PRESIDENT'S MALARIA INITIATIVE

INDOOR RESIDUAL SPRAYING FOR MALARIA CONTROL

Ghana 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

CDC	U.S. Centers for Disease Control and Prevention
CFR	Code Of Federal Regulations
CHPS	Community Health Planning Services
COP	Chief of Party
CRS	Catholic Relief Services
DHMT	District Health Management Team
EA	Environmental Assessment
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
GHS	Ghana Health Service
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome
HOTM	Home Office Technical Manager
HPU	Health Promotion Unit
IEC	Information, Education And Communication
IQC	Indefinite Quantity Contract
IRS	Indoor Residual Spraying
ITNs	Insecticide Treated Nets
IVM	Integrated Vector Management
LNA	Logistics Needs Assessment
M&E	Monitoring and Evaluation
MOFA	Ministry of Food and Agriculture
MoH	Ministry of Health
NGO	Nongovernmental Organization
NMCP	National Malaria Control Programme
NMIMR	Noguchi Memorial Institute for Medical Research
NRHD	Northern Regional Health Directorate
PEA	Programmatic Environmental Assessment
PERSUAP	Pesticide Evaluation Report and Safe Use Action Plan
PMI	President's Malaria Initiative
PPE	Personal Protective Equipment
RTI	Research Triangle Institute
SO	Strategic Objective
STTA	Short Term Technical Assistance
TA	Technical Assistance
TOT	Training of Trainers
UNICEF	United Nations Children's Fund
U.S.	United States of America
USD	United States Dollar
USAID	United States Agency for International Development
WHO	World Health Organization
WP	Wettable Powder

Table of Contents

Country Background

Ghana was selected as one of the third wave of countries to receive funding under the U.S. President's Malaria Initiative (PMI) in 2007. As part of an overarching strategy to reduce the malaria burden in the country, the U.S. government assisted the Ghana Health Service (GHS)/National Malaria Control Program (NMCP) of the Ministry of Health (MOH) to make greater use of indoor residual spraying (IRS) to prevent and control malaria. In line with this strategy, the NMCP and Northern Regional Health Directorate (NRHD) identified 5 targeted districts in the Northern Region for the implementation of round one IRS activities. The districts selected were Tolon/Kumbungu, Savelugu/Nanton, Karaga, Gushegu and West Mamprusi.

RTI International (RTI), a U.S. government contractor for IRS activities, was requested to provide technical support for IRS activities in Ghana. To this end, RTI provided strategic, technical, management and operations support to implement the GHS/NMCP and USAID goal of reducing malaria associated mortality in the targeted districts during the first round of spraying activities. RTI also procured insecticide and other equipment and managed logistics and the transportation, storage and security of all commodities on behalf of the PMI and the government of Ghana (GOG).

RTI's main responsibilities were:

- To provide strategic, technical, management, and operational support for IRS activities in the aforementioned districts (all located in the Northern Region of Ghana).
- In line with NMCP policy, treat households with residual insecticide covering a population of approximately 500,000 during the first round of IRS operations.
- To build the necessary capabilities in Ghana to enable the partners carry out IRS correctly.
- To demonstrate the technically correct way of carrying out IRS to the authorities in Ghana.

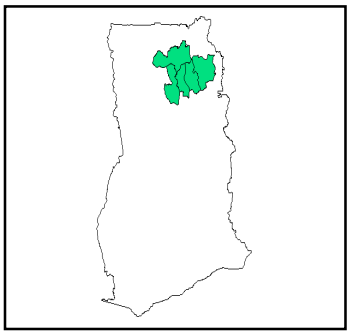
The Malaria Operating Plan (MOP) for the first round of Ghana IRS consisted of the following specific tasks:

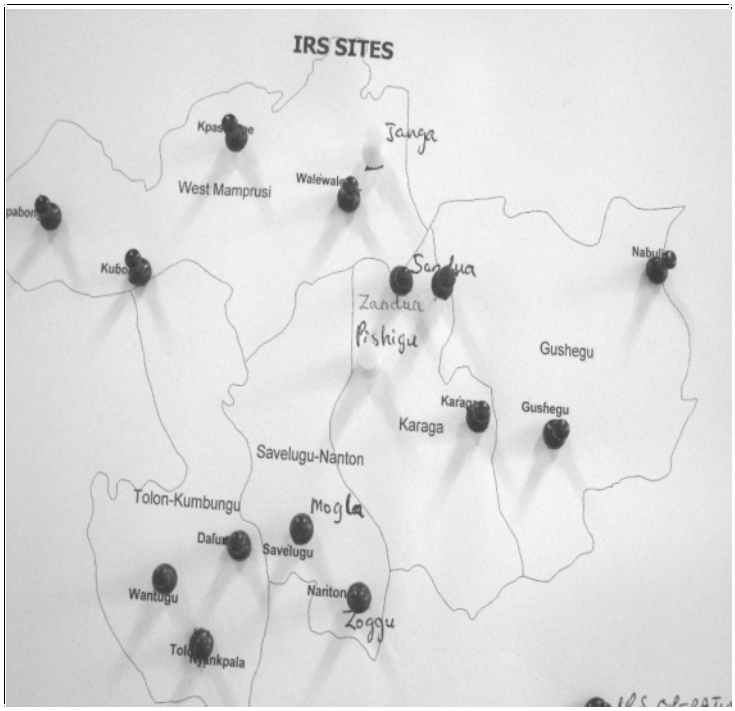
- Conduct environmental and logistics needs assessment.
- Procure IRS operational apparatus (insecticides, personal protective equipment (PPE) and other spray materials).
- Provide financial support for IRS management team, IEC implementers, and spray operators.
- Provide operational and technical support for planning, implementation, and supervision of IRS operations.
- Conduct entomological assessments to test for the most effective insecticide.
- Conduct assessments to monitor the necessary IRS indicators in line with the PMI indicators.

This end of spray report for round one summarizes the activities, achievements, lessons learned and recommendations to improve upon future IRS programs. It also spells out progress that has been made towards achieving PMI's objectives in Ghana. The report outlines the lessons and outcomes from the perspectives of RTI personnel at all levels, the MOH/GHS/NMCP from

national to sub-district level, and the experiences of community members as beneficiaries of the intervention.

Figure 1. IRS targeted districts and operational sites during the round one operation.





Summary of IRS Round One

Planning, surveillance, logistical preparation, and training took place in late 2007 and early 2008. An office was opened in Tamale and 16 operational sites were established within the five beneficiary districts. Spray operations were carried out from May 5 to July 31, 2008. Over 340 spray operators, 36 washers, and 138 community volunteers (information, education, and communication [IEC] implementers) were trained and mobilized within 3 months. At final count, 68,823 sachets of alpha-cypermethrin and 434 spray pumps were used during operations. There were 31 vehicles involved in round one spray activities. By the close of operations in August, the program exceeded its target of covering at least 85% of sprayable structures in each district and protecting at least 500,000 people. In total, 254,305 structures within 68,252 households were sprayed and the total population protected was 601,973 people. Of these, 108,124 were children under the age of five and 13,967 were pregnant women.

Background

Malaria Transmission and Burden in Ghana

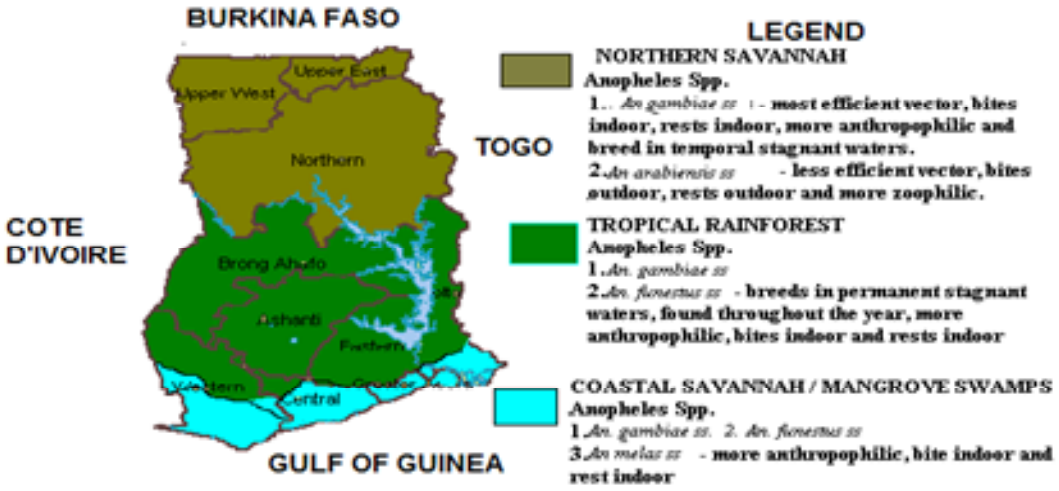
Malaria is hyper endemic in Ghana with perennial transmission affecting people of all ages throughout the country. The geographical distribution of malaria in Ghana includes areas of the country characterized by tropical rainforest (middle belt), coastal lagoons/mangrove swamps (southwestern part of the country), coastal and northern savannah, and developed urban areas. The highest year round transmission rates occur in the southeastern part of the country. In other parts of the country where the transmission is seasonal, there are typically 6 to 10 month transmission periods throughout the year. Northern Ghana, where the IRS targets districts are located, fall under seasonal malaria transmission zone.

