REPUBLIC OF ZAMBIA MINISTRY OF HEALTH

GUIDELINES FOR INDOOR RESIDUAL SPRAYING

2019

NATIONAL MALARIA ELIMINATION PROGRAMME WWW.NMEC.ORG.ZM

REPUBLIC OF ZAMBIA  MINISTRY OF HEALTH

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2019

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Abbreviations

CEHO	Chief Environmental Health Officer
CHA	Community Health Assistant
CHW	Community Health Worker
DDT	Dichloro-Diphenyl-Trichloroethane
DEHO	District Environmental Health Officer
DHD	District Health Director
DHO	District Health Office
EC	Emulsifiable Concentrate
EH	Environmental Health
EHO	Environmental Health Officer
EMA	Environmental Management Act
GHS	Globally Harmonized System of classification and labeling of chemicals
GIS	Geographical Information System
HSSP	Health Services and Systems Programme
IEC	Information, Education, and Communication
IRS	Indoor residual spraying
ITN	Insecticide Treated Net
KCM	Konkola Copper Mines
LD	Lethal dose
LD50	Lethal Dose 50
M&E	Monitoring and Evaluation
MCM	Mopani Copper Mines
MOH	Ministry of Health
MSP	Mobile Soak Pit
NGO	Non-Governmental Organization
NHC	Neighbourhood Health Committee
NMEC	National Malaria Elimination Centre
NMEP	National Malaria Elimination Programme
PHD	Provincial Health Director
PHO	Provincial Health Office
POP	Persistent Organic Pollutant
PPE	Personal Protective Equipment
PPM	Parts Per Million
PVC	Polyvinyl Chloride
TOT	Training of Trainers
UNZA	University of Zambia
USAID	United States Agency for International Development
WDP	Water-Dispensable Powder
WG	Wettable Granule
WHO	World Health Organisation
WHOPES	World Health Organisation Pesticide Evaluation Scheme
WP	Wettable Powder
ZANIS	Zambia National Information Services
ZEMA	Zambia Environmental Management Agency
ZSC	Zambia Sugar Company

Foreword

The Indoor Residual Spraying (IRS) Guidelines have been developed as supportive tools to improve the performance of the IRS Campaign for malaria and contribute to improved supportive supervision and capacity building of staff involved in IRS. The Guidelines provide general actions to assist IRS Managers and other service providers adhere to basic minimum required standards. In order to address the ever-growing need for improved quality assurance for IRS, it was vital to develop new guidelines to improve performance.

Indoor Residual Spraying is one of the core interventions for malaria elimination that firstly require optimal organizational and management performance. The development and adoption of implementation standards will contribute to a strengthened IRS health service delivery and management systems. Secondly, supervision, monitoring and evaluation hinges on the need to closely support t provinces, districts and service delivery health care facilities to improve their IRS performance.

Over the years, the implementation of IRS has revealed that intensive supportive supervision at implementation is crucial and superior to traditional approaches. However, when IRS is correctly implemented, supportive supervision during IRS campaign results in improved IRS outcomes by reducing mosquito populations and subsequently a decrease in malaria transmission. These Guidelines have been developed by heavily tapping into experiences and technical expertise of many provincial and district environmental health practitioners and other partners in the local government and mining sectors.

The Guidelines are intended for use by district IRS Managers in both public and private sectors. The major issues addressed include: IRS steps for insecticide handling and sound management, capacity building, supportive supervision, monitoring and evaluation at various levels of the IRS implementation.

I am very hopeful that the IRS Guidelines will serve as an important tool to ensure improved technical skills of IRS implementers and application of IRS in Zambia.

Dr. Kennedy Malama
Permanent Secretary-Technical Services
Ministry of Health

Acknowledgement

The process of developing the IRS Guidelines was collaborative, interactive and consultative. All Units at NMEC were involved. I wish to recognize the significant role and valuable input provided by NMEC members of staff during the development of the Guidelines. Allow me to also thank all the partners and stakeholders who contributed to the successful production of the Guidelines meant to be used by IRS implementers at national, provincial, district and community levels.

The NMEC through the Ministry of Health would like to further recognize the Vector Control Team at NMEC and Environmental Health Practitioners from all the ten (10) Provincial Health Offices for providing invaluable inputs during the development of this document.

Special thanks go to the Global Fund to Fight AIDS, Tuberculosis and Malaria for providing financial resources to support the process of developing and printing of the Guidelines for IRS in Zambia.

Finally, I wish to express my gratitude all individuals who worked tirelessly and contributed in one way or another to ensure the successful development of the Guidelines.

Dr. Mutinta Mudenda
Acting Director –National Malaria Elimination Centre
MINISTRY OF HEALTH

CHAPTER 1. GENERAL INDOOR RESIDUAL SPRAYING GUIDELINES

Background

This document is a revision of the 2009 indoor residual spraying (IRS) guidelines that had been developed to guide IRS operations in Zambia. It is intended for all implementers of IRS in Zambia: Government institutions, cooperating partners, and the private sector.

The manual is comprised of the following chapters:

- General guidelines for indoor residual spraying
- IRS insecticide handling and sound management
- IRS spray operator training

The guidelines provide information and direction to all those who are directly or indirectly involved in malaria prevention, control, and elimination through the use of insecticides for IRS. The document includes fundamental information about the use of insecticides: training, storage, safety, transportation, and disposal. The guidelines also lay out basic rules for public relations that establish and maintain rapport with households and standardize trainings of spray operators.

Adherence to the guidelines will ensure safety precautions that minimize risks to the environment, people, and other non-target organisms. It will also ensure effectiveness during the implementation of IRS operations.

As IRS operations require proper regulatory control, handling, application, and disposal to minimize adverse effects and accidental poisonings, IRS implementers should refer regularly to these guidelines for specific rules and conditions.

1.1 Introduction

Indoor residual spraying is the regular application of an insecticide that has longer residual properties inside a house to reduce mosquito life span and density resulting in the reduction in malaria transmission. The method relies on the fact that most mosquitoes enter houses at night and rest on the walls and ceilings before and after feeding. When walls and ceilings are treated with an effective residual insecticide, mosquitoes will pick up lethal doses of the insecticide and die. For IRS to be effective there must be high coverage of no less than 85 percent of all the eligible structures in order to obtain the 'mass/community effect'.

Zambia reintroduced the IRS programme to control malaria in 2002. It is one of the main interventions currently carried out by the National Malaria Elimination Centre (NMEC), partners in the private sector (such as mining companies and the Zambia Sugar Company), local authorities, and district health offices (DHOs). These guidelines are necessary to standardize protocols that guide the implementation of IRS in Zambia. They have been developed with help from various local and external consultants and partners, including the World Health Organization (WHO).

1.2 Purpose of the guidelines

These guidelines have been developed to:

- Enable the National Malaria Elimination Programme (NMEP) in Zambia to conduct IRS campaigns through standard, country-specific guidelines.
- Ensure interested institutions that are either considering adopting IRS or are already implementing IRS to consider operational, technical, and logistical issues necessary for an effective IRS programme in line with the National Malaria Elimination Strategic Plan 2017–2021.

The objectives of Indoor Residual Spraying:

- To reduce the vector's life span to less than the time it takes for the malaria sporozoites to develop.
- To reduce vector density.
- To reduce human-vector contact through a repellent effect.
- To reduce and interrupt malaria transmission.

1.3 Principles of Indoor Residual Spraying (IRS)

IRS involves regular, periodic spraying of houses with WHO-approved insecticides with longer residual effect to kill mosquitoes in order to reduce their population and therefore, reduce malaria transmission. IRS requires highly trained, competent, and committed persons to be involved in the operations. If implemented well, IRS can obtain a rapid large-scale impact. The principles of IRS are:

- Total spraying: all eligible structures must be sprayed (100 percent coverage).
- Complete: all sprayable surfaces should be covered.
- Sufficient: the required dose of insecticides should be uniformly applied to all sprayable surfaces.
- Regular: spraying should be conducted at regular intervals to ensure effectiveness during the whole transmission season.

1.4 Areas for IRS consideration

- In low- and moderate-transmission areas, IRS is used as a primary vector control intervention to reduce the seasonal annual peaks of malaria transmission, to prevent epidemics, and to support malaria elimination.

- In high-transmission areas, IRS can be used to rapidly bring malaria transmission down to a level that can subsequently be sustained through a high proportion of the population using long-lasting insecticide-treated nets.
- In areas of significant economic importance (e.g., areas with large development projects such as industries, oil refineries, mines, irrigation, and agro-forestry schemes), targeted IRS can be carried out to mitigate the impact of malaria on economic development.
- IRS has been used in some urban areas. However, it is important to take into account the biting behaviour of the vector and the actual level of malaria transmission relative to the costs of spraying a large number of structures.

1.5 Things to consider before IRS implementation

- Community engagement
- Baseline data collection
- Insecticide selection
- Geographical reconnaissance
- IRS area selection
- Planning and preparation for spraying
- Logistics and storage
- Transport
- Personal protective equipment
- Spray operators and supervisors
- Quality control
- Supervision

Community engagement

Proper community engagement must include the following:

- Working with communities (community health workers [CHWs], community health assistants [CHAs], neighbourhood health committees [NHCs], etc.) from the planning stage onward.
- Holding meetings with traditional leaders (Chiefs and Headmen) to help convey messages from the malaria elimination programme to their communities.
- Community sensitisation through live drama groups on malaria prevention, control, and elimination.
- Including community members in the monitoring teams (NHCs, CHAs, and CHWs).
- Facilitating and guiding development of radio scripts for radio stations
- Community sensitisation to help address myths and misunderstandings through NHCs, CHAs, CHWs, traditional leaders, political leaders, church leaders, and other influential people in the communities.
- Involving community members in choosing spray operators.
- Strengthening of community structures (NHC and Malaria Task force).
- Stakeholder engagement meetings (municipal council, mines, industries, and companies).

