



PRESIDENT'S MALARIA INITIATIVE



## INDOOR RESIDUAL SPRAYING FOR MALARIA CONTROL

# Senegal End of Spray Round Report

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

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

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# Acronyms

ADS	Automated Directives System
CCF	Christian Children's Fund
CDC	Centers for Disease Control and Prevention
CS	Capsular Suspension
DEEC	Directorate of Environment and Classified Factories (Direction de l'Environnement et des Établissements Classés)
DPV	Directorate of Plant Protection (Direction de la Protection des Végétaux)
EA	Environmental assessment
EIA	Environmental impact assessment
EPA	Environmental Protection Agency
IEC	Information, education, and communication
IQC	Indefinite quantity contract
IRS	Indoor residual spraying
ITNs	Insecticide treated nets
IVM	Integrated vector management
L	Litres
LNA	Logistics needs assessment
M	Meters
M&E	Monitoring and evaluation
MOH	Ministry of Health
NGO	Nongovernmental organization
PEA	Programmatic environmental assessment
PERSUAP	Pesticide Evaluation Report and Safe Use Action Plan
PMI	President's Malaria Initiative
PNLP	National Malaria Control Program (Programme National de Lutte contre le Paludisme)
PPE	Personal protective equipment
RTI	Research Triangle Institute
SO	Strategic objective
SOT	Spray operator training
STTA	Short-term technical assistance
TA	Technical assistance
TOT	Training of trainers
UCAD	Cheikh Anta Diop University (Université Cheikh Anta Diop)
US	United States
USD	United states dollar
USAID	United States Agency for International Development
WHO	World Health Organization
WP	Wettable powder

## Country Background

Senegal was identified by USAID as one of the second 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 Senegal National Malaria Control Program (Programme National de Lutte contre le Paludisme [PNLP]) identified three epidemic-prone districts (Nioro, Velingara and Richard Toll) for indoor residual spraying (IRS) activities. In 2008, USAID and the PNLN agreed to focus spraying activities in Nioro, Velingara and Richard Toll with the intention of expanding IRS coverage from 2009.

In the 2008 IRS work plan, RTI was tasked with providing strategic, technical, management and operational support for IRS activities in the above mentioned districts. RTI and the PNLN set an objective to treat at least 140,000 structures or and protect 600,000 people with residual insecticide in 3 districts during the second round of IRS. This goal represents approximately 235,000 rooms and at least 90 percent of the total estimated population in the targeted districts.

RTI was also tasked to provide support to the PNLN to strengthen epidemic preparedness and response plans.

This end of spray performance report summarizes program activities during the 2008 spray round in Velingara, Nioro and Richard Toll from June through August.

## Summary Results

The round began on June 2 and ended on August 18. Spraying was carried out for a period of 34 days in each of the three districts, Velingara, Nioro and Richard Toll. A total population of 645,346 people were covered by the spray round, including 144,825 children under five and 21,715 pregnant women. The program was deemed as a success with an overall coverage rate of 94.7%. Spraying was completed on time according to plan and WHO guidelines.

## Malaria in Senegal

Malaria is one of the leading causes of mortality and morbidity in Senegal. Outpatient morbidity rates in health facilities average 32 percent while hospital death due to malaria is estimated at 3.22 percent. Malaria cases are estimated at approximately 600,000 per year, leading to 5,000 deaths (World Health Organization [WHO]). In addition to the death rates, poor health has a negative impact on productivity among adults and school attendance. In the Senegalese context where poverty affects 48.5 percent of households on average, malaria is considered both a disease of poor people and a cause of poverty.

In most parts of Senegal, malaria transmission is related to the rainy season and takes place during the rains and at the beginning of the dry season. This season is correlated to the highest density of vector populations. Transmission is not only dependent on the seasons, but also on permanent factors such as rivers, effluents, and channels of the main rivers (Senegal, Gambia, and Casamance) and temporary factors such as floods, tides and other maritime influence.