The principal vector of malaria transmission is the female *Anopheles gambiae* complex and *A. funestus*. *A. melas* is predominantly in the swampy south-west and *A. arabiensis* in the northern part of the country. *Plasmodium falciparum* is the predominant malaria parasite in Ghana accounting for about 90 percent of all cases while *P. malariae* accounts for 9 percent and *P. ovale* is responsible for the remaining 1 percent.

Malaria Risk in Ghana

Population at risk of malaria: 100%
Negligible risk: 0%
Epidemic risk: 0%
Endemic risk: 100%

Figure 2. Map of Ghana showing epidemiological strata and predominant Anopheles species



Malaria is among the leading causes of morbidity and mortality and accounts for a significant proportion of the burden of disease in Ghana. It accounts for about 45 percent of all outpatient clinic attendances in health institutions and is ranked as the third greatest cause of death (MOH, 2007).

Vector control is an essential component of malaria control programs. The success of vector control as part of Ghana's malaria control strategy depends on a systematic review of the available vector control options and their selective use based on sound epidemiological basis.

Malaria Burden in Ghana

7,500 malaria cases are reported every day.

About 40,000 malaria related deaths recorded annually.

45 children under five years die from malaria every day.

7 pregnant women die every day from malaria.

National Malaria Strategy

After extensive research taking into account the above, the NMCP has developed an integrated malaria vector management policy with the principal objective of reducing malaria morbidity and mortality by reducing the levels of transmission. This policy seeks to outline the key integrated malaria vector management interventions adopted for use in Ghana and to guide and regulate the selection and implementation of appropriate strategies for malaria vector control. The key interventions outlined in the policy include:

- Environmental management;
- Adulticiding and laviciding;
- Biological control;
- Insecticide treated materials; and
- IRS.

The successful implementation of this policy requires an intersectoral approach, effective community participation, allocation of adequate resources, and the support of all stakeholders.

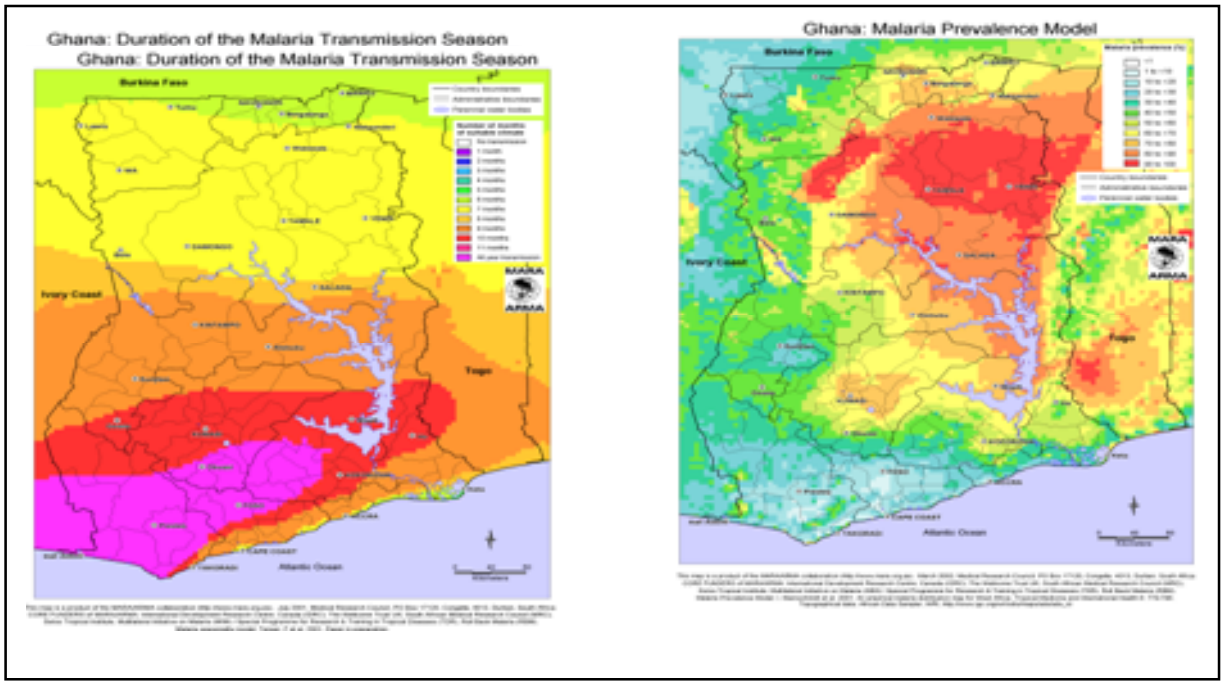
Justification for the District Selection

The GOG through the GHS/NMCP proposed to start IRS activities in an area where it will have maximum impact and demonstrate both the efficacy and sustainability of the program in the shortest possible time. Thus, the following criteria were sought for areas where IRS would take place:

- Transmission is predominantly seasonal and could be successfully interrupted through minimizing the longevity of the female anopheles mosquitoes.
- High disease and mortality burden that has potential for achieving a 50 percent reduction over the next three years.
- Vectors are sensitive to the selected pesticide.
- *Anopheles* vectors are indoor resting as well as endophargic.
- Population counts that would correspond to the amount of available funds for the IRS activities.

With these criteria, the Northern Region was selected as it had the highest disease burden and therefore the highest morbidity and mortality as per the 2005 malaria report. In addition, the NMCP indicated that the Northern Region is epidemic prone, hard to reach, and characterized by seasonal transmission of malaria. Due to limited funds and resources, five districts (Karaga, Gushegu, Savelugu/Nanton, Tolon/Kumbungu, and West Mamprusi) out of the total of twenty districts were selected for round one of PMI supported IRS activities in the Northern Region.. The following maps represent the malaria transmission season and prevalence model in Ghana by region.

Figure 3. Malaria transmission season and prevalence model.



Preparation for IRS Activities

Environmental Assessment

In November 2007, an environmental assessment (EA) was conducted by Dr. Jacob Williams, RTI's Director of Integrated Vector Management (IVM) to satisfy the regulatory requirements of Ghana's Environmental Protection Agency (EPA) and of 22 CFR 216. In addition, he conducted a situation analysis of IRS activities in the country, pesticide use (chemical, toxicological, and ecotoxicologial features), the status of mosquito resistance to pesticides, and determination of how IRS operations interact with vector control activities. The assessment involved an analysis of relevant regulations regarding pesticide use, handling (supply, storage, spraying), and waste disposal in Ghana.

Dr. Williams conducted field visits to the targeted districts in the Northern Region to take part in technical discussions being held with the staff of USAID/Ghana, NMCP, GHS, EPA, the Noguchi Memorial Institute for Medical Research (NMIMR) and regional and district Health Directorates in the Northern Region.

The EA documented results of the review and detailed procedures that must be followed to minimize potential risks to human health and the environment from the use of pesticides in IRS. The EA was prepared in close collaboration with designated staff and officials of appropriate Ghanaian ministries, including Health, Agriculture, and Environment. The review also identified any specific legal requirements to satisfy under Ghana environmental law before the IRS program can proceed.

The Pesticide Evaluation Report and Safer Use Action Plan (PERSUAP) and Impact Assessment were prepared and submitted to USAID, EPA and NMCP for review prior to the commencement of spray operations. Alpha-cypermethrin was selected as the insecticide of choice for the IRS operations. The following reasons were given as criteria for selection of alpha-cypermethrin:

- Approval by the World Health Organization (WHO) for use in IRS and according to the Preliminary Environmental Assessment for IVM, poses a low health risk to both spray operators and resident beneficiaries of the IRS program.
- Registration and approval in Ghana for public health use.
- Results of susceptibility test by NMIMR.
- Low risk level to environment and agriculture.
- Technical and logistic factors (effectiveness on wall surface types in targeted districts).
- The efficacy and cost of the pesticide.
- The capacity of the host country to manage pilferage and entomological resistance management.