Community mobilisation

Proper community mobilisation—household engagement to encourage participation—requires that:

- It must start in advance of IRS implementation and it must continue thereafter.
- It must include door-to-door sensitisation of IRS.
- Appointments must be made a day before spraying.
- Mobilisers must be paid upon reaching the target of households to be mobilised.
- Mobilisers must be members of the community.

Resource mobilisation
Meetings must be held community members in the targeted area to discuss community logistical contribution (e.g., transport).

Social mobilisation
Community meetings must be held regularly to allow community members to discuss and understand their malaria situation. This will help mobilisers properly organise and initiate action towards implementing IRS.

Baseline data collection

When selecting an area eligible for IRS, the following baseline data must be considered:

- The burden of malaria in the district; figures of incidence, mortality, morbidity, and case fatality rate
- The population at risk in all catchment areas with high incidence and each areas' relation to one another (e.g., distance and direction from the district centre).
- Total number of structures to be sprayed (both porous and non-porous) with a minimum of 25 structures in one cluster.
- Quantity of each item left over from the previous spraying campaign (e.g., insecticides, personal protective equipment [PPEs], sprayers, etc.).
- Parasitological data (e.g., parasite prevalence rates).
- Entomological data (e.g., vector densities, identification and susceptibility studies and bioassays) as the majority of vector populations rest and feed indoors and are susceptible to the insecticide being used.
- Knowledge, attitudes, and practices of the community must be assessed.
- Accessibility of the area (travel time, distance, terrain, etc.).
- Spray coverage of previous season.
- Non sensitive ecological areas such as wetlands
- Houses must be made of permanent and roofed with well covered partitions

Collecting baseline information

Geographical reconnaissance

Geographic reconnaissance in this document refers to the mapping and compilation of all information concerning geographic characteristics of a particular area necessary for planning and effective implementation of IRS.

In order to spray systematically and effectively with good coverage, geographical reconnaissance should be undertaken for each selected area so that the following is available:

- A map of the area with boundaries (sketch maps for daily operations).
- Geo-mapping of structures.
- Information on important ecological and social features, such as mosquito breeding sites or church buildings in the vicinity.
- Information on the accessibility of the area with available routes to and within the area.
- Total number of structures to be sprayed, types of structures, total surface area of structures to be sprayed, and average surface area of structures to be sprayed.
- Total population to be protected.
- Information on social factors (e.g., outdoor sleeping).

Planning and preparation for spraying

An effective residual spraying programme is rooted in a plan of operations that is created early (commencing as dictated by entomological findings) and that defines a geographical area, methods and procedures of spraying, programme duration, personnel requirements, supplies, equipment, a deployment plan, completeness of coverage, and an estimated cost. More specifically, planning must include:

- Determination of the target structures.
- Calculation of the amount of insecticides required.
- Selection of the dates to begin and to complete spraying in each area, and the dates for the whole spraying programme of the season.
- An assessment of the status of various logistics such as the availability of spray pumps, spare parts, protective clothing, spray operators, transport, drivers, and infrastructure (e.g., storage).
- An assessment of the necessary transport and fuel required for proper implementation.
- A calculation of the financial requirements of the IRS operations.
- Availability (by recruiting and training if necessary) of the necessary manpower.

Preparation must include:

- Clear terms of reference for all staff involved in spraying.
- The reporting system and necessary forms.
- Supervision programmes and supervision checklists.
- Safe and sound insecticide management plans for the field and the storage facility.

Spraying

A typical spraying day should include the following:

- Reporting and roll call.
- Feeding personnel.
- Checking spray equipment and wearing PPE.
- Triple-rinsing equipment at the station.
- Filling spray pumps with initial fill with left over insecticide (in drum 1) from previous day.
- Collecting and signing for insecticide supplies and daily report forms by supervisors.
- Transporting spray operators, equipment, and supplies to the field.

- Creating mobile field stations.
- Refilling cans at mobile field stations.
- Issuing insecticides for first fills.
- Issuing report forms.
- Visiting structures chosen and prepared the previous day.
- Introduction of spray operators and inspection of prepared houses in the company of household residents.
- Closing windows and doors before spraying.
- Providing instructions to household residents after spraying, affixing IRS stickers to the household indicating that it has been sprayed, and data collection.
- Inspecting and double-checking work done and have stickers signed by the supervisors.
- Allocating an area to be sprayed the following day to the mobilisers who must then visit and prepare them.
- Transporting spray operators, equipment, and empty insecticide sachets back to station or IRS base.
- Balancing the insecticides back at the station
- Finalizing daily reports and handing them to supervisors who aggregate them onto the supervisor's form and submit to the IRS manager or data entry personnel.
- Cleaning equipment (triple rinsing), checking it, and hanging it upside down on racks ready for use the following day.
- Washing PPE, showering, and signing out.
- Updating all data and accounting for all chemicals and equipment by supervisor and store officer.

Post spraying review and monitoring

Activities that must be done after a spraying campaign include the following:

- Monitoring malaria mortality and morbidity data.
- Holding meetings with stakeholders (e.g., councilor, headman etc.) to find out the effectiveness of the spraying.
- Larval source management such as targeted larviciding.
- Mapping and updating structures data.
- Producing maps showing structures that have been sprayed (e.g., Mspray map).
- Maintaining spray equipment.
- Planning and budgeting for the next spraying campaign.
- Disseminating IRS results.
- Conducting malaria surveys, including bioassays, basic entomological surveys, and follow-ups of confirmed positive cases of malaria.

Insecticide selection

The World Health Organization Pre-Qualification Team recommends certain insecticides for use in IRS against malaria vectors. Based on these recommendations, the NMEC chooses one or more insecticides for spray operations in Zambia. The NMEC's selections must be strictly adhered to by anyone working in the national programme; insecticide choice is a matter of the country-wide insecticide resistance management plan. Districts and IRS partners are therefore required to coordinate with the NMEC regarding the choice of insecticides.

Storage and transport

To avoid adverse effects and accidental poisonings, insecticides must be stored and transported in accordance with specific rules and under specific conditions. These rules and conditions are discussed in details in Chapter 2 in the Insecticide Handling and Sound Management of Indoor Residual Spraying section.

Quality control

The NMEC conducts quality control in collaboration with the sub-national level. Intra-district quality testing should be conducted to the ensure exchange of information among districts.

A number of technologies have been suggested to complement the usual supervision of spray operators conducted at the district level. These include:

- The use of florescent dyes in insecticides which can be read on walls using ultra violet lamps but are otherwise invisible.
- The use of paper stickers on walls that can be used to check the amount of insecticide deposited after sprayings.
- WHO contact bioassays on sprayed structures.
- The testing of random samplings of insecticides at both national and district levels for laboratory quality control checks.

Spray operator in full personal protective equipment

Recommended provisions for the spray team member must include the following:

- Overalls (2 pairs)
- Gumboots (1 pair)
- Spare respirator cartridges (2 sets)
- Respirators (1 set)
- Hardhat (1)
- Clear safety goggles (1 pair)
- Polyvinyl chloride (PVC) gloves (at least 2 pairs)
- Mutton cloth (1)
- Socks (2 pairs)
- Light source (preferably head lamp)
- Towel (1)
- Bath soap
- Washing detergent

1.6 Training
Spray operators should be trained in accordance with specifications outlined in Chapter 3 to ensure quality and standardisation. Districts should coordinate with the NMEC through the Provincial Health Office for technical assistance and help in implementing successful trainings.

All trainers who train spray operators must themselves be trained and certified by the NMEP.

1.7 Information, education, and communication (IEC)
For a spraying programme to be successful, people need to be aware, and accept and support its implementation. This requires effective IEC interventions. The National Malaria Elimination Communication Strategy should be referred to and can be obtained from NMEC.

In an IRS program, IEC is important for the following:

- Creating awareness about IRS.
- Increasing levels of knowledge about malaria and IRS.
- Building approval of IRS as an effective intervention.
- Developing positive attitudes toward IRS.
- Developing skills and ensuring action with regard to what the households should do before and after their house is sprayed.

Creating awareness
Programme implementers should use multiple and various channels of communication to inform community members in their zones about spray programmes. Examples include the use of:

- Community centres, such as churches and schools.
- Banners, posters, and flyers.
- Local public announcement systems.
- National media (e.g., radio, television, newspapers).
- Community radio stations.
- Social media.

Increasing knowledge
Programme implementers should also identify and engage in IEC activities that give IRS-related knowledge (e.g., how malaria is transmitted) to community members in their zones. In addition to the channels mentioned above, they should also use local drama groups and NMEC-approved leaflets.

Regardless of channel, programme implementers must make sure that people understand that mosquitoes are the only cause of malaria and that killing mosquitoes would thus contribute significantly to reducing the incidence of malaria.

