were returned to the central warehouses in Bla and Koulikoro. Figure 17 shows the number of empty sachets returned. As seen below, in Koulikoro there was loss of a single sachet (sachet K3-2502-01).

Figures 16 and 17. Insecticide usage per district.

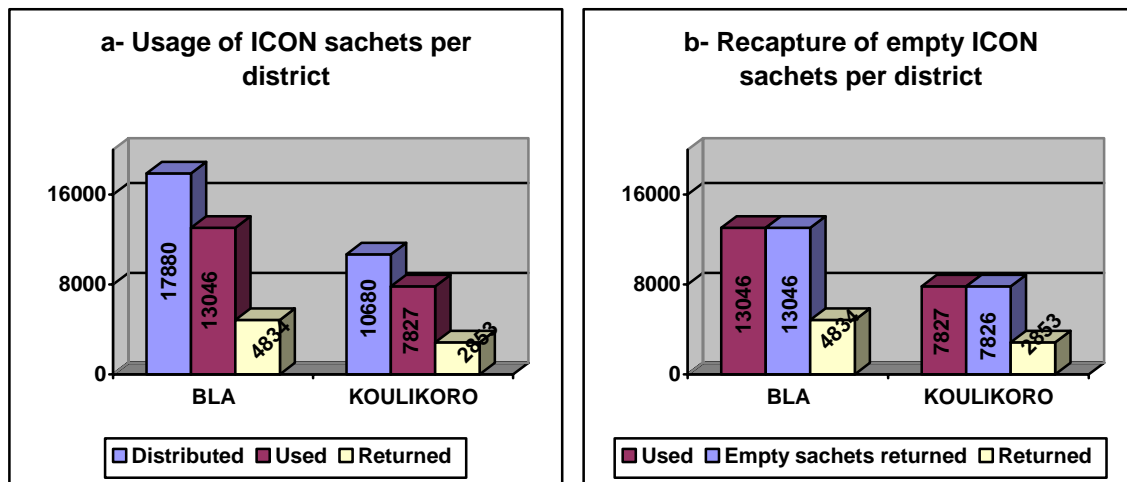
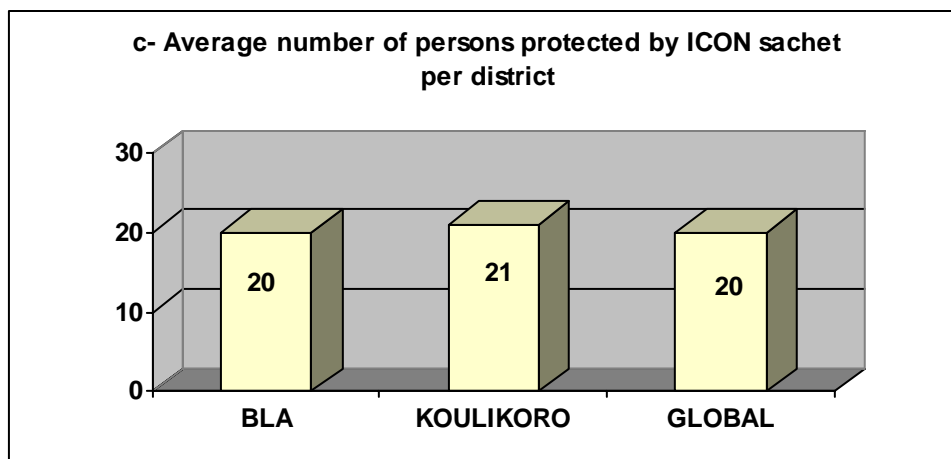


Figure 18. Persons protected per sachet of ICON.



Following safety measures that were put in place, solid and liquid waste were recaptured. Empty insecticides sachets were recollected, checked against the data base code, and then sealed in barrels and stored in containers that will be picked up by PASP.