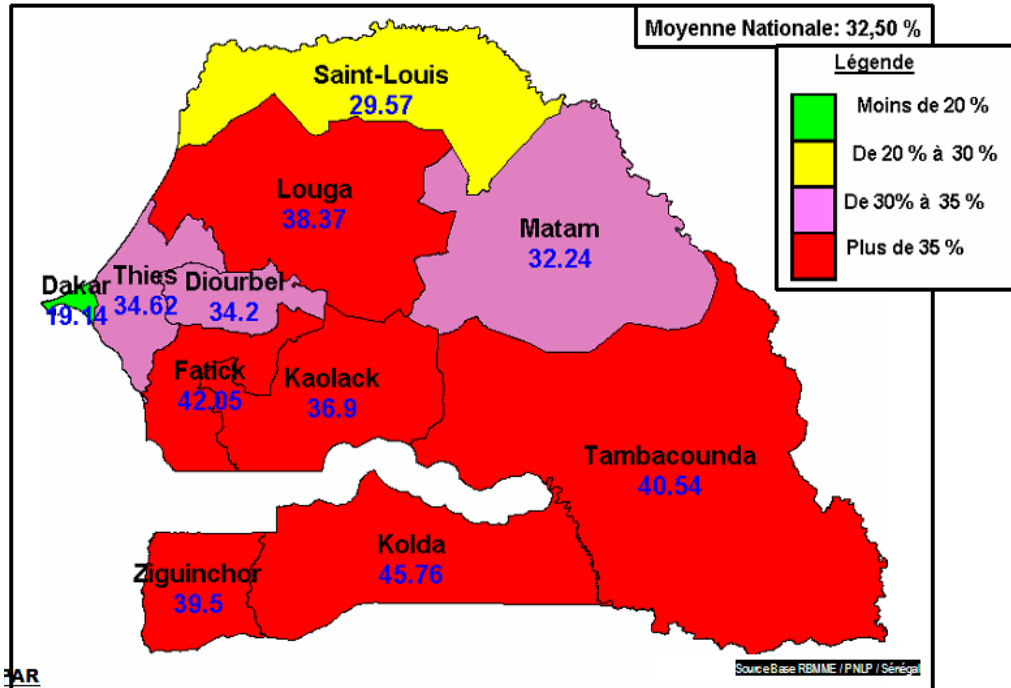
Social conditions create a third set of factors:

- Irrigation of rice fields and other crops;
- Migration and nomadic lifestyle; and

- Urbanization.

These man-made factors alter the natural epidemic patterns and create a man-made secondary malaria season in some parts of the country.

Figure 1. Malaria burden in Senegal by region.



The three targeted districts in Senegal are located in the north (Richard Toll), in the southeast (Velingara) and in the center (Nioro) of Senegal. Richard Toll is in the region of St Louis, Nioro in Kaolack, and Velingara in Kolda. The districts are predominately rural, agrarian, and comprise of an estimated total population of 630,264 inhabitants.<sup>1</sup>

Richard Toll with a surface area of 2,912 square kilometers (km<sup>2</sup>) is characterized by irrigation networks sourced by the Senegal River and Lac de Guiers, the largest lake in Senegal and a major source of portable water in the Dakar. The agrarian society mainly produces rice tomatoes and potatoes. The existence of huge irrigated surfaces and the numerous natural humid zones favor a second malaria transmission peak in comparison to the rest of the country where the usual peak occurs between August, September, and October.

Velingara is 5,435 km<sup>2</sup> and located in one of the rainiest areas of the country with annual rainfall ranging between 800 to 1200 millimeters (mm). The area is humid with tributaries and mosquito breeding sites.

Nioro has a surface area of 2,279 km<sup>2</sup> and hosts many valleys and ponds that are filled by rain and stagnant water.

<sup>1</sup> Population data from health districts. Richard Toll, 144, 803; Velingara, 221,068; and Nioro, 264, 393.

Figure 2. Main vector species in the three targeted districts.

<b>Richard Toll</b>	<b>Velingara</b>	<b>Nioro</b>
<i>An. arabiensis</i>	<i>An. gambiae</i> form M and S	<i>An. gambiae</i> form M and S
<i>An. gambiae</i> form M	<i>An. arabiensis</i>	<i>An. arabiensis</i>
<i>An. pharoensis</i>	<i>An. funestus</i>	<i>An. funestus</i>
<i>An. funestus</i>	<i>An. nili</i>	

## IRS Operations

### Training

In March 2008, RTI trained 14 spray operator trainers from partners such as Ministry of Health (MOH), PNL, the Hygiene Service (Service d'Hygiene), the Parasite Control Service (Service de Lutte Antiparasitaire [SLAP]), district public health offices, and University Cheikh Anta Diop (UCAD) of Dakar. In May 2008, the trainers attended a refresher course to reinforce their skills and knowledge in IRS. These spray operator trainers later led the larger spray operator trainings where 674 spray operations staff (599 males and 75 females) were trained at district level. Active support for both training workshops was provided by PNL, the Department of Animal Biology at UCAD, SLAP, and the Directorate of Plant Protection (Direction de la Protection des Végétaux [DPV]).