Building approval and developing positive attitudes

To ensure that communities approve of IRS campaigns, programme implementers should:

- Look out for any misinformation about IRS as misinformation may disillusion communities.
- Develop messages that answer the specific concerns raised by communities.
- Liaise with relevant authorities such as the District Commissioner and the District Director of Health so that they help campaign for IRS.
- Reinforce messages by having prominent members of communities also help campaign for IRS. Provide them with information and have them emphasise that IRS is a national public good.
- Hold advocacy meetings with the local leadership to solicit their support.
- Encourage community members who have had their houses sprayed to give testimonials and appeal to other community members to cooperate with spray operators.

Interpersonal communication with households
Spray operators should provide the following to households:

- Simple explanations of how insecticides work to kill the mosquitoes (i.e., mode of action) and how long they will be active.
- Assurance that spraying does no harm to walls, ceilings, or furniture.
- Assurance that spray operators are responsible people who handle and protect household property responsibly.
- Assurance that insecticides are not hazardous to humans, dogs, chickens, cats, or other domestic animals provided that precautions are followed.
- Explanations about how insecticides can cause insects to come out of their hiding places—households will probably see large numbers of non-target insects, such as cockroaches, for a certain period after spraying.
- The need to remove certain household goods prior to the spray operation, and not to enter the home for at least two hours after spraying.
- Upon re-entering, allow air to move by opening and windows and doors. Properly dispose of any dead insects.

1.8 Monitoring and evaluation

IRS monitoring and evaluation (M&E) should be a continuous process. It should help with the following:

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

M&E should be designed to provide information on or for the following:

Progress
M&E should document whether activities are carried out as planned, ensure accountability, detect problems, and make recommendations. All M&E information collected as a basis for planning should be brought together and reviewed. Review includes assessment of broader programme aspects such as quality of policy, effectiveness, and efficiency of interventions, sustainability, and management.

Outcomes and impact
M&E should document results in terms of improved delivery quality, coverage, and changes in malaria morbidity and mortality.

Research
Research must answer priority questions that require rigorous studies to add to evidence-based programme implementation.

Indicators
The key M&E indicators for IRS are as follows:

- Number of structures sprayed per spray operator per day.
- Percentage of targeted structures sprayed.
- Number of structures sprayed against structures found.
- Number of people protected against the target.

- Incidence rate from both sprayed and unsprayed areas.
- The average number of structures sprayed per unit of insecticides.
- Number of households mobilized against target.
- Number of sensitisation meetings with traditional leaders.
- Number of sensitisation meetings held with other influential leaders including senior citizens.

Routine entomological studies

It's important to understand the vector—species, density, biting habits, etc. through regular assessments.

- Vector susceptibility tests.
- Bioassay spot-checks of application quality, dosage, and residual period of insecticides on treated surfaces.
- Anopheline indoor resting density assessed by appropriate entomological methods (e.g., pyrethrum spray catches etc.).
- Mosquito molecular assessments (e.g., species, infectivity, etc.).

Supervision

- All communications on IRS must be through the Provincial Health Office.
- Supervision should be done at all levels (national, provincial, district health facility, and community) with coordination by the Provincial Health Office.
- The supervision teams should be comprised of people who are trained in IRS.
- Supervision should be done using the checklist to be determined by NMEC.
- Team leaders should be selected from amongst spray operators to lead a team of three spray operators.
- Each supervisor to supervise two teams.

Supply chain management

Current policy mandates that the Ministry of Health (MOH) and partners quantify and procure all IRS commodities as per district requirements. These commodities are distributed to the districts based on need. For details, refer to Chapter 2.

CHAPTER 2. IRS INSECTICIDE HANDLING AND SOUND MANAGEMENT

Section I. Insecticide guidelines for IRS

2.1 Introduction

Insecticides are toxic to both humans and the environment if not handled according to specifications. It is important that scrutiny is paid to storage and the commodity chain of custody in order to avoid mismanagement, loss, or leakage of insecticide stocks. It is important to ensure that these insecticides are used safely, thereby avoiding adverse impacts on human health or environmental contamination.

In order to facilitate the safe and judicious use of insecticides in vector control programmes, there is a need to develop an insecticide management system based on regular monitoring and reporting of insecticides.

There are five different classes of insecticides in use, namely: organochlorines, organophosphates, carbamates, pyrethroids, and neonicotinoids, and these play a significant role in public health vector control interventions.

Generally, all insecticides are poisonous and can be harmful if improperly used. Users should be fully aware of the hazards they pose. They can enter the body by three different routes: the skin (dermal absorption), the mouth (ingestion), and the lungs (inhalation). Poisoning may occur while preparing, spraying, storing, or transporting insecticides. Taking special safety precautions and adhering to these guidelines minimizes the risk of possible poisoning.

Precautions must therefore be clearly stipulated. An insecticide management and monitoring system should clearly indicate the kind of training that people who work with insecticides must undertake. It is imperative that people who work with insecticides undertake training in safe insecticide handling procedures. These guidelines contain fundamental information and instructions for IRS in Zambia.

2.2 Definitions

Insecticide: An insecticide is a chemical compound that is used to kill insects. In public health, insecticide is used to kill vectors of disease such as mosquitoes. In agriculture, insecticide is used to kill pests that damage crops.

Formulation: Insecticides are seldom used at full strength but, rather, formulated with other substances. Thus, an insecticide as it appears on the market is composed not only of a toxic part (either called the toxicant or the active ingredient), but of a toxic part and also one or more non-toxic parts (often referred to as inert materials). The typical ingredients of a formulation include an active ingredient, solvents, carriers, surface-active agents, and special additives. The inert materials may serve to dissolve the active ingredient, act as carriers, disperse the active ingredient, improve effectiveness, reduce toxicity, or break the active ingredient down into smaller parts, making the resulting formulation diluted, extended, and easier to apply. Formulation has great influence on the effectiveness of an insecticide.

Active ingredient: The active ingredient is the toxic or poisonous part of the insecticide. It is the most important part of a formulation as it determines the other ingredients. Relevant properties of active ingredients include its melting or boiling point, water solubility, and stability.

Toxicity: Toxicity measures the degree to which a substance may cause harm to human, animal, or insect. It is usually expressed in terms of lethal dosage (LD). To compare the toxicity of various insecticides, the value of Lethal Dose 50 (LD50—see below) is used. Acute oral and acute dermal

toxicity is measured by observing test animals' responses to single doses of toxin. Toxin doses are measured in milligrams of active ingredient per kilogram weight of test animal (e.g., rat, rabbit). A milligram is one millionth of a kilogram so these units are called parts-per-million (PPM).

LD50: LD50 refers to the dose, measured in PPM, of a chemical that kills 50 percent of a population of test animals. Insecticides are divided into various hazard classes according to their LD50 values. The toxicity of an insecticide is determined by the concentration of its active ingredient and its formulation. For any insecticide, a granule formulation is safer to use than a spray, and a coarse spray is safer to use than an aerosol.

The most highly toxic chemicals are applied as granules since fine powders are too easily inhaled. A chemical's LD50 value is not absolute: it varies between different species of animals and even different individuals within a single species of animal. Each species, and each individual (to a lesser extent), reacts differently to different chemicals. This often causes toxicity to be misinterpreted but also allows for species targeting. Toxicity also varies depending on the route of absorption into the body. An LD50 value of a chemical may vary depending on whether it enters the body through the mouth (ingestion), the skin (dermal absorption), or the lungs (inhalation).

Modes of action: Insecticides generally kill insects by interfering with their normal life processes. There are two main types of insecticides based on their modes of action: knockdown and systemic.

2.3 Insecticide formulations

As mentioned above, insecticides are rarely used in their pure form (i.e., solely active ingredient). Usually a pure active ingredient is mixed with different inert ingredients to create a formulation that makes it easier to apply the active ingredients.

The common formulations are dusts, wettable granules, wettable powders, emulsifiable concentrates, suspensions, solutions, and capsule suspensions.

Dusts: Dusts are used dry. In general, the smaller the size of the particles of an insecticide, the less toxic it is.

Wettable powders (WP) and water-dispensable powders (WDP): Powders consist of active ingredients, wetting agents, and inert carriers. They tend to be odorless and easily absorbed by porous materials. Special care must be taken while working with them because they are easily inhaled.

Wettable granules (WG): Granules are like wettable powders but less hazardous: they are coarser and therefore do not become airborne and inhaled easily.

Emulsifiable concentrates (EC): Emulsifiable concentrates consist of an active ingredient, a solvent, and an emulsifier. The formulation is economical as it may be shipped in high concentrations and diluted later with water. However, they tend to stain sprayed surfaces.

Capsulated suspensions: Capsulated suspensions consist of either wettable powder and water or suspension concentrate and water held in a capsule. Since their ingredients take longer to settle, they are easier to keep suspended in water than wettable powders.

Solutions: Solutions are made up of an active ingredient and a solvent. They are ready- to-use formulations.

2.4 Insecticide packaging and labelling

Insecticides should be packaged and labelled according to WHO specifications. Packaging them

in water-soluble sachets ensures that the insecticides can be added easily and directly into water-filled spray pumps thereby reducing the hazard associated with handling and mixing them in separate containers.

Labels must be in English and indicate the following:

- Date of manufacture
- Date of expiry/shelf life
- Trade or brand name
- Generic name
- Contents
- Active ingredients
- Net volume or weight
- Registration or license number
- Type of formulation
- Storage conditions/requirements
- Name and address of manufacturer, distributor, and/or formulator

Labels should also provide directions for use, safety instructions, warnings (symbolic or textual), and measures to take in case of accident (e.g., ingestion, contamination). It should also provide physicians with instructions on which antidote to use in case of poisoning.