Logistics Needs Assessment

RTI determined the managerial, logistical, and financial support required for the IRS program and associated environmental compliance activities. The assessment included site visits to the selected targeted districts to meet with regional and district authorities. Individual assessments were on storage facilities, human resource requirements, operational organization and the financial resources required for the implementation of spray operations. The following tables summarize the major logistics inputs required for IRS operations in targeted districts within the Northern Region.

Figure 4. Matrix of Personnel Inputs for the Ghana IRS Program

District	Pop.	HHs	Rooms	Spray operators	Teams	Team leaders	Super-visors	Washers	Cans	Sachets
Tolon/Kumbungu	165673	17907	89535	80	16	16	5	6	114	18690
Savelugu/Nanton	112210	12128	60640	55	11	11	4	6	82	15192
Karaga	60500	6539	32695	30	6	5	3	2	60	6276
Gushegu	95428	10314	51570	38	9	9	4	6	72	9092
West Mamprusi	143462	15506	77530	48	14	12	5	10	106	19573
Total	**577273**	**62394**	**311970**	**251**	**56**	**53**	**21**	**30**	**434**	**68823**

Figure 5. Matrix of Material Inputs for the Ghana IRS Program

District	Hudson Pump	Nozzles	Inline Filter	Vehicles
Tolon/Kumbungu	28000	264	264	7
Savelugu/Nanton	19250	180	180	7
Karaga	10850	102	102	4
Gushegu	16450	156	156	6
West Mamprusi	24500	231	231	7
Total	**99050**	**933**	**933**	**31**

Figure 6. Additional Inputs for the Ghana IRS Program

PPE	Accessories	Entomological Monitoring	Washers	Other
Rubber boots	Sachet bag	Bioassay cones	Apron	Personnel allowances
Rubber lined gloves	Soap	CDC bottle assay	Rubber boots	Transportation
Face mask	Data forms	Paper cups	Gloves	Fuel
Visor	Tool set	Sucking tubes	Soap	Storage
Overalls	Pen/pencil	Test tubes	Pail	IEC mobilization
Wide brim hat		Window traps	Bucket	Environmental assessment
		Isopropanol	NaOH	Entomological assessment
		Presscap tube	Detergent	Capacity development activities
		Dessicator	Water tank	Stationery
				Partnership coordination

RTI's team, in consultation with NMCP/GHS, the United Nations Children's Fund (UNICEF), WHO, and USAID, conducted the operational needs assessment. The purpose of the assessment was to determine the operational requirement for the implementation of IRS in the 5 selected districts. The assessment team was made up of environmental scientists, logistics specialists, technical officers, and representatives of each of the key local government authorities.

At the national level, the team met with MOH/GHS, the Ministry of Food and Agriculture (MOFA), NMCP/GHS, UNICEF, Catholic Relief Services (CRS), WHO, and USAID and gave details of the IRS program. After the initial discussions with the key stakeholders, the joint team conducted field visits to the IRS operational sites. Further meetings were held at the local level to inform local leadership, during which the team called on them to assist in the implementation of the IRS operations in their various districts. Some of the districts assisted RTI by supplying offices and storage spaces for commodities procured for district level IRS operations. The local level authorities (district assemblies [DAs] and district health management teams [DHMTs]) also assisted in identifying human resources for the IRS operations. The team made reconnaissance visits to communities, villages, and towns to determine the ground situation in the IRS target districts. Some of the indicators sought during the reconnaissance visits were average household size, types of houses, distance between homes, road access, and hard to reach areas.

Insecticide and Spray Equipment Requirements

There are many insecticides available for the control of disease causing vector organisms. However the choice of an insecticide for IRS operations depends, among others factors, on rainfall pattern, the efficacy and the life span of an insecticide, and the nature of the wall surfaces. The following factors were taken into consideration during the selection of the insecticide for Ghana IRS round one:

- Pesticide registration in Ghana
- Acceptability of the pesticide to the NMCP and national authorities
- Risk to human health: pesticide must be approved by WHO and safe as described in USAID's Environmental Assessment for Integrated Vector Management
- Risk to environment, livestock and agricultural trade
- Vector susceptibility and resistance
- Appropriateness of surface for spraying
- Duration of effectiveness (and implications for cost)
- Cost of insecticide.

In consideration of the above factors, alpha-cypermethrin (Fendona 5WP) was chosen as the preferred insecticide for the first round of IRS operations in the five districts of the Northern Region of Ghana.

Human Resource Requirements

To ensure an effective IRS operation, a robust human resource structure was put in place at all levels. All the IRS staff were recruited by the GOG and seconded to RTI for training, supervision, and remuneration in line with the PMI goal of national capacity development for IRS.

Based on the logistical and human resource needs assessment, a spray operator was expected to spray on average 6 households in a 5 hour work day and a 6 day work week. A total of 341 spray operators were recruited and trained to spray all households in the targeted districts within a time frame of 3 months (90 work days or 450 work hours). In addition to spray operators, 36 washers were recruited for IRS operations. Spray operators were supported by the program management team made up of team leaders, supervisors, site managers and RTI district staff. The chief of party (COP) and the RTI team who were based in Tamale during spraying coordinated and supervised spray operations in all 5 districts.

The RTI Ghana office in Accra hosts a full time staff consisting of the chief of party, finance manager, logistics officer, IEC officer, M&E and environmental officer, data manager, office manager, and administrative assistant. The following tables describe other personnel for IRS.

Figure 7. District staff (hired on a temporary basis).

	Savelugu/ Nanton	West Mamprusi	Gushegu	Karaga	Tolon/ Kumbungu	Total
Dist. Opr. Mgr.	1	1	1	1	1	5
Dist. Coordinator	1	1	1	1	1	5
Finance Assistant	1	1	1	1	1	5
Logistics Assistant	1	1	1	1	1	5
IEC Assistant	1	1	1	1	1	5
Store Assistant	2	5	2	2	3	14
Site Manager	2	5	2	3	3	15
TOTAL	**9**	**15**	**9**	**10**	**11**	**54**

Figure 8. Spray operators and other auxiliary staff.

	Savelugu/ Nanton	West Mamprusi	Gushegu	Karaga	Tolon/ Kumbungu	Total
Spray operators	55	48	38	30	80	251
Team leaders	11	12	9	5	16	53
Supervisors	4	5	4	3	5	21
Washers	6	10	6	2	6	30
Security guards	4	6	4	2	6	22
IEC implementers	25	34	35	15	25	134
Drivers	7	7	6	4	7	31
Total	**112**	**122**	**102**	**61**	**145**	**542**

District environmental health officers and disease control officers were regularly engaged in environmental monitoring and supervisory roles at the district levels.

Training on IRS and Spray Pump Maintenance and Repair

RTI in collaboration with NMCP and AngloGold Ashanti organized a one week training of trainers (ToT) workshop that covered all aspects of IRS at Obuasi in the Ashanti Region of Ghana. The training took place at the AngloGold Ashanti Malaria Center from April 14 to 19, 2008 with Dr John

Chimumbwa as the lead facilitator. Facilitators for the TOT were drawn from NMCP, USAID/CDC, the Health Promotion Unit (HPU) of the GHS, WHO, AngloGold Ashanti Malaria Program, and RTI.

As a way of initiating country ownership and building national capacity in IRS, RTI included all major stake holders in the TOT workshop to ensure that Ghana develops a sustainable IRS program and develops capacity to handle IRS operations.

Participants for the training comprised of staff from:

- NMCP
- Disease control officers from IRS targeted districts
- District environmental health officers from IRS targeted districts
- MOFA
- HPU
- Representatives from EPA
- RTI country office staff
- RTI district operations managers.

In total, 34 participants attended the TOT. Topics discussed during the TOT included:

- Overview of the President's Malaria Initiative and IRS
- Malaria burden, epidemiology and control policies and strategies
- Choice of insecticides
- Safe use of insecticides
- Personnel protection
- Data collection tools in IRS
- Quality assurance
- Spray practice sessions.

Lessons learned from different countries were also shared with the Ghanaian participants.