Prior to the start of spray operations, health workers from the three districts were trained in poison treatment and availability of essential medicines for the three districts. In total, 51 nurses from the health posts and the district team leaders were trained.

### Spray Operations

The IRS program was officially launched on June 10 in Kounkane, located 30 km from Velingara. The launch ceremony, which was held one week after the start of IRS operations, was chaired by the Prefect of Velingara and was attended by officials from PMI and PNL, administrative and customary authorities, and local government representatives. There was a very high turn out by the Kounkane population and the chairman of Kounkane Rural Council expressed his gratitude to the American people on behalf of his constituents. Participants expressed that the IRS program is greatly contributing to the government of Senegal's (GOS's) effort for malaria control.

Prior to the commencement of spray operations, spray teams were briefed on the challenges of IRS and the COP issued instructions to group leaders to carry out field reconnaissance on the eve of each spray day. The IRS spray schedule, jointly prepared by RTI and the district health officers, were handed over to the group leaders.

Spray activities commenced on June 2 in Velingara, June 10 in Nioro and on July 10 in Richard Toll. Spraying was carried out for 34 days in each district. Staggering the start of activities for the 51 health posts (sub-counties) was strategically planned so that spraying would start from the south to the north and all villages within a health post could be completed before moving on. ICON 10% CS was the insecticide selected for the round.

Figure 3. A spray operator at work.



The success of the IRS project depended largely on its organization, labor, logistics, and the cooperation of community members throughout the exercise.

The households were required to do the following:

- Provide about 8 liters of clean water for spray operators;
- Remove their property from the house before spraying;
- Keep the items outside their homes for a minimum of two hours after spraying to allow the solvent in the formulation to vaporize and dry on the sprayed surface; and
- Prior to moving belongings back into houses, to sweep up any dead insects found on the floor and dispose of them in pit latrines or bury them to avoid contaminating the food chain (to prevent insects being eaten by domestic poultry).

Spraying was typically conducted from 8:00 AM to 5:00 PM with 5 effective hours in the field, factoring in transportation and meal time. Spray operators were trained in data collection and required to collect household level data on their daily activities on a spray card. Each card was evaluated and spot checks conducted by team leaders and supervisors. Team leaders collected aggregated team and household level information on a card and submitted the cards to data managers. Daily IRS progress was recorded, summarized, validated, and entered into the IRS database by data managers. Data managers and district coordinators monitored and evaluated the daily and cumulative coverage of the IRS project and tracked insecticide usage by spray teams.

The new data collection card for round 2008 was developed jointly by PMI, PNLN and RTI after many discussion meetings. The following data was recorded on each spray card:

- Number of compounds
- Number of buildings in the compound (equivalent of number of structures)
- Number of rooms in each building

- Number of people living in the sprayed structures (including the number of children under 5 and pregnant women)
- Number of people living in the unsprayed structures (including the number of children and pregnant women)
- Number of insecticide treated or ordinary bed nets.

The spray teams also recorded the number of ICON sachets received, the number used, and the number returned at the end of each working day. Structures that were not sprayed were also recorded on the spray operator's daily card along with a code that corresponding to the reason the structure was not sprayed. The most common reasons for not spraying a structure were that the owner refused spraying (with a refusal rate of 5.3 percent) or the house was locked.

### **Maintenance of Sprayers**

Pump technicians were in charge of the progressive rinse and the maintenance of sprayers in order to help reduce pump damage. Each spray group was equipped with F3 and F4 Gallon X-Pert repair kits. All Hudson compression sprayers were regularly calibrated and maintained according to the manufacturer's guidelines before use. This maintenance ensured that sprayers maintained the accurate pressure for generating the flat fan swath required for efficient spray results and also extended the functional life the spray pumps.

Figure 4. A pump technician repairs a broken sprayer in the field.



## **Safety and Environmental Compliance Activities**

### **Spray Operator and Beneficiary Safety**

A general medical examination was conducted for all spray operators, team leaders, supervisors, washers, and storekeepers to assess their medical fitness for the IRS activities. All female spray operators and team leaders were given pregnancy tests. Findings indicated



that no female staff member was pregnant and that the team was generally medically fit to conduct IRS activities. After spraying, an additional medical evaluation of all the staff was conducted to determine pregnancy status and general health status. Two women were found pregnant at the end of the IRS round (one in Nioro and another in Velingara). It was determined that their participation in spray activities did not have any negative consequences on their pregnancies.