2.5 Insecticide types and their characteristics

All the five major classes of IRS insecticides—organochlorines, organophosphates, carbamates, pyrethroids, and neonicotinoids—have been registered for use in Zambia.

Organochlorines
Organochlorines are hydrocarbon-based compounds that contain chlorine.

DDT
DDT is an organochlorine insecticide that is white, crystalline, tasteless, and almost odorless. A solid substance, it does not occur naturally in the environment. It is considered to be a relatively safe insecticide for use in public health vector control activities. However, environmental safeguards such as evaporation tanks should be put in place for managing liquid waste.

Organophosphates
Organophosphates are a group of synthetic insecticides that work by damaging an enzyme called acetyl cholinesterase. This enzyme is critical for controlling nerve signals in the body. The damage to this enzyme kills the pest. Organophosphates are widely used to control malaria vectors.

Pirimiphos methyl
Pirimiphos methyl is a liquid synthetic organophosphate insecticide developed specifically for the control of major vectors that are harmful to human health. It is a broad spectrum, high performance product that acts through contact. It is highly toxic to mammals and aquatic organisms and should thus be used in accordance with safety guidelines as indicated on the label.

Carbamates
Carbamate pesticides such as bendiocarb are derived from carbamic acid and kill insects in a similar fashion as organophosphates through inhibition of cholinesterase enzymes thereby affecting nerve impulse transmission.

Pyrethroids
Pyrethroids are a group of synthetic insecticides that are similar to a natural pesticide called

pyrethrum, which comes from chrysanthemum flowers. Pyrethroids are widely used to control malaria vectors.

Alphacypermethrine
Alphacypermethrine is a synthetic pyrethroid insecticide developed specifically for the control of major vectors harmful to public health. It is a broad-spectrum, high performance product that acts through contact or ingestion and provides extended control at exceptionally low dose rates. It is of low mammalian toxicity, and, when used in accordance with directions on its labels, is safe for humans and domestic animals. Alphacypermethrine is available in a variety of formulations and concentrations.

Lambdacyhalothrin
Lambdacyhalothrin is a synthetic pyrethroid discovered the early 1980s as an insecticide for agricultural and public health applications. The compound is made up of two isomeric forms (known as enantiomers) which are present in equal proportions. It is a broad-spectrum insecticide effective at low rates of application against major insect pests in a wide range of crops. It also has the ability to prevent a buildup of insect populations and acts both by direct contact with insects and ingestion.

Deltamethrin
Deltamethrin is one of the most popular and widely used insecticides in the world. It is a broad-spectrum insecticide with uses ranging from agriculture to home pest control. While mammalian exposure to deltamethrin is classified as safe, it is highly toxic to aquatic life, particularly fish, and therefore must be used with extreme caution around water.

Neonicotinoids
Neonicotinoids (neonics) are a class of synthetic insecticides whose mode of action is through affecting the nervous system of insects resulting in paralysis and death. Neonicotinoids persist in the environment and are highly toxic to aquatic organisms.

Clothianidin
Clothianidin is a synthetic neonicotinoid insecticide developed for the control of pests of public health interest such as mosquitoes, bedbugs, and flees.

Clothianidin combination with Deltamethrin
Deltamethrin, a pyrethroid, is combined with Clothianidin in the Fludora Fusion formulation. It is one of the most popular pyrethroids and widely used insecticides in the world. It is a broad-spectrum insecticide with uses ranging from agriculture to home pest control. It is an environmentally safe insecticide with no mammalian toxicity.

2.6 Insecticide selection

The safety, residual properties, ease of handling, cost, and community acceptance must all be considered when selecting a particular formulation. The vector, environment (including housing), surfaces, and other factors may influence the outcome of IRS insecticide selection. Therefore, consideration must be given to the following:

- Resting behaviour and ecology of target vectors.
- Cost of insecticides.
- Residual effect
- Safety to people and the environment.
- Biological effectiveness of the insecticide against the target vectors.
- Susceptibility of the local vector species.
- Resistance of target vectors to insecticides (not considering this can make vector control difficult and expensive).
- Impact of insecticides on the environment (including non-target organisms, such as fish,

birds, people).
- Registration status of insecticides by relevant regulatory authorities such as the Zambia Environmental Management Agency (ZEMA).
- Transportation requirements from point of manufacture to point of use.
- Availability of application equipment.
- Close collaboration with suppliers or manufacturers in choosing insecticides most suitable to targeted localities.
- Type of wall surfaces in targeted localities.
- Waste disposal methods.

2.7 Safe handling of insecticides

In order to safeguard the health and safety of both humans and the environment, insecticides must be carefully and correctly applied on target surfaces. Spray teams are thus required to observe all instructions as stipulated on the labels, and this requires careful understanding of the guidelines.

All insecticides must be stored in their original containers with their labels intact in a designated insecticide storage facility. The designated storage facilities should be:
- A minimum of 100 meters away from schools, animal feed depots, water courses, and residential homes.
- A minimum of 30 meters away from health clinics, and generally away from pedestrian routes to the clinic. Due to access limitations and distances of some spray sites, small-scale storage facilities are often necessary. It is not always feasible to locate facilities away from hospital/clinic/markets. It is therefore important to be extra vigilant that access to unauthorized personnel is denied.
- Out of potential flood zones, wells, and other supplies of water for domestic or stock animal use.
- An appropriate distance away from areas where ground water is close to the surface.
- Easily accessible by transport with easy exit in case of an emergency.

The following precautions should be taken into consideration when handling insecticides:
- Full PPE must be worn.
- Insecticide labels must be read before any insecticide use.
- Eating, drinking, or smoking is prohibited when handling insecticides

2.7.1 Mixing of Insecticides
Mixing of insecticides should be done according to the instructions on the label which include dilution rate, any special safety precautions, first aid measures in case of exposure and the type of the nozzle to be used. The recommended volume of water for mixing the insecticides is 10 L (without the CFV) or 7.5 L if the sprayer is fitted with the CFV. Here are the basic steps to take when mixing the insecticides:

Insecticides in Water soluble sachet
- If packed in Water Soluble Sachets or unit dose sachets, insecticide should be added directly to the spray tank

Mixing Organophosphates e.g. Actellic 300CS
- Fill the spray pump with water up to 5 litres
- Thoroughly shake the bottle of Actellic and pour in the tank
- Triple rinse the Actellic bottle
- Fill the remaining portion with water up to 10 or 7.5 litre mark
- Pressurise and shake the pump before spraying

Mixing of Neonicotinoids and Pyrethroids

- Fill the spray pump with water the right volume of water either 10 litres or 7.5 litres
- Tear the sachet and pour the content into the spray pump
- Close the lid, pressurise to 55 PSI and shake the pump before spraying

Mixing DDT

- Place the pump on the plastic sheet
- Pour 2 litres of water in the spray tank
- Add DDT in the spray pump; cover the orifice and pressurize to mix the content
- And more water to the required mark of either 10 or 7.5 litres
- Close the pump and pressurise to 15 PSI
- Shake the spray pump vigorously
- Pressurise to 55 PSI and shake the spray pump vigorously again
- Spray the house.
- Continue agitating the pump while spraying (Chinese greeting)

2.8 Storage of insecticides

It is important that insecticides are correctly stored to maintain their potency. The following should be considered in the storage of insecticides:

- The storeroom should be lockable with a double locking system.
- The storeroom should be well ventilated with concrete floors and surfaces.
- Insecticides should be packaged on wooden pallets and not on the floor.
- The storeroom must have clear walkways.
- The storeroom must be fenced and only authorized personnel should have access to it.
- Warning signs should be placed at each entrance of the storeroom including the fence of the storeroom.
- The storeroom must be barred and screened.
- Insecticides should be stored in their original containers with labels intact.
- Drinking, smoking, or eating must be prohibited in the storeroom.
- The storeroom should be kept dry.
- Insecticides should be stored away from direct sunlight and must never be put in contact with fire.
- Insecticide containers should not be stacked more than 2 meters high to enable free circulation of air.
- An updated stock record for stored insecticides must be available in the storeroom.
- A first aid kit and fire extinguishers must be in place in the storeroom.
- A spill and emergency response kit should be present in the storeroom.

2.9 Regulation of insecticide use

Insecticide transportation, storage, disposal, and use are regulated by the Environmental Management Act (EMA) of 2011 (refer to Chapter 2). Vendors conducting door-to-door spraying of housing must be regulated to ensure quality, standardized, and safe spraying services. Insecticides should be handled and used by professionally qualified personnel.

Zambia is currently permitted to use Dichlorodiphenyltrichloroethane (DDT) for malaria vector control. The permission is granted, provided that Zambian authorities ensure that DDT is used solely for malaria control and in accordance with all the regulations and requirements of the Stockholm and Basel conventions and WHO. The use of DDT for any other purpose, including agriculture, is strictly banned in Zambia. Locally, DDT use is regulated by ZEMA.

2.10 Procurement

Procurement of insecticides will be centrally done on behalf of implementing districts (refer to Chapter 1). All insecticides used for IRS, must be approved by all responsible institutions.

2.11 Safety precautions and first aid procedures

The following precautions and procedures should be followed to ensure maximum safety and minimum harm:

- If insecticide accidentally comes in contact with skin or clothing, remove the clothing and wash the skin with plenty of water.
- Keep extra sets of PPE.
- Maintain effective communication with supervisors (with mobile phones, etc.).
- If insecticide is accidentally inhaled, immediately get to a location where there is fresh air.
- If insecticide is accidentally ingested, rinse the mouth with plenty of water and see a healthcare provider at once (do not induce vomiting unless specifically instructed to do so on the insecticide label).
- When seeking care from a healthcare provider, ensure the insecticide label is made available.
- Ensure familiarity with first aid procedures on insecticide labels.