District Level Training (Operator Training Course)

Through a collaborative effort by AngloGold Ashanti and RTI, the training of spray operators took place in each of the selected districts from April 28 to May 3, 2008. The facilitators at the district level spray operator training were the RTI district operations managers, supported by the district disease control officers, the district environmental health officers and regional authorities who had all participated in the TOT at AngloGold Ashanti. Field supervisors and technical officers from AngloGold Ashanti IRS operations provided technical support at the district level training.

Recruitment and selection of spray operators was done according to the criteria of literacy, numeracy, residency in target area, acceptability by the community, and physical fitness. The selection was carried out by the relevant authorities, DAs, and DHMT. All spray operators were recruited from the various target districts. The nominated candidates were then presented to RTI for training and supervision.

The district level training involved sessions in both theory and practical instruction. Spray operators were trained in the following areas:

- Methods of malaria prevention with an emphasis on IRS.
- Spray techniques, including hands on practice in swath width, spraying rhythm, swath overlaps, timing, and distance maintenance.
- Safety and first aid.
- Maintenance of the spray equipment, including parts, stripping and assembling, trouble shooting, calibration, cleaning, storage, and preventive maintenance.
- Environmental protection, including progressive rinse, soak pit, pit latrines, and showers.
- Data collection and transmission, including data recording forms and analysis.

Figure 9. Spray operators undergoing training at Karaga.

To ensure the quality of the district level spray operator training, a number of technical support visits were made by the RTI home office technical manager (HOTM), RTI IRS COP and RTI IRS team in Ghana, the Northern Regional malaria representative, and the Northern Regional community based surveillance officer.

Clinical Evaluation of Spray Operators

RTI, in collaboration with the Northern Regional Health Directorate of GHS, conducted pre-training medical examination for all identified spray operators. The purpose of the medical examination was to have spray operators who were both medically and physically fit for the spray operations. A total of 389 spray operators went through the pre-training medical examination out of which 341 were declared fit. Similarly, after the spray operations, a medical examination was conducted for all spray operators to ensure that the health of spray operators was not adversely affected by IRS operations.

Apart from the general medical examination for all those working on IRS field operations, all females underwent pregnancy testing. This was done before, during, and after the spray operations.

IEC Activities and Community Mobilization

Stakeholder Meetings

The IEC team held a number of stakeholder meetings in 22 sub-districts across the 5 beneficiary districts from March 2008 to July 2008. These meetings were intended to sensitize the community leaders and members about the IRS program, to seek their participation, and to inform them of what role they play before, during, and after the spraying exercise. Participants of these meetings included chiefs, assembly members, unit committee members, women leaders, religious leaders, health workers, environmental officers, heads of departments and other opinion leaders.

Figure 10. Chiefs, assembly members and other community leaders at a stakeholder meeting in Savelugu/Nanton District.

Responses from the meetings were positive and encouraging. The following table provides the breakdown of stakeholders meetings held and the number of attendees during the first round of IRS operations.

Figure 11. Breakdown of stakeholders meetings held at the sub-district level during the first round of IRS operations

District	Sub-district	Number of Participants		
		Male	Female	Total
Karaga	Sandua	150	0	150
	Zandua	70	0	70
	Karaga	61	15	76
	Pishigu	50	14	64
	Subtotal	331	29	360
Tolon/Kumbungu	Tolon	60	10	70
	Dalun	96	14	110
	Kumbungu	91	9	100
	Nyankpala	66	6	72
	Subtotal	313	39	352
Gushegu	Gushegu	70	17	87
	Galwie	100	40	140
	Nabuli	48	7	55
	Katani	33	13	46
	Kpatinga	52	16	68
	Zinindo	26	11	37
	Subtotal	329	104	433
Savelugu/Nanton	Pong-Tamale	55	15	70
	Savelugu	73	27	100
	Diare	58	12	70
	Nanton	59	21	80
	Subtotal	245	75	320
West Mamprusi	Walewale	23	8	31
	Kpasenkpe	50	30	80
	Janga	67	33	100
	Yizesi	65	15	80
	Kubori	70	30	100
	Subtotal	275	116	391
Total		**1,493**	**363**	**1,856**

In general, female participation in IRS stakeholder meetings at the district level was low compared to the male participation . The highest female participation in the meetings was recorded in West Mamprusi where they constituted about 30 percent of the 391 total participants. Karaga recorded the least female participation in stakeholder meetings as female constituted less than 1 percent of the 360 total participants.

Women's Group Sensitization

Following the low participation of women in IRS stakeholder meetings and other activities in the beneficiary districts, the IEC team instituted a campaign targeting women's groups. During June and July 2008, the IEC team reached out to 34 women groups consisting of 1,428 women. Ante-natal and post-natal clinics were also targeted with IRS information. The women were educated on malaria in general and more specific in relation to pregnancy and children under 5, as well as prevention strategies such as IRS.

Figure 12. Breakdown of women's group sensitization.

District	Groups	Participants
Karaga	6	275
Gushegu	9	382
Savelugu/Nanton	8	148
Tolon/Kumbungu	6	459
West Mamprusi	5	164
Total	**34**	**1,428**

Community Discussions

From March 2008 to the end of July 2008, the IEC team engaged community members in discussions regarding the IRS program. Faith based groups and trade and craft associations were also targeted with IRS information. The members were sensitized on malaria, prevention strategies, and IRS. A question and answer session was lead by IEC assistants. The discussion helped to raise community interest in the program and facilitated the high level of cooperation enjoyed by the program.

School IRS sensitization

Based on the fact that malaria is the leading cause of school absenteeism in the districts, the IEC team targeted students within the five beneficiary districts, educating them on malaria and IRS. In total, 14,783 students from 57 schools were sensitized within the beneficiary districts from May 2008 to July 2008. IRS brochures were distributed to the students to give them more insight about the program and to equip them with knowledge so that they might disseminate the IRS messages to their peers and to members of their communities. Responses from the students were very positive and they were very appreciative of the program. IRS school club members served as peer educators and malaria/IRS ambassadors in their respective communities.

Figure 13. Breakdown of in-school IRS sensitization.

District	Schools	Students
Karaga	16	4,247
Gushegu	12	3,617
Savelugu/Nanton	9	3,181
Tolon/Kumbungu	11	2,484
West Mamprusi	9	1,254
Total	**57**	**14,783**

Figure 14. IEC assistants with IRS school club members.

Radio Program

The IEC team used local radio stations to disseminate the IRS messages to listeners across the entire Northern Region. Eight 45 minute live phone-in discussions were held from April 2008 to July 2008 on two radio stations in the Northern Region - Radio Savannah and Radio Justice. The IEC coordinator served as the primary resource for all the programs. Listeners were given the opportunity to phone in to ask questions or make comments about the IRS program. A total of 112 people phoned from various communities including non-beneficiary districts to enquire about IRS operations.

Two episodes of IRS audio drama were aired on the radio stations. The drama was in Dagbani, the predominant language within the IRS beneficiary communities. The drama performance was staged by the Suhuyini Drama Group in collaboration with the IEC team. It was an interactive thematic drama that relayed IRS messages to the community.

In addition, 15 radio spots of an IRS musical jingle were aired on Radio Justice throughout the spray period. The jingle was also in Dagbani and contained IRS messages targeted at the general public and the beneficiary communities in particular. It was developed by the Suhuyini Drama Group and the IEC team.

Community Sensitization Using Information Vans

The Ghana IRS program office partnered with the Information Services Department of the Ministry of Information to use the department's information vans to carry out community sensitization in some communities in the beneficiary districts. To this end, 292 communities within Savelugu/Nanton, Tolon/Kumbungu and West Mamprusi districts were sensitized about the IRS program using the information vans in May and June 2008. The exercise was interactive as community members were able to ask questions and responses were given by IEC assistants. The IEC team also took advantage of special days such as market days and festivals for maximizing the number of people impacted by the IEC messages.

Press Briefing

On April 25, 2008, the Northern Region Health Directorate held a series of activities to commemorate the 2008 World Malaria Day in Tamale, the Northern Regional capital. The Ghana IRS program team was invited by the Northern Region Health Directorate to brief the local media about the IRS program. They were sensitized on malaria, prevention strategies and IRS. The event was interactive and served as a platform for the media to ask questions about IRS and constructively criticize the various interventions of malaria control in Ghana.

Figure 15. RTI's COP makes a presentation on IRS during the press briefing.