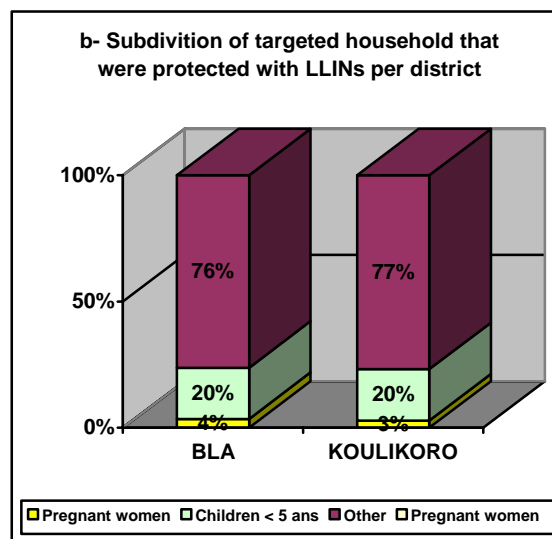
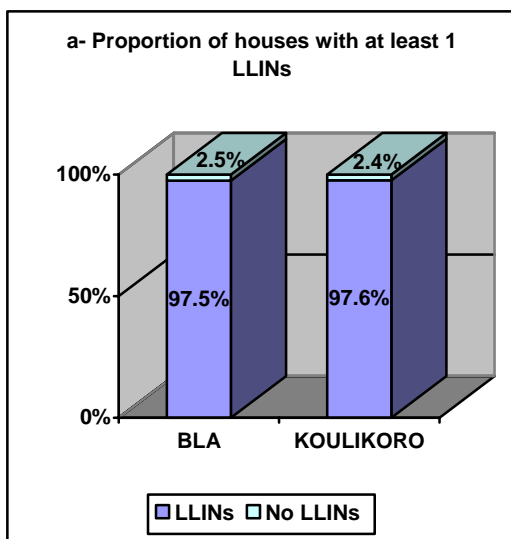
Figure 19. Empty insecticide sachets recovered in Koulikoro and Bla.

District	Sachets distributed	Sachets used	Empty sachets returned	% empty sachets returned	Average number of persons protected by one sachet
Bla	16,355	13,046	13,046	100	20
Koulikoro	20,368	7,827	7,826	99.987	21
Total	36,723	20,873	20,872	99.993	20

Usage of Mosquito Nets

During spray operations, data was collected on the usage of nets in households that were targeted for IRS. Figure 20 shows that in 98 percent of houses sprayed there was at least one LLIN. Figure 21 shows the subdivision of the targeted population illustrating that all children under 5 years and pregnant women who were in the targeted zones slept under LLINs. Of the people sleeping under LLINs, 20 percent were children under 5 years (in both Koulikoro and Bla) and 4 percent and 3 percent were pregnant women in Bla and Koulikoro, respectively.

Figures 20 and 21. LLIN usage.



Collaboration and Coordination

During spray operations, RTI worked in close collaboration with PNLP, regional, district, and community health offices, ASACOs, the MOE, the MOA, the Ministry of Social Development, MRTC, CНИЕCS, and a number of other partners and Ministries including National Pesticide

Management Committee (Comité National de Gestion des Pesticides [CNGP]). There was also an IRS task in place which followed closely operations and was frequently updated on the progress of spray operations.

The regional, district and community health offices, the chief nurses, chief doctors, ASACOs, and PNLP were engaged in planning and implementation of IRS activities. During planning meetings, it was agreed that IRS operations will be organized around CSCOMs and that district personnel from the MOH and MOE would supervise the operations. RTI worked in close collaboration with the PASP project and the MOE throughout the operations and will continue to do so in the next spray operation. RTI also worked with CNI ECS and the Ministry of Social Development in the implementation of the IEC strategy. At the end of spray operations MRTC began entomological monitoring activities. RTI will work in close collaboration with MRTC.

Through capacity building and the participation of PNLP in spray operations, PNLP is well placed to progressively take on more IRS tasks.

Environmental Compliance

In July 2008 an environmental compliance visit was completed by the RTI environmental specialist based in the RTI regional office in Nairobi to make sure that IRS in Mali complied with the requirements included in the approved SEA and EIA. It is important to note that there were a number of challenges during the spray operations including having all the rural secondary storages in full compliance with all environmental rules and managing 42 IRS sites in full compliance throughout the entire spray operations.