Occupational exposure to lambda-cyhalothrin for spray teams was mitigated by the use of personal protective equipment (PPE). Spray operators were provided helmets, face shields, face masks, long-sleeved cotton coveralls, rubber gloves, socks, and robust work boots. At the end of the day, spray operators turned in their PPE to washers for cleaning. The contaminated waste water generated from the washing of coveralls was emptied into soak pits after washing in soap which also denatures the pyrethroid.

The following measures were taken prior to and during IRS activities to mitigate exposure to insecticide and potential adverse effects of such exposure.

- Prohibition of eating, drinking, or smoking while working (to avoid dermal exposure, inhalation, or ingestion exposure).
- Providing washing facilities with privacy for spray operators.
- Ensuring that workers washed their hands and face with soap after spraying and before eating, smoking, or drinking.
- Coveralls were washed by trained laundry staff.
- All clinical health workers in the districts were trained in poisoning case management.
- Spray operators were trained on safe handling and reporting procedures for insecticide related emergencies.
- Parents, guardians, and home caretakers were advised to prevent children from coming into contact with sprayed surfaces after returning to the house and to avoid plastering, painting the sprayed surfaces...

The number of adverse events reported at health facilities was very low. There were reports of 23 cases among the community residents and 11 cases from spray operators. Skin and eye irritations were the most commonly reported problems and the patients were successfully treated within a number of hours.

## **Driver Safety**

In each district, the spray operation drivers were equipped with a protection kit consisting of a pair of gloves, plastic bags, a brush, soap powder and a 5 or 10 litre (L) water can. A training session was held for drivers to learn about the measures to take in case of ICON liquid spillage in the vehicle. No ICON spillage was reported by drivers.

Figure 5. A vehicle carrying spray material.



## Environmental Compliance

Before the start up of spray operations, RTI in collaboration with DPV and the Hygiene Service carried out an environmental assessment in the three targeted districts in order to validate the selection of the storage areas. Storage facilities had to have locking doors, a roof in good condition, adequate ventilation, accessible to trucks, and not be susceptible to flooding. Storage facilities were secured with two guards, a fence, and proper warning signs.

Following the start of the IRS round, RTI's environmental compliance inspector from regional office in Nairobi, RTI Senegal's environmental officer, and officer biologist/environmentalist from DEEC conducted a working visit to Velingara and Nioro from June 16 to 21, 2008. The objective of the visit was to conduct environmental compliance monitoring to assess the implementation status of the program's environmental and social management plan. At the end of the environmental compliance inspection, RTI was praised by the DEEC for the good implementation of PGES during the round. The inspection team provided recommendations for improving subsequent rounds, including:

- Procure appropriate boots for female team leaders because the existing boots are too heavy and not appropriate.
- Procure medicine for insecticide poisoning in the health facilities.
- Change the insecticide storage area in Nioro and use the established warehouse after rehabilitation of the roof.
- Supply Velingara with good vehicles that are more adapted to the field environment.

## Solid Waste Management

Collection cards for the contaminated solid wastes (gloves, masks, empty ICON sachets) were completed on a daily basis to track used and unused supplies. The material storage areas for contaminated solid wastes in each district are well managed, kept clean, and ventilated thoroughly. Stock monitoring cards greatly aid in logistics management. Each category of contaminated solid wastes (ICON sachets, face masks, and gloves) was stored separately in boxes.

At the end of the spray round, the solid wastes in the health districts of Velingara, Nioro and Richard Toll were consolidated and stored in the central warehouse in Dakar. In total, there were 65 empty ICON sachet boxes containing a total of 101,130 empty sachets. In the solid waste storage room the ICON pictogram is posted with “No smoking” and “No entry” notices.

The IRS environmental officer from RTI Senegal closely worked with DEEC on issues related to disposal of empty sachets. The following institutions and businesses below were identified as possible options for incineration of the contaminated solid wastes:

- SOCO CIM and Ciments du Sahel cement factories
- Dakar’s Hospital principal incinerator
- FOMSEN smelting plant
- PFIZER, an agro-pharmaceutical firm.

For safety in the IRS storerooms, the ICON storage areas have been isolated from possible flammable sources. Given the product’s flammability, “No smoking” pictograms have been posted in each insecticide storage centre.

Figure 6. Storage area of the contaminated solid wastes.