Public Awareness

As part of the IEC strategy to create awareness and sensitize the public on IRS operations, the Ghana IRS program team mounted IRS sign posts at entry and exit points in all of the IRS beneficiary districts. The message on one side is "You are entering IRS zone. IRS protects you and your family from malaria". The other side reads "You are leaving IRS zone. IRS protects you and your family from malaria". The sign posts are meant to remind people about the IRS program and its purpose as they enter or leave IRS protected areas.

Figure 16. The COP and M&E/ environmental Specialist inspect an IRS sign post.

Social event -football match

As part of the strategy to inform community members about the IRS program, the Ghana IRS program organized a series of football matches between community football teams and "IRS Babies" made up of spray operators and RTI staff. This was meant to boost the good relationship existing between the RTI-IRS team in the district and the beneficiary communities. The events attracted a lot of community support and were used to reinforce IRS messages.

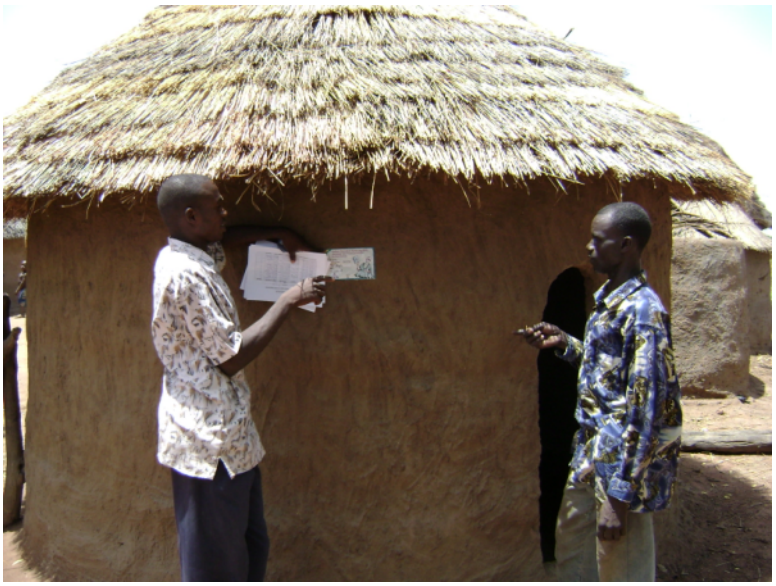
Figure 17. "IRS Babies" in yellow and the "Jaagbo Stars of Tolon" in blue and yellow in a group photograph before a football match.

Coordination with Spray Operations

House-to-house sensitization

Before spray operators commenced spraying in a particular community, the IEC implementers informed the families about the spraying date and time and any special instructions before, during and after the spraying. In total, the IEC implementers conducted house-to-house sensitization in 68,252 houses across the five districts from May 2008 through July 2008. IEC stickers were put on the walls of houses to signify that members of the house had received IRS IEC information and approved of their house being sprayed. IEC implementers then reported to the spray teams on communities that had been sensitized and were ready for spray operations. A second sticker was placed at the entrance of the house to signify that the house had been sprayed and therefore protected.

Figure 18. An IEC implementer (left) explains IRS procedures to a beneficiary in the Karaga district. An IEC sticker is put on the wall of the house after the message has been delivered.



Post-Spray Interviews

To obtain the perceptions and reactions to the IRS program from the beneficiary community, post-spray interviews were conducted in 1,129 houses within 146 communities from May 2008 to July 2008. Responses from the interviews were very positive and encouraging. About 95 percent of the interviewees applauded IRS as a viable and less stressful strategy to combating malaria. There were no complaints of adverse effects from spraying and about 99 percent of the people interviewed reported that they have seen positive effects from the spraying. The 1 percent who reported they had not seen any effects, were given additional education on the purpose of the IRS exercise and the expected results. Findings from post-spray interviews in the district were shared with the district RTI staff.

Community Acceptance Research

A USAID commissioned research project on community acceptability of the IRS program was undertaken in all the five beneficiary districts. A public health intern from the University of North Carolina was assigned the primary responsibilities of carrying out the research with technical and supervisory support from the RTI IEC team and Quality Health Partners. A total of 500 questionnaires were administered in the five districts. Fifty IEC implementers (10 from each district) were chosen for the administration of the questionnaires in the districts.

Recommendations that resulted from the research study included:

- The institutionalization of targeting women's groups with IRS IEC.
- IEC messages on IRS should educate community members about the main purpose of IRS, emphasizing the difference between the malaria transmitting mosquitoes and other mosquitoes.

- Proper records and data about houses should be maintained.

Implementation of IRS Activities

Program Monitoring and Technical Support Supervision

Technical support and supervision for round one IRS operations was provided by RTI staff, NMCP/GHS, USAID, EPA, and regional and district authorities to ensure that spray operations were conducted in accordance with prescribed technical procedure for required dosage of insecticides on the walls, ceilings, and other places suitable for mosquito resting. Corrective actions for mistakes in spray operations were taken immediately to improve performance and quality of the spray operations. Daily feedback sessions on standard operating procedures for IRS operations were conducted with spray operators.

The output from each spray operator and all spray teams was assessed using daily data sheets. The data sheet collected information on the number of rooms and households sprayed, number of people covered, and the amount of insecticide used per structure. This sheet enabled the monitoring teams to detect operational problems and track progress throughout the spray round.

Spray teams that had completed activities earlier were mobilized to assist other teams from different sub-districts to complete spray operations in other villages in order to complete spraying on schedule.

Key activities were emphasized during routine monitoring and supervision of spraying included the following:

- Observing the spray operator when mixing the insecticide with water to ensure adherence to guidelines.
- Observing the spraying techniques of the spray operator and checking the insecticide spray pattern on the sprayed surfaces to verify uniformity.
- Validating the number of rooms in each house sprayed and not sprayed.
- Verifying the data recording by the spray operators and by the supervisors to ensure proper documentation of the day's activities.
- Verifying the logistics supplied to each spray team against the number reportedly used, unused and the amount available in stock.
- Evaluating the cleaning and maintenance procedures followed by the spray team.
- Verifying the washing process of PPE and spray pumps.
- Verifying the proper procedures of progressive cleansing to ensure that spray operators wash the compression sprayers properly at the end of the day.
- Verifying routine and regular maintenance of the compression sprayer according to the manufacturers' guidelines to ensure quality of the spray results.

Based on monitoring and evaluation observations, supervisors continually provided feedback to spray teams and team leaders upon observing areas for improvement.

Strategic Technical Assistance

The Ghana IRS program benefited from a number of technical and managerial visits before, during, and after the spray round.

Dr. John Chimumbwa, RTI IRS Technical Director, visited the Ghana IRS program to engage the USAID, NMCP, regional and district authorities and other partners in discussions assessing the material, logistical and financial resources needed to undertake IRS operations. Dr Chimumbwa was also the lead facilitator at the TOT workshop organized by RTI in collaboration with NMCP and AngloGold Ashanti.

Dr. Jacob Williams conducted field visits to the targeted districts in the Northern Region to assist the districts in the selection of appropriate IRS operational sites for the construction of the soak pits and ensure that any environmental issues are addressed before the commencement of spray operation. In addition, technical discussions were held with USAID/Ghana (health and environment teams), NMCP, GHS, EPA, NMIMR and regional and district health administrations in the Northern Region for incorporation in the Environmental Impact Assessment (EIA) document. Dr. Williams also gave technical assistance in supervision of entomological monitoring.

Other technical visits include environmental compliance by Mr. Tito Kodiaga of RTI and Mr. John Pwamang and Mr. Salifu Wahab of the EPA. Dr. Cliff Mutero, IVM consultant, visit the program to assess entomological capacity among Ghanaian institutions.

The program was also visited by the Mission (Ms. BethAnne Moskov and Dr. Paul Psychas), the NMCP (Ms. Aba Baffoe Wilmot and Mr. Kwame Gakpey), and Dr. Henrietta Fore, USAID Administrator, who visited the NMCP where Ghana IRS operations were highlighted.

IRS Support Facilities

Before the commencement of spraying, RTI rented and obtained offices and warehouses in each of the targeted districts in the Northern Region. The main central warehouse is located in Tamale and the other warehouses are located in each district. Secured storage facilities were established at each operational site away from residential structures with the purpose of storing insecticides and equipment. Offices and warehouses were identified to minimize environmental effects from IRS operations on both human and animals and to ensure secured storage areas to prevent pilferage. Security guards were hired and posted on a 24 hour basis to protect the facilities in all the operational sites throughout the spray operations.