Security Measures

In IRS the use of pesticide can be risky for spray operators, the recipients, and the environment. To minimize the risk, precautions and measures are taken before, during, and after IRS. The following list outlines measures that were taken throughout IRS operations:

- IRS actors, including spray operators, washers, drivers, storekeepers, service engineers, and others manipulating the pesticides were trained on the proper handling of lambda cyhalothrin and the precautions to take during IRS operations. Moreover, each spray operator, washer, and storekeeper was equipped with PPE composed of: long sleeved shirt, a helmet, a face shield, a mask, a pair of robust boots, and resistant gloves. The masks and overalls were changed daily and the gloves were changed every 10 days or immediately if they were damaged. The actors were also taught on what to do in case of a contamination or an emergency.
- Supervisors monitored the proper wearing of PPE by the spray team.
- IEC messages explained to the target population through door to door visits, radio, and television broadcasts on the measures to be taken before, during and after the spray operations.
- All women recruited as spray operators (6 in Koulikoro and 14 in Bla) underwent a pregnancy test. As for the washers, 30 women in Bla were also tested and in Koulikoro, none were tested as they were all beyond menopause.

- Seventeen head nurses from Koulikoro and 30 from Bla were trained on what to do in case of contamination, side effects or acute pesticide poisoning.
- First aid kits were placed in community health centers and in vehicles carrying spray operators. Throughout spray operations, 5 mild cases of itchy skin and eye irritation were reported and treated with a first aid kit.

Environmental Safeguards

A number of environmental safety precautions were taken to follow the SEA and EIA rules and regulations. These steps include:

- Central warehouses and all secondary storages were not located close to a flood zone, school, market, or well. Those that were discovered to be in close proximity were immediately moved to an appropriate location.
- Soak pits were built according to the environmental rules and regulations and those which were situated in flooding areas such as in Kamani in the district of Koulikoro were relocated.
- A soak pit system was constructed to permit the purification of waste water before its infiltration in the ground. To prevent dispersion of water outside the soak pits, the borders were surrounded with thick plastic. Suits were daily washed and were hung to dry above the soak pits. The used detergent water which was contaminated by the pesticide was poured into the soak pits. The entire area including the washing area and rinsing was protected with a fence to keep pets and livestock out. The fence was constructed in local material and the areas were guarded 24 hours.
- There were fire extinguishers in the central warehouses and a bucket of sand in secondary storages. Thermometers were placed in all warehouses and secondary spaces to take the temperature 3 times daily. An additional door was installed as an emergency exit in both warehouses and secondary storages.

At the end of spray operations, all secondary storage spaces were cleaned before being returned to the community. All PPE and other spray equipment was also cleaned and stored in the central warehouses of Bla and Koulikoro. RTI is in the process of identifying appropriate incinerators for the disposal of solid waste (masks, empty sachets, and contaminated gloves).

Figure 22. Operators' overalls dry above a soak pit.



IRS Costs

The following tables outline basic IRS field costs for personnel.

Figure 23. IRS personnel daily stipends.

Personnel	Number	Days	Daily rate (in CFA)
Operators	330	45	2,000
Team Leader	17	45	2,500
Team leader and Supervisor	35	45	3,000
Supervisors	7	45	3,000
Washers	48	45	800
Service engineers (pump repair men)	14	45	4,000
Data clerk	2	60	4,000
District/District logisticians	2	60	6,000
Warehouse Managers	2	60	5,000
District/commune Coordinators	2	60	7,000
Finance Assistants	2	60	6,000

Figure 24. Daily stipends paid to IRS supervisors from Ministries.

Organization	Number	Days	Daily rate (in CFA)
PNLP	3	4	15000
DNACPN	1	4	15000
MRTC	2	4	15000
DNS	2	4	15000
MOA	2	4	15000
DRS – Segou & Koulikoro	2	12	7500
CSREF – Bla & Koulikoro	8	20	5000
Head Nurses	42	8	4000

Figure 25. Other IRS costs.

Item	Number	Days	Daily rate
Meals for operators	330	45	300 (per person)
Vehicles	50	45	75,000
Fuel	50	50	35,000

End of Round Evaluation and Lessons Learned

The success of the operations was due to the cooperation and collaboration with all partners from the central, district, and local levels – from CSCOM, ASACOs, PNL, MRTC, CNI ECS, and MOA and MOE. End of spray workshops were conducted in Bla, Koulikoro, and Bamako where stakeholders discussed a number of lessons learned:

- Avoid spraying during the rainy season.
- If possible, reduce the number of spray sites by consolidating those that are in proximity.

- Establish a supervision system in which each supervisor is responsible for monitoring activities at a specific area from the beginning to end of the IRS operations.
- Train all health technicians of the region of Segou and Koulikoro as trainers of trainers to build capacity and establish a core group of trainers to be used for future IRS rounds.
- Have in place an RTI environmental consultant months ahead of spray operations.