## Liquid Waste Management

At the end of each spray day, rinse operations were carried out in the soak pit area. The residual ICON in the sprayer was poured into the first drum. The first rinse is done with the clean water in drum two and the contaminated liquid is poured into the third drum. A second rinse is done in drums 4 and 5, and another in drums 6 and 7.

Other spray equipment such as coveralls, plastic sheeting, and vehicle seat covers were also washed and rinsed using the soak pit process and then hung up to dry.

Figure 7. Progressive rinse drums in a soak pit area.



Figure 8. A washer in PPE filling the water reserve drums. Behind her, overalls are hung up to dry.



## Logistics and Inventory

### Insecticide Warehouse and Use

An ICON illustration that says “No entry” was posted at the entrance of each warehouse. Daily temperatures of ICON storage areas were recorded on data cards. Hooks for hanging compression sprayers to dry were available in the soak pit area at each warehouse.

The storekeeper was responsible for maintaining and conducting accurate inventory of all insecticide, compression sprayers, personal protective equipment, and other bulk supplies on hand. The district manager was tasked with warehouse management. Responsibilities include maintaining a record of morning and peak temperatures in the insecticide storage area, as well as documenting any shortages, spills, accidents, or other incidents.

A logistics assessment was conducted and results made available three weeks before the start of operations. Ten percent more ICON™ 10% CS was procured than in previous years to ensure that there would be no shortage during the spray period in the event that the district had more than the estimated number of households.

Figure 9. Items procured for spray operations.

Description	Nioro	Velingara	Richard Toll	Total
Icon 10 CS (Unit dose)	25,000	20,000	15,000	60,000
Sprayer X-Pert Model 67642WD	110	90	0	200
Repair kit	150	125	100	450
Hard hat	200	200	0	400
Support visor	200	200	0	400
Visor	275	250	225	750
Boots	250	200	0	450
Overalls	500	450	0	950
Respirator mask	13,750	12,500	11,250	37,500
Gloves	2,000	1,800	1,600	5,400
Nozzles 8001	555	525	495	1,575
Regulation Valve	555	525	495	1,575
Strainer (152-356)	1,200	1,100	1,000	3,300
Thermometer	10	10	5	25
Apron	100	80	70	250
Funnel with strainer	350	300	250	900

### Commodities Management

Several measures were taken to minimize insecticide pilferage and waste. The inventory of all commodities (ICON, PPE, sprayers, and other logistical items) was carefully managed through forms and checklists. Only authorized staff was allowed to remove items from stores and each withdrawal was documented. All storage facilities were locked and secured to avoid break-ins. Security guards (two per site) were also hired to protect the facilities on a 24 hour a day basis. A logistics assessment and inventory was conducted twice a month. Furthermore, spray operators were only given their final pay after turning in all their supplies.

## Management and Supervision

Technical support supervision was provided by the RTI environmental inspector, the RTI in-country management team, team leaders, and Hygiene Service and PNL staff to ensure that spray operations were conducted in accordance with technical procedures and correct spray technique to maximize effectiveness of the insecticide on walls, ceilings, and other surfaces suitable for mosquito resting.

RTI organized spray operators into 5-member teams with one person designated as the team leader. The team leader was responsible for supervising the spray team and ensuring quality in spraying, compliance with safety and environmental guidelines, and data collection. Team leaders were also tasked with distributing the insecticide and with reporting on insecticide use.

Spray operators were monitored throughout the operations in order to immediately address any areas that needed to be corrected. Supervisors were notified of the most commonly identified mistakes and the recommended actions to improve operations. Some of the most critical areas for monitoring were:

- Observing the mixing of insecticide by spray operators to ensure the correct amount of water was being added to the powder.
- Verifying the data being recorded by spray operators and the daily activities of spray teams as reported by supervisors.
- Monitoring inventory by tracking supplies in use and inventory in the warehouse.
- Monitoring the cleaning and maintenance procedures of spray equipment by pump technicians.
- Observing the washing of PPE and sprayers and the disposal of rinse water into soak pits.

## Management Structure

RTI has a field office in Dakar, Senegal to carry out management and operation functions in support of the IRS program in Senegal.