All logistics items required for spraying were procured and delivered to the five district warehouses before commencement of spray operations. There were about 70,000 sachets of Fendona procured for the first round of spray operations.

After the first round of spray operations, the logistics team took inventory of all items and retrieved all equipment and waste generated from all the operational sites for storage in the Tamale central warehouse. Spray pumps were serviced and storage shelves were constructed to ensure safe storage of the spray pumps. Appendix A provides a summary of the procurement inventory by districts.

Chain of Custody

To minimize pilferage and misuse of insecticide and other items, the Ghana RTI IRS management team put in place appropriate measures to control and monitor its stock of commodities, including:

- Inventory of procured items (sprayers, PPE, etc.) were recorded using forms, checklists and log books.
- Items withdrawn from stores or warehouses (national and district stores) were documented and requisitions approved and supervised by authorized staff only.
- Logistics assessment and auditing were carried out on a weekly basis.
- All storage facilities were properly secured and reinforced with security guards both day and night (24 hours) to prevent break-ins and theft.

Health and Safety

The health and safety of all staff including spray operators and IEC implementers was of paramount importance during the IRS operations in the beneficiary districts. As mentioned previously, spray operators were given medical screenings before and after spray operations. Women were given pregnancy tests on top of basic medical checks.

To protect spray operators against hazards during spray operations, they were first trained on the handling and correct application of the insecticides. Spray operators were provided with PPE such as coveralls, gloves, nose and mouth masks, boots, hard hats and face shields. The use of PPE was mandatory for taking part in daily spray operations. At the end of the day's operations, spray operators handed over the PPE to the washers for washing. Nose masks were disposed of on a daily basis and gloves were changed fortnightly but replaced immediately when damaged. The contaminated waste water generated from washing of the coveralls was discarded into the soak pits that were gated and padlocked to prevent access by unauthorized personnel. Danger signs and warnings were posted at the IRS sites and insecticide storage facilities to prompt and warn the general public from coming close to these restricted areas in order to avoid any contamination and health risks. A wash bin, clean water, soap, and towel were provided at all the stores for hand washing after handling of insecticide. Additionally, thatched bath rooms were constructed at the operational sites for body washing after field operations at the IRS sites.

All IRS staff at the regional and district levels went through training to gain knowledge on techniques of fire fighting. All of the offices, store facilities, and operational sites were provided with fire extinguishers to fight unexpected fire outbreaks. To further ensure personal safety, a required two day workshop on poisoning management was organized by RTI Ghana and the GHS Northern Regional Health Directorate (NRHD) for prescribers, nurses, and managers of health centers and Community-based Health Planning and Services (CHPS) zones in the five IRS beneficiary districts.

Figures 19 and 20. Left, spray operators dressed in their PPE ready for action. Right, participants listen during the poisoning management training.

Important measures taken prior to and during IRS activities to minimize exposure to the insecticide and the potential adverse effects of such exposures are summarized below:

- Eating, drinking or smoking while working was strictly prohibited to avoid dermal exposure, inhalation or ingestion.
- Safety regulations were enforced by ensuring that workers washed their bodies with soap and large quantities of clean water after spraying and before eating, smoking or drinking.
- Coveralls were washed daily by the washers.
- In the cases of accidental spillage of insecticide on the skin, the victim was advised to thoroughly wash the affected areas with soap and clean water immediately to avoid prolonged dermal exposure.
- Spray operators and washers were advised to immediately inform their supervisors or team leaders about any adverse side effects of the insecticide to seek immediate health care.
- Parents, guardians, or home caretakers were advised to prevent children from coming into contact with sprayed surfaces after returning to the house to avoid the extension of side effects of the insecticide. These people were cautioned not to plaster, paint, or paste pictures or photographs on the sprayed surfaces to avoid concealing the insecticide and reduce the sprayable wall surface.
- Residents were advised to sweep, collect, and bury all dead insects from sprayed rooms to avoid poisoning domestic animals and poultry.
- Residents were educated to stay out of sprayed rooms for at least 2 hours.

There were few cases of minor insecticide exposure among spray operators who reported accidental spillage in the course of normal pressurization of the pump gauge during use. However, no adverse effect was reported because the spray operators were appropriately using PPE. As one of the measures to promote safety, accident reporting forms were designed and distributed to team supervisors, drivers, site managers and IRS office staff to record and report all accidents. Two accident cases were experienced during the round one spray operations.

The first accident involved a cargo vehicle which had been hired to transport insecticides for IRS operations from the port in Accra to Tamale in the Northern Region. After consultations with the HOTM and RTI environmental specialists, the COP directed the logistics officer and M&E/environmental specialist to visit the accident site, conduct their own investigations to ascertain the extent of spillage, and address other environmental concerns. A detailed report on the accident was submitted to USAID, NMCP, and EPA for their consideration and necessary action.

The second accident involved a group of eight spray operators from Savelugu IRS team in a twenty-three-seat bus which ran into a ditch during the execution of mop-up spray operations. The spray operators were all taken to the Tamale Teaching Hospital where they received prompt medical attention. Three of them who were in critical condition were admitted for observation and discharged after 3 days when their conditions improved. Fortunately, no lives were lost and they joined their colleagues to continue with the spray activities.

Environmental Monitoring During Spray Operations

Following the approval of the PERSUAP and EIA, the RTI country team was oriented on environmental compliance monitoring of spray operations. At the onset of the IRS operations, the EPA, GHS, NMCP, USAID/PMI, WHO, and other stakeholders were involved in all environmental monitoring activities to render appropriate technical advice throughout the period of spray operations. During the spraying operations, the RTI IRS team conducted daily monitoring visits to the operational sites to offer technical support and undertake monitoring compliance inspections. An internal environmental monitoring compliance inspection was conducted by an RTI environmental specialist during spray operations in June 2008.

As a means of promoting collaborative efforts and promoting of sound environmental management throughout IRS round one operations, the EPA assigned a program officer to work closely with RTI to monitor field activities and to ensure the enforcement of safety measures and sound environmental compliance. The officer worked closely with RTI for the submission of progress reports to the EPA offices in Tamale and Accra.

Figure 21. The COP inspects the equipment of spray operators during a monitoring visit to Moglaa in the Savelugu/Nanton district.

The level of environmental compliance under this project in relation to the specific conditions stated in the PERSUAP is summarized in the Appendix B.

Data Management and IRS Results

The program was successfully implemented, yielding a high coverage rate of 93 percent for the spray round in the planned period of time. The total population protected was 601,973 people; the total number of children less than five protected was 108,124 while 13,967 pregnant women were protected.

The spray forms for the collection of household level data by the spray operators were assessed by the team leaders and supervisors before being handed over to the district data manager. The district data manager reviewed all the data checking for completeness and accuracy. The data was then transmitted to the Tamale office for compilation into a comprehensive data set. All of the spray cards from the districts were sent over to the RTI Tamale office and are kept there for reference purposes.

Figure 22 and 23. Summary results from IRS round one as reflected by key outputs.

Districts	Houses/compounds visited			People covered			Rooms		Coverage		
	Com-plete	Incom-plete	Total	Total pop.	Children <5	Preg. women	#	Sprayed	Unsprayed	Spray-able	Cov-erage
Savelugu/ Nanton	6,818	2,415	9,233	116,579	19,678	2,428	59,240	44,610	5837	50,447	88%
Tolon Kumbungu	15,835	7,241	23,073	160,043	29,231	3,965	79,559	68,182	6519	74,701	91%
West Mamprusi	9,520	970	10,490	160,067	27,145	3,465	88,602	73,525	3512	77,037	95%
Gushegu	7,546	1,388	8,934	89,994	17,759	2,325	43,618	38,874	2012	40,886	95%
Karaga	16,469	50	16,519	75,290	14,311	1,784	33,198	29,114	101	29,215	100%
Total	**56,188**	**12,064**	**68,252**	**601,973**	**108,124**	**13,967**	**304,217**	**254,305**	**17,981**	**272,286**	**93%**