2.12 Symptoms of poisoning

In order to protect one another, workers must know the signs and symptoms of insecticide poisoning. If someone has been poisoned, co-workers should get medical help immediately. They should not leave them alone. When taking them to a healthcare provider, they should take with them the insecticide label or, if necessary, the entire insecticide container. If they take the entire container, they should not carry it in the passenger space of the vehicle. Symptoms for different insecticides are detailed below.

Chlorinated hydrocarbons (e.g., DDT, Chlordane, Lindane)
Not many chlorinated hydrocarbons have poisoned insecticide users. Early indications of poisoning include headache, nausea, vomiting, general discomfort, and dizziness. The poisoned may also be unusually excited or irritable. With severe poisoning, convulsions occur with or without earlier symptoms. Coma may follow the convulsions (refer to hospital).

Synthetic pyrethroids (e.g., Deltamethrin, Icon)
Toxicity to warm-blooded animals is generally low, but pyrethrins, the active ingredient in pyrethroids, may elicit inhalant allergic responses: stuffy or runny nose, scratchy throat, asthma and, rarely, anaphylactic shock in extremely sensitive persons. Symptoms can be managed with antihistamines for less severe reactions and adrenalin or hydrocortisone for severe asthma or anaphylaxis.

Organophosphates (e.g., Actellic 300CS, Malathion)
Symptoms almost always begin within 12 hours after exposure. They usually occur in approximately the order in which they are listed below:

- Mild poisoning causes fatigue, headache, dizziness, blurred or dark vision, excess sweat and saliva, nausea and vomiting, stomach cramps, and diarrhea.
- Moderate poisoning causes difficulty in walking, weakness, chest discomfort, muscle twitches, pinpoint pupils, and increased severity of earlier symptoms.
- Severe poisoning causes unconsciousness, severely pinpointed pupils, muscle twitches, secretions from mouth and nose, breathing difficulty, and death if not treated.

Carbamates (e.g., Bendiocarb, Propoxur)
Carbamates cause roughly the same symptoms as organophosphates, but a physician can treat the poisoning more easily.

2.13 Management of chemical poisoning

Management of mild-to-moderate toxicity
Treatment is symptomatic and supportive. Administer IV fluids for hypotension.

Management of severe toxicity
Treatment is symptomatic and supportive.

- Treat hypotension with IV fluids; add vasopressors if hypotension persists.
- Consult a gastroenterologist for patients with pain on swallowing, drooling, or other evidence of caustic injury to evaluate for esophageal damage.
- Atropine should be considered if a patient is bradycardic or experiencing cholinergic symptoms because these insecticides are frequently mixed with organophosphate and carbamate pesticides.

2.14 Waste management

Waste management involves the safe handling of waste from the point generation until final disposal. Waste may be defined as anything that is discarded during IRS operations. The waste material generated from IRS operations may be categorized in two groups (i.e., liquid and solid waste).

Liquid waste management
In the implementation of IRS activities, waste water (effluent) is generated on a daily basis, at the end of a spray day and during the cleaning process. Because this wastewater is contaminated with the pesticide, unsound or improper disposal of the IRS effluent can have an adverse effect on the environment. Liquid effluent from the rinsing of pumps will be reused as water for mixing chemicals on the following day and the wash water from washing the outside of the spray tank and rinsing of the strainer and nozzles will be allowed to drain into soak pits that are carefully sited.

Additionally, this section addresses progressive rinsing, site considerations, standard design and construction, proper use, and decommissioning protocols for the following IRS effluent cleaning and disposal facilities: soak pits (fixed and mobile), evaporation tanks, as well as wash areas for PPE.

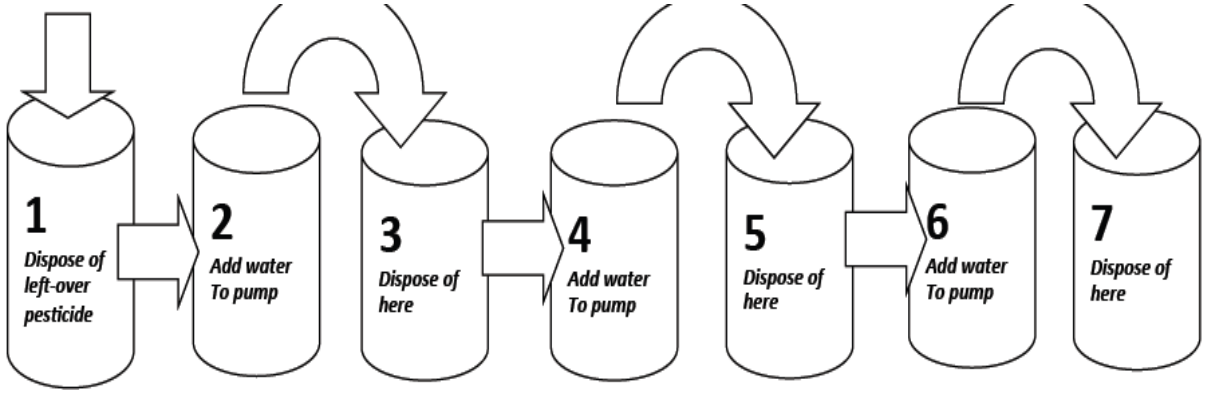
Progressive or triple rinsing of spray pumps
Progressive rinsing, also referred to as triple rinsing, is a method used for cleaning spray equipment used during IRS. The equipment is washed daily through a series of rinses that re-uses water, thereby reducing the amount of water used and effluent produced. This in turn minimizes the quantity of water reaching soak pits and storage tanks and reduces the potential for pollution from contaminated rinse water. Below is the explanation of steps involved in progressive rinsing:

- Spray teams return to their staging areas at the end of spraying operations each day, where the spray pumps are depressurized and any leftover pesticide is poured in the first barrel (No. 1; empty).
- Approximately two liters of water is added to the spray pump from the second barrel (No. 2; containing clean water). The spray pump is then closed and shaken so all inside surfaces are rinsed. The pump is then pressurized and discharged into the third barrel (No. 3; empty). After the tank is depressurized, any remaining contents are poured into barrel No. 3.
- The spray operator then rinses the tanks two more times using the remaining barrels—No. 4 (full) and 5 (empty), No. 6 (full) and No. 7 (empty). After the third rinse is added,

the tank should again be pressurized, and discharged into barrel No. 7. Upon rinsing the spray pump three times, the water emptied into the No. 7 barrel should appear clean.

- The outside of the spray tank is washed using water from barrel No. 6. The strainer and nozzles should be disassembled and rinsed also using water from barrel No. 6. The wash-water from this cleaning should drain to the soak pit. At this point, the spray pumps are considered cleaned.
- Supervisory personnel must develop a plan to ensure that all leftover pesticide and rinse-water in barrels 1, 3, 5, and 7 is used to fill spray tanks for the next day of operations. Because of the degradation that takes place overnight, the leftover pesticide from the first barrel cannot be used as full-strength pesticide, and is therefore used as makeup water, along with the rinse-water from barrels three (3), five (5) and seven (7). This re-use of water continues on a daily basis until the spray season ends. The final rinse water can be disposed in the soak pit or storage tank, depending on which pesticide is in use.

Figure 1: Steps involved in progressive rinsing.



Site consideration

Appropriate site considerations for locating all IRS cleaning and waste facilities (progressive rinse, soak pits, tanks, and wash areas) depend on soil, topography, ground water, and proximity to lakes or streams and sensitive areas. In general, most facilities should be located adjacent to the storage facilities, where they can be more easily protected and monitored. Due to access limitations and distance of some spray sites, it may be more feasible to locate a small facility in an appropriate area near the site.

Soil characteristics affect how pesticides move through the soil. Clay soils have a high capacity to absorb many pesticides, while sandy soils have a much lower capacity to absorb. Where possible, locate facilities on fine textured soils with good absorptive properties. Hard packed clay or rocky soils are not appropriate.

Pesticides may move in water runoff as compounds dissolve in water or attach to soil particles. Facilities should be located on high, level ground to minimize exposure to runoff. Avoid steep slopes or natural runoff flow lines. Where feasible, construct berms to divert runoff away from the facility. Furthermore:

- Groundwater may be contaminated if pesticides leach from the facilities.
- Avoid areas with high groundwater table or that are prone to flooding.
- Do not locate soak pits within 30 meters of crops, animal enclosures, beehives, or public buildings such as schools and surface waters. The soak should be adjacent or collocated to the wash areas so that the effluent flows into the soak pit.
- Leaves and mud can clog the soak pit and need to be excluded or removed periodically.
- Constructing soak pit covers will limit access by birds, bees, and other wildlife, as well as

prevent the growth or deposition of vegetation that would need to be removed, thus reducing operating costs. These benefits are substantial, so covers should be used wherever possible. These can be constructed out of cement or metal, depending on availability of materials, and should contain a way to secure them closed.