The management structure comprised of:

- Chief of party (COP), Dr. Amadou Lamine Gueye. Responsible for oversight of IRS operations and client and stakeholder relations in the field.
- Finance officer, Mrs. Sow Ndeye Fatou Gueye
- Logistics officer, Mr. Mamadou Diallo
- Environmental compliance officer, Mrs. Diop Rokhaya Ndiaye
- Program Assistant, Cheikh Sadibou Diatta
- District Staff (temporary)
  - 3 district coordinators
  - 3 district logisticians
  - 3 district finance assistants
  - 3 data clerks
  - Field site managers

## **Roles and Responsibilities**

In total, over 700 people were involved in the spray round for the three districts. The spray teams were comprised of group leaders, team leaders, and supervisors. Group leaders manage an entire sector. They report to the district coordinator and to the health post where they are working. They are responsible for ensuring compliance with the PERSUAP, environmental compliance, safety and security of personnel, proper work distribution, and spray related data management.

Supervisors report to the group leader. They have the overall responsibility to supervise spray teams and ensure high quality of spraying. Supervisors will work with existing community-based structures (like village health teams, development councils, and religious groups) to maximize community mobilization and sensitization. They evaluate and record spray operator compliance against best practices with the goal of:

- Continuously improving the quality of IRS
- Ensuring the safety of the community and the spray teams
- Maintaining environmental compliance
- Minimizing the occurrence of adverse events.

Team leaders report to the supervisors. They are responsible for managing and supervising each spray unit consisting of 4 spray operators. Team leaders assign the daily work to each spray operator and provide supervision for the spray team to ensure proper technique and compliance with safety procedures. They distribute insecticide and oversee the security of the insecticide and spray pumps while they are in use by the spray unit. Team leaders report on spray data such as type and amount of insecticide used per house and other data as required on their daily record forms.

## **Personnel Requirements**

### **Richard Toll**

In Richard Toll, the 185 seasonal personnel for the third round included 6 supervisors, 25 team leaders, 110 spray operators, 6 storekeepers, 12 pump technicians, 14 washers, and 12 guards. The 21 drivers were also a critical component for the transportation of the spray operators.

### **Velingara**

The Velingara district spray round involved 253 seasonal staff and included 6 group leaders, 1 supervisor, 28 team leaders, 176 spray operators, 6 storekeepers, 12 pump technicians, 12 laundry women, and 12 guards. Velingara district operations required the use of 24 drivers to carry out the round.

### **Nioro**

The spray round in Nioro district involved 236 seasonal personnel including 6 group leaders, 3 supervisors, 31 team leaders, 150 spray operators, 6 storekeepers, 12 pump technicians, 16 laundry women, and 12 guards. In addition, there were 23 drivers needed for operations in Nioro district.



## **Roles and Responsibilities of Participating Organizations**

### **Ministry of Health**

RTI worked closely with MOH officials as counterparts to build the capacity of the MOH to such an extent that the IRS program could be turned over to them and other national stakeholders in the future. MOH personnel at many levels of the health system were involved in IRS activities.

The planning, implementation, management, training, and monitoring of IRS activities were conducted by RTI in collaboration with MOH (PNLP) in the three districts. The MOH recruited required personnel and in collaboration with RTI, conducted training for spray operators. RTI developed and provided the training manual used by MOH for such training. The district health officer (DHO) was involved in micro-planning, implementing IRS, recruiting operators, coordinating, and monitoring IRS activities, as well as managing IEC at district level. Coordinating and monitoring activities were fully implemented in Nioro and Richard Toll. However, there were disagreements between the DHO and the local CCF IEC coordinator in Velingara leading to challenges for the coordination and management of IEC.

At health post level, nurses worked with existing community structures to maximize community mobilization and sensitization and to infuse local ownership in the success of the IRS program. Nurses were involved in the recruitment of spray operators and in the management of the IRS progress calendars. Community nurses informed RTI of any adverse effect cases reported in the local health post.

### **Hygiene Service**

Supervision was reinforced by the active participation of Hygiene Service staff on the national, regional and district level. The objectives of supervisions were as follows:

- To make sure the work schedule is strictly followed.
- To motivate, encourage, and advise field workers.
- To ensure that strict discipline, quality of work, and safety are maintained.
- To assess individuals' work output.
- To assess the overall performance of the IRS effort and provide recommendations to RTI for action.

The IEC component of the IRS program was managed by the Christian Children's Foundation (CCF) Consortium. CCF was selected by USAID to lead IEC activities in collaboration with RTI. CCF is a consortium of many organizations with existing mechanisms developed to deliver health information from the national level to lower level communities.

Three environmental assistants from UCAD were hired and trained to manage entomological monitoring in the three districts. They conducted inspections to ensure compliance with EA requirements and established best practices; provided recommendations on compliance issues where best practices have not been established; and reported to the environmental compliance officer of RTI/Senegal.