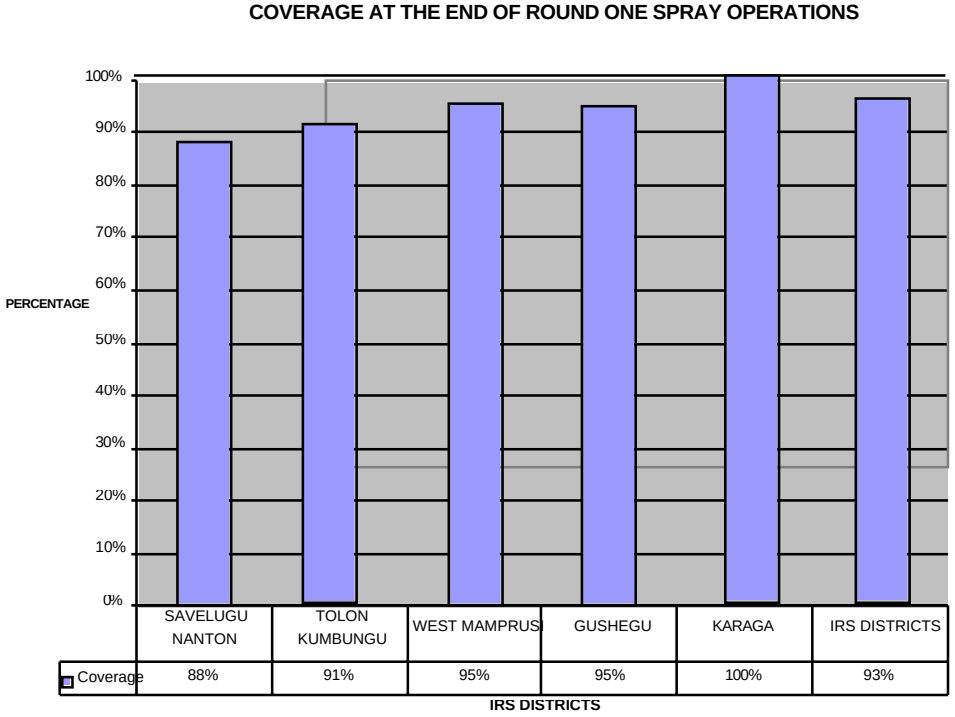


Figure 24. Mosquito net and insecticide usage.

District	Mosquito Nets			Population using mosquito net		Insecticide usage
	Net found	Treated	Untreated	Child-ren < 5	Pregnant women	Sachets used
Savelugu/Nanton	21,157	13,674	7,483	11,359	1,220	15,192
Tolon/Kumbungu	26,386	17,437	8,949	13,568	1,894	18,690
West Mamprusi	29,857	12956	16901	13,749	2,014	19,573
Gushegu	2,990	2,216	774	1,654	296	9,092
Karaga	15,597	8,306	7,291	5,995	1,071	6,276
Total	95,987	54,589	41,398	46,325	6,495	68,823

Closing of IRS Operations

RTI organized closing ceremonies in all the beneficiary districts. The purpose of the closing ceremony was to provide all stake holde rs at the district level the opportunity to present their observations about the IRS operations in their various communities. Representatives present at the closing ceremonies included key chiefs and elders, DHMT, district assembly, spray operators, Information Service Department, and RTI staff.

RTI used the closing ceremonies to inform the communities, particularly the opinion leaders, to continue to support IRS activities. Community members were full of praise for the IRS operations and the intended bene fits in their various communities. They also applauded RTI for creating short term employment for the youth.

Figure 25 and 26. Left, chief of Moglaa addresses the district closing ceremony. Right, IRS club members and spray operators at closing event.

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Post-spray Evaluation Meeting

RTI organized a post spray evaluation meeting in Tamale on October 7, 2008 to solicit views and feedback on round one spray operations from all stakeholders and partners. Representatives from the

national, regional and district levels were in attendance, including NMCP, Regional Health Directorate, DHMT, UNICEF, EPA, Association of Church Development Projects (ACDEP), CRS, WHO, and key chiefs and elders.

Topics were discussed and recommendations were offered in the following thematic areas:

- Community education and mobilization
- Human and environmental safety
- Spray operations
- Institutional arrangement and collaboration
- Environmental Protection Agency (findings of IRS monitoring).

A report on the post spray evaluation meeting was prepared and has been circulated to all stakeholders and partners.

Lessons Learned and Recommendations for Future Programs

The recommendations made in this report are based on RTI IRS experiences from the first round of IRS operations in Ghana and the contributions of partners and stakeholders. The lessons learned and recommendations for future IRS operations are presented in the following thematic areas.

Country Ownership and Utilization of Government Officials

- The involvement of all stake holders at the national level facilitated the IRS operations at the district level. For example, there were instances where there could have been operational delays at the regional or district level but directives from the national level fast tracked the process.
- The involvement of participants from the national and regional level in the TOT gave the stakeholders a deeper insight and knowledge on IRS, which proved beneficial during their monitoring visits.
- The absence of an IRS oversight committee resulted in bureaucratic bottlenecks which hampered intersectoral collaboration and prompt decision making.
- The reliance on a single intuition for the entomological surveillance and monitoring has not been very effective.
- The identification of council premises for use as office space during IRS operations facilitated a smooth take off and established a clear presence of the IRS program in the districts.

Recommendations

Future IRS programs in Ghana should continue to build capacity in country by:

- Collaborating with the MOH/GHS/NMCP and other stakeholders to establish and maintain national IRS oversight committee.
- Forming district IRS oversight committees to be led by the DHMTs.
- Working closely with national research institutions to manage entomological monitoring and surveillance for IRS activities.
- Engaging district disease control officers and environmental health officers with clear-cut roles on IRS activities.

Cleaning and Maintenance of Spray Equipment

- The inclusion of pump mechanics at the district level training contributed immensely to the proper maintenance of the pumps.
- The inspection of all PPE at the end of daily operations helped in early identification of items that required additional washing, and repair or replacement.
- The late return of spray operators from the field compromised the standardized practice of spray equipment cleaning especially in relation to the progressive rinse system due to sprayers being in a hurry to go home.
- A number of the pumps gauges were not working only after a few days of operations and thus made proper calibration of the spray pumps difficult.

Recommendations

- Increased training in spray equipment cleaning and management.
- Increased monitoring and supervision of spray equipment use.
- Strengthen daily inspection of spray equipment prior to commencement of spray operations.
- Daily maintenance of spray equipment.
- Increase the number of spray operators and avoid long working hours.

Environmental Monitoring and Compliance

- During the first round of IRS operations, high environmental standards were maintained especially in relation to the handling and disposal of insecticide. Designated areas (soak pits) were created for washing of spray equipment, personal protective clothing and disposal of left-over insecticides. As a result, no adverse effects were reported.
- The involvement of officials from the EPA and the district environmental health officers in environmental monitoring and compliance inspections contributed to a high level of environmental compliance.
- Instant corrective and disciplinary actions for spray operators when found to not be complying with safety measures helped to enforce compliance.
- On the spot monitoring and training to reinforce standard operating procedures maintained environmental compliance standards.

Recommendations

- Increase the number of operational sites with designated soak pits.
- Intensify the training on best practices on environmental compliance.
- Enforcement of strict disciplinary actions on environmental non-compliance.
- Opportunities for local procurement of PPE especially boots and gloves should be fully explored to reduce occurrence of mismatching boot/glove sizes and facilitate quicker procurement.
- Visible precautionary and danger signs with appropriate illustrations should be displayed at all operational sites to ward off intruders and trespassers.

Increased IEC Activities at Community Level

- The use of existing community based volunteer structures developed by the GHS helped immensely in the IEC since these were people already known in the various communities.
- The involvement of local authorities in the development of the IEC materials helped to create culturally sensitive and effective messages.
- The numerous channels used in disseminating the IEC messages were very useful and reached the targeted audience.
- The district stakeholders meetings were very effective. This further increased community participation in the IEC activities.
- The lack of means of transport for some IEC implementers affected the IEC activities in a number of communities.
- The involvement of traditional and community opinion leaders in IRS operations resulted in the smooth implementation of IRS activities emphasizing that effective community entry is very crucial in all IRS operations.
- The absence of daily monitoring forms for IEC activities made cross monitoring of IEC implementers difficult.

Recommendations

- Some monetary or material provision should be made available to address the need for offering a token of respect to chiefs and cultural leaders (a traditional requirement as part of community entry efforts).
- IEC implementers should be provided with some means of transportation (bicycles or motor bikes).
- In order to address community concerns that the spraying is not having an effect on the mosquito populations, the main purpose of IRS (targeting indoor resting, malaria transmitting mosquitoes to decrease mosquito-human contact) should be better conveyed through appropriate IEC strategies and messages.
- IEC media messages activities should start very early in the day so people who leave their homes during the days and cannot be reached by door-to-door IEC implementers have a chance of hearing the message through some other means such as radio, newspapers and other communication channels.
- Existing human resources in IEC, such as Red Cross volunteers and Peace Corps volunteers, who are already trained in community mobilization, should be integrated in IEC activities for subsequent spray rounds.
- Incentives should be offered to volunteers to assist in retention and improving the quality of work.
- Other non-IRS malaria prevention information should be included in the IEC messages to create a more holistic approach to malaria control.