Standard design and construction of soak pits

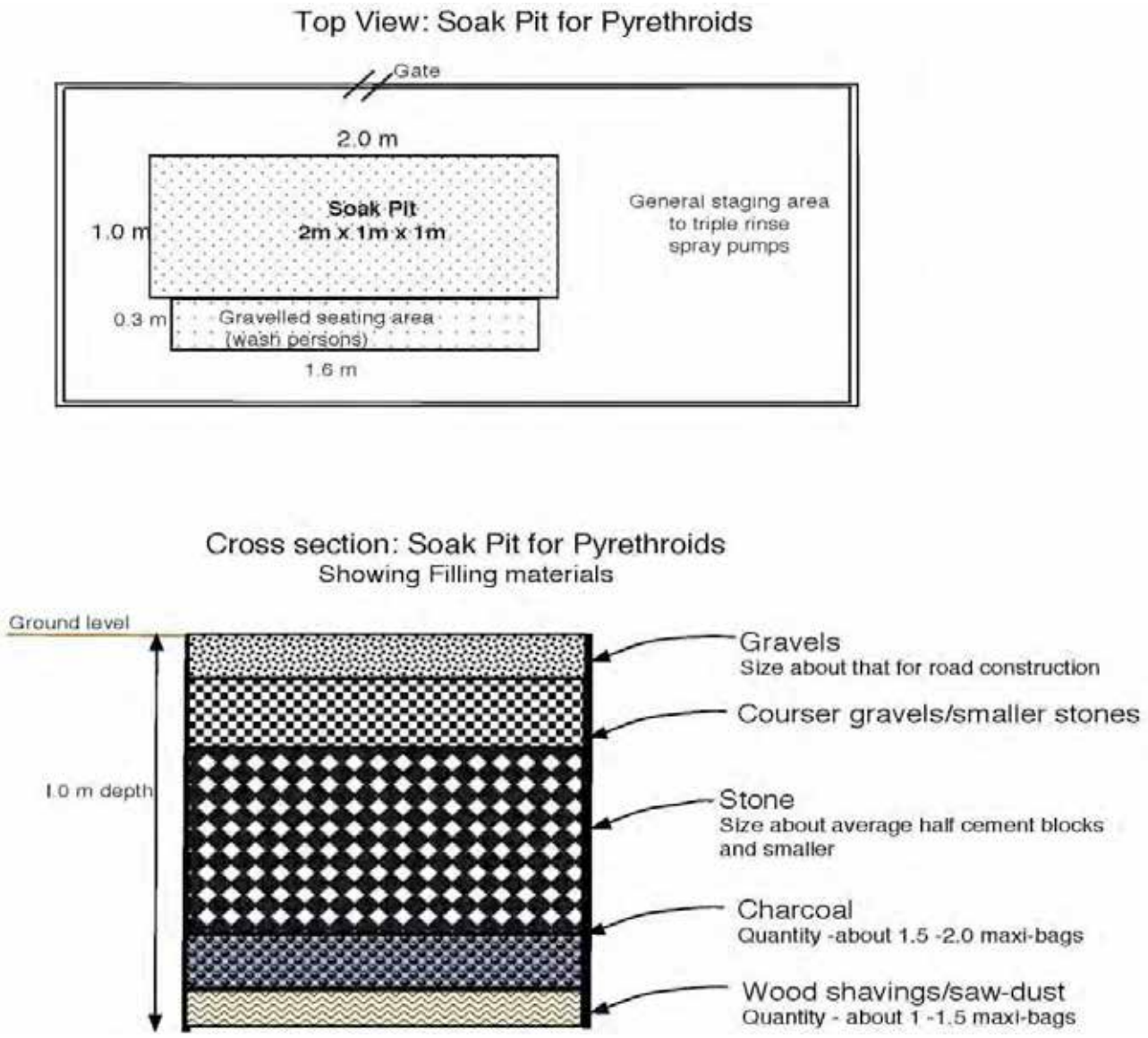
The standard designs and construction of soak pits have been discussed below and further details can be found in the appendices.

Fixed soak pit

A soak pit is a specially-designed hole in the ground for disposing of biodegradable waste (e.g., waste from pyrethroids, carbamates, organophosphates, and neonicotinoids). Soak pits work by the absorption of pesticide in water by charcoal and subsequent biodegradation which are well-known and common treatment techniques. A properly constructed and sited soak pit protects the environment from contamination while allowing pesticides to degrade and become harmless. See images below and Figure 2 for standard design and construction of a soak pit.

Wash bay (left) and soak pit (right) sections

Figure 2: Schematic diagram of the soak pit.



Decommissioning of soak pits

Soak pits should be decommissioned at the end of each spray season by applying a cover to prevent access to contaminated materials by animals, humans, birds, and bees. Several options are available, depending on resources, and can include year-round, lockable covers, a thin layer of cement that can be broken the next season, heavy but removable cement slabs, or simply a tarpaulin covered with soil.

Permanent decommissioning should not take place until at least three months after the spray season, when the pesticide has broken down through environmental action. Soak pits may not require full extraction of the gravel, stones, charcoal, or saw dust; instead, the pit area will require restoration to previous conditions with at least six inches of soil, by filling in, leveling, and planting with appropriate local vegetation.

Mobile soak pit (MSP)
The mobile soak pit filter is a 20–25 L bucket with highly adsorbent activated carbon that removes pesticide contamination from the wash water, so that the water that exits to the ground is purified.

The MSP uses a four-barrel rinse system to minimize the number of barrels that the spray team must carry, and reduce the necessary size of the wash area constructed. The four-barrel rinse system uses three barrels for rinse water, but only one barrel to receive both the leftover pesticide, and the water from all three rinses. This system simplifies the reuse of all leftover pesticide and rinse-water the following day, as the operators draw from only one barrel, instead of four.

Installation of a mobile soak pit

Below are the steps to follow when installing an MSP:

1. Choose a flat 4m x 4m spot to install the MSP. Do not install the MSP in depressed areas where rainwater and mud will run onto the wash area and into the soak pit. Excess mud will clog the MSP prematurely.
2. Dig a hole large and deep enough to hold the MSP.
3. Slope the entire wash area ~1 cm: 15 cm gradient so that all wash water drains into the soak pit.
4. Build a 5–10 cm earthen curb (berm) around the entire wash area to exclude rainwater and mud.
5. Pour a 10 cm layer of charcoal in the bottom of the hole and level it.
6. Place MSP with cover attached in the hole on top of the charcoal.
7. Fill in the gaps around the MSP with dirt, being careful not to get dirt inside the MSP, and sloping the earth towards the MSP.
8. Center the 4 m x 4 m tarpaulin on top of the sloped wash area.
9. In the center of the tarpaulin cut an X that is smaller than the top of the MSP.

Mobile soak pit use
In order to adhere to the correct use of MSPs, the following steps must be followed:

1. Before entering wash area, operators should step into the boot wash basin and wash mud off of boots.
2. Empty any pesticide left over in spray pump into the large reclaim barrel.
3. Scoop two liters of water from the first rinse water barrel and place in pump. Install pump cap, shake pump to rinse inside, and pressurize pump.
4. Discharge rinse water from pressurized pump into the reclaim barrel.
5. After pump is depressurized, remove pump cap.
6. Scoop two liters of water from the second rinse water barrel and add to pump.
7. Replace cap and shake pump to rinse insides of the pump.
8. Remove cap and dump rinse water into the reclaim barrel.
9. Scoop two liters of water from the third rinse water barrel and add to pump.
10. Replace cap and shake pump to rinse insides of the pump.
11. Remove cap and dump rinse water into the reclaim barrel.
12. Scoop two liters of water from the third rinse water barrel and add to pump.
13. Replace pump cap, pressurize, and shake pump to rinse insides of the pump.
14. Discharge rinse water under pressure into the large reclaim barrel.
15. Remove cap and dump any excess rinse water into reclaim barrel.
16. Using measured amounts of water, wash outside of pump on wash area.
17. Take spray hose, wand, and nozzles apart and rinse as per standard procedure. Reassemble pump.
18. Using measured amounts of water from any of the rinse barrels, thoroughly wash PPE as per standard procedure.
19. Using brushes and clean water, wash plastic sheets used to cover household goods.
20. When all operators have completed washing, wash down tarpaulin covering wash area with water and brushes.
21. Carefully decant water from boot washbasin into MSP, leaving the mud in the basin.
22. Remove and fold up tarpaulin.
23. Remove MSP from ground and place the MSP holding container, and then secure location overnight.
24. If work is completed at the site, dump collected mud from boot washbasin on top of the coal at the bottom of the hole, and then refill hole. Transport MSP to new site and repeat installation instructions.
25. Otherwise, empty mud into a white bucket for temporary storage.
26. The next day, reinstall MSP and tarpaulin at the same site. Refill boot washbasin with clean water.

Solid waste management

At the end of the spray season, non-pesticide-contaminated wastes will be cleaned thoroughly with soap and water. IRS solid waste will further be categorized into four groups: paper, plastic, rubber, and cloth. Subsequently, these waste categories will nicely be labeled and kept in the storage facility awaiting a safe and an environmentally sound disposal. The table below shows the summary of type and disposal method of each type of IRS solid waste.

Table 1. Categories of IRS solid waste.

Plastic	Cloth	Rubber	Paper
Empty bottles/ sachets	Used nose masks	Gum boots	Empty actellic boxes
Polythene sheets	Cloth	PVC gloves and boots	Nose mask Ppackages
Helmet and face shields	Worn out overalls		

Table 2: Summary of type and disposal stream of IRS solid waste.