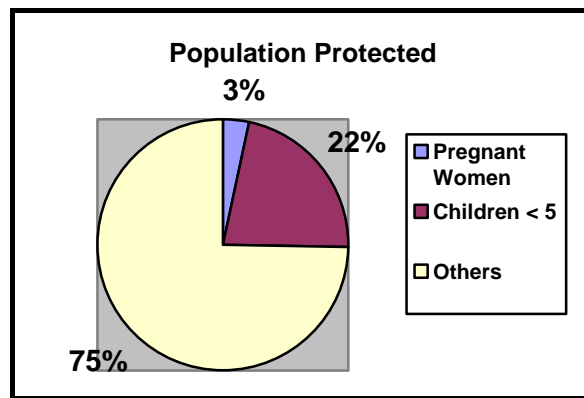
## Ministry of Environment (MOE)

There was strong collaboration between the Ministry of the Environment, RTI Senegal, and the RTI regional office in Nairobi for the selection of insecticide, environmental monitoring and for finding a solution for sachet disposal.

## Monitoring and Evaluation

The objective for the spray round was to exceed 85 percent spray coverage for all IRS target districts. The percentage of structures sprayed was 94.1 percent, 95.1 percent, and 95.4 percent for Velingara, Nioro and Richard Toll, respectively. A total of 645,346 people were protected from malaria in the three districts including 21,715 pregnant women and 144,825 children less than five years of age. The proportion is 98.4% of population.

Figure 5. Breakdown of population protected by IRS.



Data on insecticide use was also evaluated. Using IRS spray coverage data collected in the field, RTI supervisors created spreadsheets to evaluate the number of structures sprayed against the amount of insecticide sprayed per structure. This spreadsheet enabled project staff to detect spray operators that needed additional training in spray techniques to improve efficiency in the use of the insecticide. The average number of rooms sprayed per insecticide sachet used was 5.5. This number was in agreement with the specifications of the insecticide being able to cover 200m<sup>2</sup> per sachet and the average surface area of a structure in the field being 40m<sup>2</sup>.

Spray coverage in Nioro and Velingara met or exceeded the coverage data from 2007. However, the number of rooms covered in Richard Toll was slightly less than in 2007, although spray coverage was still high at 95.4 percent. The difference in outcomes between the spray rounds is explained by:

- In Rosso, many cattle breeders were reported to have left their hamlets for more abundant pastures during the rainy season. Their homes were found locked and thus not sprayed.
- The 2007 spray round coincided with the harvest period for a large sugar cane company in the region, which brought many seasonal workers to the district. However, for the 2008 spray round, those seasonal personnel had returned to their homes and were no longer occupying their houses in Richard Toll.

- During this spray round, latrines, places of worship, public places, and schools were not counted. These places had been sprayed and counted in the first spray round in 2007.
- In the district of Richard Toll, a substantial part of the population in the neighbourhood of Thiabakh, which is mainly composed of Mauritanian refugees, was repatriated since the 2007 spray round. The RTI district coordinator met with the UNHCR senior repatriation officer and was told that 4,670 refugees had repatriated from this zone.
- The spray record cards in 2008 were improved from the record cards used in 2007. Thus, data collection was slightly different.

The following figures demonstrate weekly progress against spray objectives (the objective being approximately 20 rooms per spray operator per day).

Figure 6. Treated rooms in Richard Toll by week of spray operations.

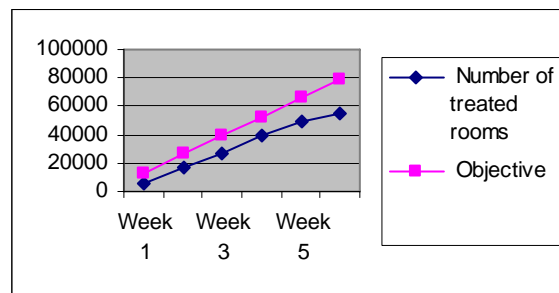


Figure 7. Treated rooms in Niuro by week of spray operations.

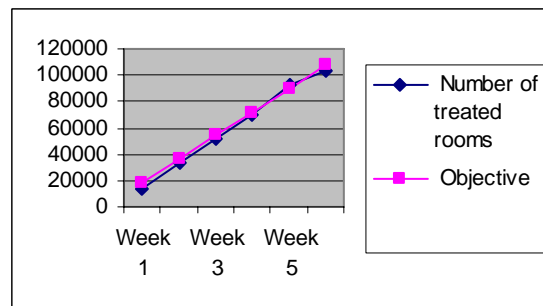


Figure 7. Treated rooms in Velingara by week of spray operations.