Geographical Reconnaissance

- Knowledge of IRS geographic operational areas is crucial to the success of the program. Before the commencement of the first round of IRS operations in Ghana, geographical

reconnaissance visits were made and it helped in the planning of IRS operations. This process should be strengthened.

Recommendations

- For subsequent IRS rounds, geographical reconnaissance should be conducted ahead of the spray season, especially in new IRS areas. This is because the ground truthing will assist in calculating a better estimate of the logistics required, the development of a spray work plan and the proper timing of the spray operations.

Training of Health Workers in Poisoning Management

- Though no adverse effects were reported during the first round of operations, the poison management training was relevant and it strengthened the capacity of health workers at the local level in all the operational districts.

Recommendations

- The poison management training should be conducted before spray operations.
- District specific training should be organized to increase the number of participants at the local levels.
- RTI in collaboration with the Ghana Health Service should ensure that medicines for poison treatment are available.

References

ATSDR (Agency for Toxic Substances and Disease Registry). 2003b. Toxicological Profile for Malathion. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. Available at http://www.atsdr.cdc.gov/toxprofiles/tp154.html

EXTOXNET (Extension Toxicology Network). 1996. Pesticide Information Profiles: Malathion. Revised June 1996. Available at http://extoxnet.orst.edu/pips/malathio.htm

Suglo, J. V. (2002). Pesticide Dealers Handbook, Plant Protection and Regulatory Services Directorate (PPRSD), Ministry of Food and Agriculture (MOFA), Ghana.

MoH (2007). Integrated Malaria Vector Management Policy. National Malaria Control Programme (NMCP), Ministry of Health (MoH) Ghana.

Appendix A
Distribution of IRS Equipment by District

Item	Qty.	Gushegu	Karaga	Savelugu	Tolon/ Kumbungu	West Mamprusi	Tamale	Balance
Office tables and chairs	10	2	2	2	2	2	0	0
60 L basin	56	8	12	8	16	12	0	0
Boots	430	65	47	67	95	87	7	2
Coverall	720	109	70	136	190	153	12	188
Face shield window	360	55	40	75	90	80	0	20
Hard hats	360	55	40	75	90	80	0	20
Laptops	17	1	1	1	1	1	8	4
Jerry cans	434	72	60	82	I14	106	0	0
Gloves	2880	320	184	396	446	106	0	0
Nozzle brush	305	36	36	36	89	60	0	48
Heavy duty brash	42	8	8	8	8	8	0	2
Bathing bucket	50	10	10	8	10	12	2	0
Fire extinguisher	20	2	2	2	3	5	4	2
Nose mask	19840	2704	1872	3120	5220	3900	0	12500
Hand washing basin	30	4	4	4	6	10	2	0
X-Pert pump	360	40	40	65	90	80	0	0
Fendona bag	365	53	50	60	115	75		12
Aprons	64	12	12	12	12	16	0	0
Plastic cover sheets	1000	100	100	100	110	100	0	490
1000L plastic water tanks	15	2	3	2	3	4	0	1
Thermometer	22	2	3	2	3	5	2	5
Visitor's chair	10	2	2	2	2	2	2	0
150 and 200L barrels	108	14	21	14	21	35	0	3
First aid kits	24	3	4	2	4	5	0	6
Pregnancy test kits	200	25	25	25	25	25	0	0
Sand bucket	15	2	3	2	3	4	1	0
Hand washing tables	14	2	2	1	3	5	1	0
Wooden pallets	44	6	6	7	6	1	18	0

Appendix B
Mitigation Activities for IRS Program

Storage conditions	Generally in good condition with the majority adhering to minimum standards. Lighting system and security guards were available to protect the facility. Temperature and ventilation was closely monitored to suit the conditions for the storage of insecticide. Safety equipment such as fire extinguishers, soap and water for hand washing etc. were provided for use at the stores.
Prevention of environmental impacts, particularly water pollution	Spray operators received training and intensive supervision in waste management and disposal to minimize the potential risks at the well fenced and protected soak pit sites. Progressive rinse method was used during round 1 IRS operations.
Pregnancy testing	100% of women candidates completed pregnancy test.
Worker safety	Hand gloves and nose masks were adequately supplied through out the program. Spray operators wore the protective boots, nose masks, helmets, head gear and coveralls through out the field operations. Progressive rinse and end-of-day washing was regularly enforced. Thatched bath rooms were constructed at the operational site for use.
Residential safety	Communities enforced conformity with the required safety rules: People stayed out of rooms for a minimum of two hours after spraying; No food item, water or cooking utensil was found inside rooms during monitoring of spraying activities. Rooms with sick or pregnant people were not sprayed. Such rooms were however sprayed during the mop up. Plastic sheeting for covering furniture and food items was procured and used.
Disciplinary action to enforce compliance	Spray operators who violated basic standard operating procedure or code of conduct were sanctioned. Some spray operators were sacked due to misconduct or poor performance.
Emergency preparedness	Health workers were given training in poison management for early detection and management of accidental poisoning. Routine fire management training was organized for operational site managers, logistics assistants, store keepers, drivers and office workers between 30th May and 24th June 2008. Arrangements were made with the operational district and sub district hospitals and health centers for the provision of treatment medicines. First aid kits were made available in vehicles and warehouses for use.
Spray quality	Additional on-the-job supervision and training in application techniques and management of equipment will be done during Round 2 IRS operations. The required nozzle size was supplied for all the spray pumps to produce a normal swath width.
Stock management	All the used IRS pumps received weekly routine maintenance and broken parts were repaired. Each IRS field worker had two sets of boots, cover alls to allow for washing and changing at specified time intervals. Used nose masks were changed daily whilst worn out gloves were changed fortnightly and damaged ones replaced immediately with new ones. All the used Fendona sachets were collected and transported to Tamale warehouse for storage. Sachet use per spray operator was recorded at the district level. A total of 68,823 sachets of Fendona were used during Round 1 spray operations. Stock books were kept at all the sub district and district ware houses. Additional records keeping books were provided for documentation for daily, weekly and monthly stock management records.
Disposal of sachets/waste management	The Ghana IRS Team is working closely with the Environmental Protection Agency to coordinate the disposal of empty sachets according to the standard specifications of the WHO guidelines.

Appendix C

IRS Generic Sustainability Chart

Activity	Proportional Responsibility (%)							
	Round One		Round Two		Round Three		Round Four	
	MOH	**RTI**	**MOH**	**RTI**	**MOH**	**RTI**	**MOH**	**RTI**
Partnership development								
Establish IRS oversight committees	50	50	50	50	80	20	90	10
Environmental compliance								
Prepare Environment Assessment	20	80	20	80	50	50	80	20
Environmental monitoring Plan	0	100	20	80	40	60	50	50
Environmental compliance inspection	0	100	10	90	20	80	20	80
Entomological surveillance								
Identify an d train entomological technicians	50	50	50	50	60	40	80	20
Baseline survey	10	90	50	50	80	20	90	10
Periodic surveys	10	90	60	40	80	20	90	10
IEC Program								
Formative research	10	90	40	60	60	40	90	10
Training of IEC mobilizers	0	100	40	60	70	30	90	10
Production of materials	0	100	10	90	20	80	40	60
Pre-IRS IEC mobilization	10	90	50	50	70	30	90	10
IEC coordination with IRS	0	100	50	50	70	30	90	10
Post spray IEC survey	10	90	20	80	40	60	50	50
Logistics procurement and management								
Field vi sit for logistics needs assessment	50	50	50	50	60	40	60	40
Issue requisitions	0	100	10	90	50	50	50	50
Logistics delivery	0	100	10	90	50	50	50	50
Micro -planning	50	50	50	50	50	50	50	50
Logistics chain of custody	0	100	10	90	30	70	30	70
IRS operations								
Geographical reconnaissance	10	90	20	80	40	60	40	60
Training of s pray operators/supervisors etc	0	100	20	80	20	80	20	80
Spraying operations	10	90	20	80	20	80	20	80
Post spraying Activities	50	50	50	50	80	20	80	20