Waste category	Disposal method
Empty bottles	Recycling in Zambia
Empty sachets	Empty sachets will be incinerated at the ZEMA licensed incinerators
Plastic sheet	Disposal at the designated dumpsite after thorough cleaning with soap and water
Helmet & face shields	Disposal at the designated dumpsite after thorough cleaning with soap and water
Boots	Worn out boots will be given to deserving SOPs after been thoroughly cleaned with soap and water
PVC gloves	Prior to their disposal in a landfill, worn out gloves will be cleaned with soap and water and shredded
Used nose Mmasks	Masks will be weighed at the point of generation and will be incinerated ZEMA licensed incinerator
Mutton cloth	To be given to each and every spray operator for their personal use after washing with soap and water
Worn out overalls and back Packs	Overalls and bags will be given to deserving SOPs after been thoroughly cleaned with soap and water
Empty carton boxes	Contaminated boxes will be incinerated whereas uncontaminated boxes will be supplied to paper mills as raw material

Below are the methods of handling IRS solid waste at specific points of generation.

The field
All empty insecticide containers and left over insecticide must be returned to the supervisor for safe keeping prior to an environmentally sound disposal in the presence of ZEMA inspectors.

District stores
The insecticide packaging materials and leftover insecticide should be handed over to the stores manager for safe keeping.

Central level
The principle supplier, in liaison with the NMEC, must arrange to reclaim all stored insecticide waste and dispose of it. Foreign suppliers must also liaise with ZEMA to reclaim waste across country boundaries. The NMEC will, from time to time, review the guidelines and facilitate preparation and implementation of the Insecticide Waste Management Plan.

Special consideration for DDT
Management of effluents during end-of-day clean up when the insecticide in use is DDT requires the use of ventilation tanks (also refer to DDT guidelines).

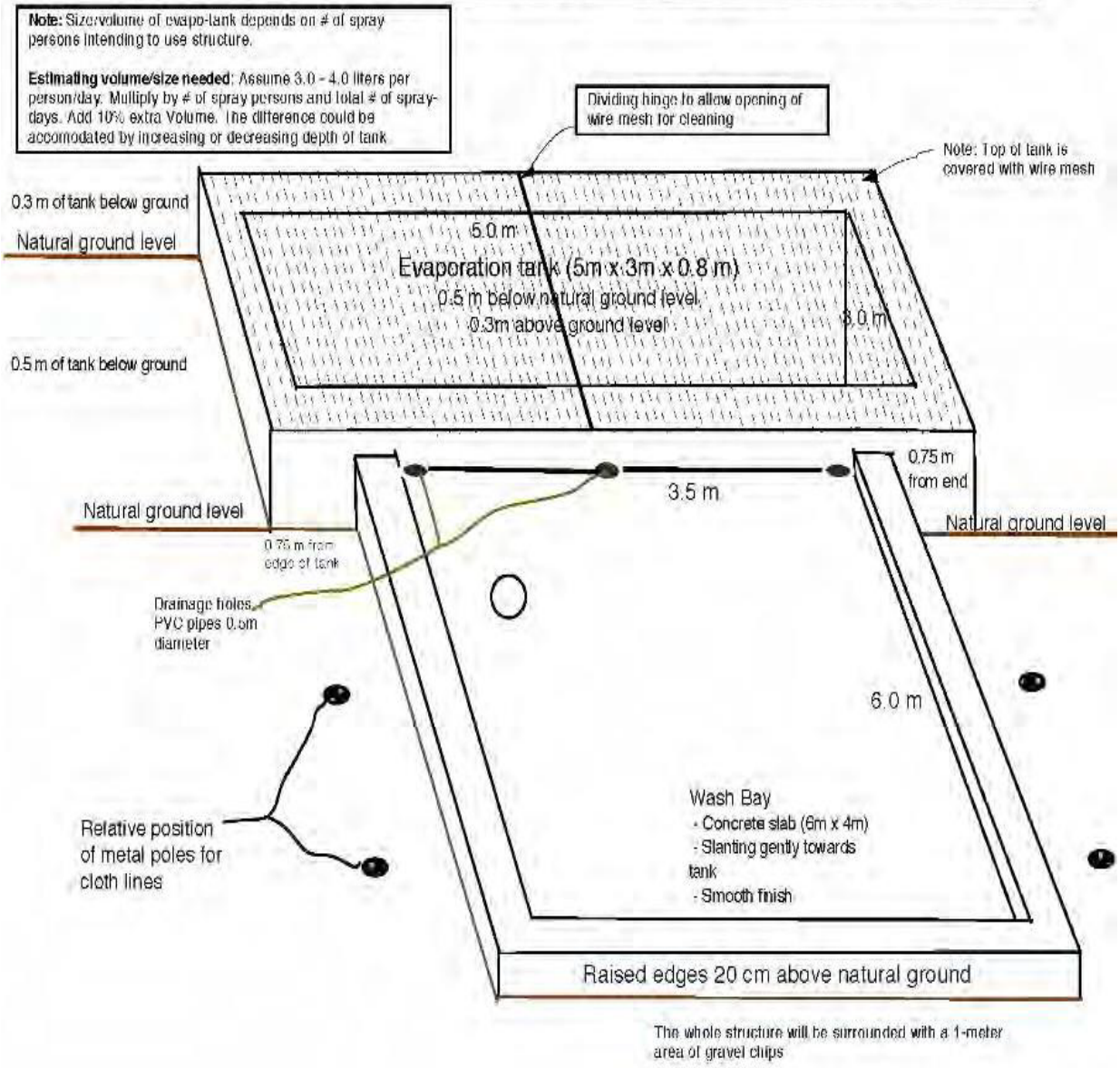
Evaporation tanks
An evaporation tank is an impermeable tank for the storage of water contaminated with non-biodegradable liquid pesticide waste such as DDT. It can be designed to evaporate the water collected, leaving the solid pesticide behind, or to facilitate other means of treatment. If evaporation is used, there is substantial potential for exposure to the dried residue when cleaning it up. PPE must be used during the final cleaning, including gloves, masks with organic cartridges, rubber boots, and overalls.

Standard design and construction

An IRS holding tank should hold approximately 15,750 liters or 4,100 gallons, which should be sufficient to allow disposal of effluent from 20–30 DDT spray operators during the spray season. If a larger number of operators will be using the facility, it should be designed accordingly. The tank can be designed and engineered to maximize evaporation if that is the separation mechanism, or to accommodate various forms of treatment.

The tank must be constructed with an impermeable surface (e.g., concrete) and covered with a lockable wire mesh on top of a window screen to exclude birds, bees, and other insects. It should be simple to connect a pump for treatment or evacuation. If evaporation is used, the dried residue should be carefully collected wearing full PPE, and then disposed of together with other DDT waste. If overflow is a risk during operations, an overflow tank should be provided, and a berm should be constructed around the perimeter of the tank for further protection. Figure 3 shows the basic design of an evaporation tank.

Figure 3: Basic design of evaporation tank and wash bay for DDT-based IRS operations.



Siting

Evaporation tanks should be constructed away from flood prone areas, steep gradients and slopes, traffic areas, and water sources (wells and springs). A berm may be required to prevent run-on of storm water into the tank. The tanks should also be located slightly downhill from the progressive rinse area so that so that run-off from this facility can be directed into the tank. The wash area must be covered when not in use to prevent overflow of the tank due to collected rain flow.

Proper use

All operations that involve handling dried DDT must be performed by technicians dressed in full PPE, including an organic filter respirator. After a spray round, all of the sand, sludge, and pesticide residue remaining in a storage tank should be scooped out, placed into a sealed, labeled container, together with empty sachets, and disposed according as DDT-contaminated waste.

Cover the tank with a raised tarpaulin to allow cross airflow for evaporation while excluding rainwater from refilling the tank.

If water level in the tank comes within 6 inches of the drainage hole, liquid should be siphoned into plastic poly tanks for temporary storage, until they can be added back to the tank for evaporation.

Completed DDT Evaporation tank

Decommissioning of evaporation tanks

If transferring operation of evaporation tanks to another entity, remove DDT residue from tank prior to transfer. If evaporation tanks are to be decommissioned, they should be dismantled after thorough cleaning, and the area should be restored back to its natural state as much as possible once IRS activities discontinue permanently. Pesticide sampling of the site should be done to determine that DDT levels in the soils are not above ambient concentrations.

2.15 Community perception of insecticides

The following are common causes of community perceptions, misconceptions, and actions that can negatively affect the efficacy of malaria vector control programmes in Zambia:

- Lack of adequate information about mosquito behaviour can skew community perception on the effectiveness of insecticides.
- Community opposition to insecticide-based control can be due to a lack of insecticidal effect on non-target insects and pests.
- Certain social customs, like regular re-plastering and painting of housing, could render sprayed surfaces ineffective.
- Expectation of immediate mosquito death may influence community acceptance.
- Communities may expect to both smell insecticide and see dead insects as evidence of working insecticide for long periods of time.
- Lacking information about why different insecticides are used for different types of housing, communities may believe that some insecticides are simply more effective and, therefore, reserved for people of higher social economic classes.
- Communities may expect to see neither mosquitoes nor cockroaches in their houses after spraying.
- Communities may believe that insecticides are over-diluted and stolen. Whether this theft is real or perceived, an explanation of how insecticides are diluted can assuage suspicions.
- There may be either real or perceived insecticide resistance.
- Lobbying by environmental groups against certain insecticides (e.g., DDT) may influence

community acceptance.

- Media may serve as a source of information that influences community perception.
- These problems can be overcome by sensitizing communities about common perceptions, misconceptions, and encouraging their participation in malaria elimination and prevention campaigns.