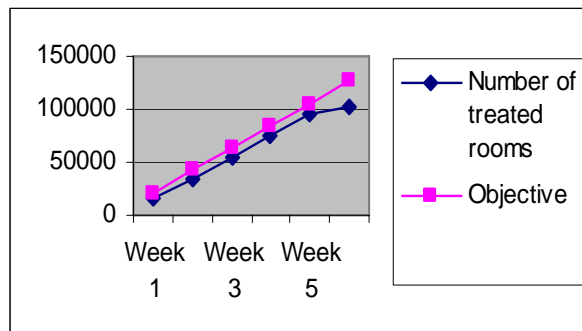


Figure 8. Final IRS results in the 3 districts.

District	Concessions		Structures in the concessions		Structures sprayed				Structures not sprayed			
	Sprayed	Not sprayed	Sprayed	Not sprayed	Rooms	Pop.	Children <5 years	Pregnant women	Rooms	Pop.	Children <5 years	Pregnant women
Nioro	20 195	72	68 683	3 502	103 522	269 104	64 115	8 058	8 842	3 233	802	202
Richard Toll	12 929	129	21 721	1 039	55 176	129 074	22 280	2 701	5 303	3 029	528	80
Velingara	18 257	62	63 538	3 956	102 294	247 168	58 430	10 956	6 622	3 743	781	102
<b>Total</b>	<b>51 381</b>	<b>263</b>	<b>153 942</b>	<b>8 497</b>	<b>260 992</b>	<b>645 346</b>	<b>144 825</b>	<b>21 715</b>	<b>20 767</b>	<b>10 005</b>	<b>2 111</b>	<b>384</b>

Figure 9. Mosquito nets found.

District	Untreated nets	Treated nets
Nioro	7,787	38,791
Richard Toll	28,201	17,453
Velingara	28,438	37,754
<b>Total</b>	<b>64,426</b>	<b>93,998</b>

Post spray interviews from 118 households visited in Velingara, 167 households visited in Niore, and 104 households in Richard Toll show that all beneficiaries are satisfied with the spray operations and there were no complaints.

## **End of Round Evaluation and Lessons Learned**

During the implementation of this IRS round, many best practices were established and there were a number of lessons learned. There was an end of spray round meeting that was held to review all areas of IRS in order to document these lessons and recommendations for subsequent rounds. Participants included representatives from MOH (PNLP and SLAP), WHO, RTI, CCF, PMI, Hygiene Service, and UCAD.

During the end of spray round meeting, the following entomological monitoring conclusions were made by UCAD:

- IRS effectiveness is notable in all types of housings including straw huts.
- A lower density of the indoor living *Anopheles gambiae*.
- The majority of households in all districts were free of *An. gambiae* s.l females.
- Entomological indicators for effectiveness improved in this second spraying year.

The following recommendations were made for subsequent rounds.

## **Country Ownership and Utilization of Government Officials**

A significant emphasis was put on using government (district and central MOH) staff for various components of program implementation in this round. The RTI Senegal IRS team worked daily in excellent collaboration and consultation with PNLP at the central and district level and with the MOE throughout operations, particularly in supervision which was conducted by the Hygiene Service and MOE.

This approach was quite successful at building capacity and creating ownership of the IRS program at all levels. Continuing to involve MOH and MOE in all aspects of IRS will be critical for scaling-up IRS and the eventual turn over of IRS to the GOS.

## **Maintenance of spray equipment**

Hiring of pump technicians to be in charge of the progressive rinse and maintenance of the spray cans was highly effective at reducing the number of damaged spray equipment during the spray round by 6 percent when compared to the previous year.

## **IEC Activities at Community Level**

In this round, there was less emphasis on IEC activities at the community level than was necessary. This shortage of IEC resulted in spray operators having to play an IEC role by conducting community education, mobilization, and assistance in the removal of property and household items prior to spraying in some villages. It is highly recommended that IEC is greatly strengthened at the community level in subsequent rounds.

## **Planning**

Start up of spray operations was delayed due to procurement issues for this round. The delay in starting operations created difficulty during the spray round and lead to losses in efficiency and effectiveness as many areas were not accessible during the rainy season. Furthermore, having people leave their homes for spraying while it is raining is challenging and undesirable. In the future, it will be necessary to implement IRS activities as planned prior to the start of the rainy season, accomplished through better planning and earlier procurements.