Section II: Sound management of IRS insecticides

2.16 Section II introduction and scope
Insecticides are an integral part of IRS and those used for IRS, such as DDT, are potent. If managed carelessly, they could contaminate the environment and cause perennial harm to plants, animals, and human beings. If, however, they are managed carefully, any potential harm can be averted. Section II of Chapter 2 outlines the standard management of IRS insecticides that minimize environmental contamination and avert potential harm. They were developed to guide environmental health practitioners and others involved in procuring, transporting, storing, or using IRS insecticides.

Purpose
These guidelines are intended to ensure that IRS insecticides are managed in strict compliance with local regulations and international conventions so that their potential adverse effects on the environment are averted.

2.17 Regulation
IRS insecticides are regulated locally by the Environmental Management Act No. 12 of 2011. The act defines and mandates sound management of pesticides under environmental management (licensing) regulation of 2013. Internationally, the insecticides are regulated by the Stockholm Convention on persistent organic pollutants, which Zambia ratified in 2006. The convention seeks to phase out the use of persistent organic pollutants (of which IRS insecticide DDT is one) and, currently, has limited their use solely to IRS in malaria burden countries.

2.18 Procurement
The policy mandates that the MOH and partners to procure all IRS insecticides and distribute to them districts as needed for all IRS programmes.

2.19 Distributors
Currently, all IRS insecticides are distributed by MOH trucks and drivers are trained in insecticide handling; licensed by ZEMA working in conjunction with the MOH through the NMEC. A detailed plan is required for IRS insecticide and waste management to ensure that all IRS insecticides distributed are used solely for IRS. The pre-departures requirements should be met as outlined in 2.18.

2.20 Transport

Pre-departure
Most damage to IRS commodities occurs during transportation, loading, and off-loading. Therefore, the drivers transporting IRS insecticides must have their vehicles checked for the fitness of transporting harmful commodities. Meeting the requirements outlined below should ensure that the driver and the vehicle have met these prerequisites and can transport the insecticides with minimal risk and damage even in case of emergency.

Drivers
Any driver who transports IRS insecticides is required, by law, to have:
- A driver's license which qualifies them to transport dangerous goods.
- A ZEMA permit to transport pesticides and toxic substances.

In addition, a driver should also carry and know how to use:
- A transport emergency card (Tremcard).
- Material safety data sheets.

These documents are useful in case of accident. They contain a list of emergency phone numbers,

information on toxicology, and guides on administering first aid and containing chemical spills.

Vehicle

Any vehicle that transports IRS insecticides should:

- Have a fitness certificate.
- Be ideal for transporting IRS insecticides.
- Be clearly labelled with hazard warning signs.
- Not carry food or any other consumables.
- Be loaded carefully and not overloaded.

2.21 Post-arrival

Recipients of shipments of IRS insecticides should follow a standard procedure for receiving. The procedure should ensure that all insecticides shipped are accounted for and moved safely to the storeroom. At minimum, the procedure should include:

- Checking the transport vehicles for spills (if found, the spills should be documented and the vehicles decontaminated).
- Recording the insecticides received along with their manufacture and expiration dates on a stock record sheet.
- Obtaining a “delivery note” from the transporter.
- The transporter should obtain a “goods received note” from the stores officer.
- Comparing the insecticides received with the delivery note.
- Carefully and promptly off-loading and moving them to the storeroom.
- Storing the insecticide boxes as outlined in 2.21.

2.22 Water crossings

Transporting pesticides across water, whether lakes, rivers, streams, or any other water body, carries substantial risk to the environment, and potential risk to the health and safety of nearby populations of humans and animals.

All WHO-recommended pesticides are especially toxic to aquatic organisms, and if they were to be released into a water body due to a transportation accident, there would likely be a substantial die-off at the site of the accident, and potentially far downstream, as well. In addition, if humans or animals were to drink water contaminated by these pesticides, they could suffer symptoms and possibly death. For these reasons, it is essential proposed shipments adhere to the following:

- Avoiding water crossings and use alternative route, if available.
- Determine that a water crossing is truly necessary.

For smaller shipments:

- Pack bottles in 220-liter open top barrels with a tight-fitting top and a locking ring. Each barrel must hold 100 one liter bottles weighing not more than 100 kg when loaded.
- At least two people, and preferably three, are required to lift a full barrel onto the vehicle and/or vessel(s) to be used.
- Waterproof labeling must be affixed to the barrel, with all of the information found on the cardboard cartons, including the identity of the pesticide, number of bottles inside, the weight, the type of hazard posed by the contents, and the personal protective equipment to be worn when handling the barrel.
- The empty cardboard cartons must be carefully flattened and transported with the pesticide, so that they can be reconstituted and repacked with the pesticide upon arrival at the storeroom.

For larger shipments:

- Ship pesticides in their original cartons, but wrapped in plastic so as to be waterproof and

so they will float in water.
- No more than six cartons must be packaged together in order to be able to load and unload the packages at each transition point,

2.23 Storage

Licensing
Due to the hazardous nature of IRS insecticides, all storage facilities need to be licensed by ZEMA. A recommended IRS storeroom must be designed and managed in accordance with the guidelines below. This is to ensure that insecticide exposure to the environment is minimized and safety and security is maximized.

Location
The structure should be located in an area:
- Neither highly populated nor heavily farmed.
- With a low water table and not subject to flooding.
- Easily accessible to delivery vehicles and fire-fighting vehicles (ideally, fire-fighting vehicles should have access to at least three sides of the structure).

2.24 Structure
The structure must be environmentally compliant, and able to withstand and contain damage caused by accidents such as fires, storms, floods, and spills. It should also be well ventilated to prevent insecticide vapours from building up and temperatures from getting too high. To ensure all this, the integrity of the structure must be maintained, and maintenance should be considered annually.

Roof
The roof structure must be:
- Made of sound materials.
- Intact and well-maintained to prevent leaks.
- Made of incombustible materials, preferably concrete.
- Able to withstand severe storms.
- Furnished with gutters to collect and direct water and waste into the drop pipe.

Walls
The wall structure must be:
- Made of sound materials.
- Furnished with drop pipes from gutters that direct water and waste into a sump.
- Smooth and free from cracks and crevices.
- Lined from the floor to a height of 14 cm with an impermeable material.

Floor
The floor structure must be:
- Made of impermeable materials, preferably concrete.
- Smooth and free of cracks.
- Raised at the edges to contain spills within structure and prevent entry of rain water.

Layout
The storeroom should be dedicated solely to the storage of IRS materials. It should not, for example, be used as the stores manager's office. It should have:
- Enough space to store all IRS materials including empty containers, sachets, and expired stock.
- About 15 percent extra empty space to allow for movement of materials and expansion.
- Access directly to the outside (that is, not via intermediate rooms).
- An insecticide dispensing area that is not too close to the entrance.

- An area dedicated to storing empty insecticide containers and sachets.
- An uncluttered floor, and 1 m wide aisles between storage and work areas that allow ease of movement and airflow.

Lighting
The storeroom should be well lit by both natural and artificial lighting to facility visibility of insecticide labels, general cleanliness, and orderliness. Artificial lighting should consist of a well-insulated wiring system to prevent fire outbreaks.

Temperature
The storeroom must have a thermometer and temperature should be monitored at least twice daily: once in the morning, and once in the afternoon. The temperature should be maintained between 20 ° and 25 °C at all times. The readings should be recorded on a chart kept within the storeroom.

"Temperature should be monitored at least twice daily"

2.25 Security

To ensure security, the premises in which the storeroom is located should be:

- Surrounded by an embankment and wall that is fitted, if possible, with wall-top electric fencing or razor wire. The entrance should have concrete ramps.
- Protected by a security guard stationed in a guardhouse at the entrance.
- Furnished with danger and warning signs that are visibly posted to prevent illegal trespassing.
- Protected by an alarm system.
- Equipped with a means of communication in case of emergency.

2.26 Fire safety

The storeroom should be equipped with firefighting equipment, such as: smoke detectors, fire horse reel, water fire extinguishers, carbon dioxide fire extinguishers, and sand bucket. All personnel working on the premises should be trained in firefighting techniques and should have regular fire drills.

2.27 Hazard warnings

Hazard warning signs, at minimum, displaying skull and crossbones, should be prominently displayed both inside and outside the storeroom and should follow the conventions laid out by the key in the annex. Such a key should also be displayed in the storerooms. In addition, all warning text should be displayed in the local languages and in English.

2.28 Stock

Insecticide should be stored in an area separate from personal protective equipment (PPE) and managed in the following manner:

- The First Expiry, First Out rule should always apply.
- Insecticide should always be stacked on pallets, not directly on the floor.
- Each insecticide should have its own stock control card that is updated.
- Each type of insecticide should be stored in separate rooms.
- All shortages of and damages to insecticides must be reported to ZEMA.
- All personnel entering the storeroom must put on protective clothing.
- The stock should be checked daily for leaks, spills, caking powder, sedimentation, gelling, and discoloration (note that shelf-life declines rapidly if stock containers are left partially open).
- Damaged or expired stock should be transferred to the area designated for empty stock containers and sachets.
- All transfers of stock to another storage facility should be documented.
- All accidents and theft must be reported.
- Insecticides should not be committed to the field for more than a week at a time, and on their return, usage figures must be documented.

2.29 Water

The storeroom must have access to safe, clean, adequate running water. Where there is inadequate water, a backup supply should be kept in drums. In cases where a water bowser is available, it can be used to store and transport water during field operations, this water should be used solely for mixing chemicals.

"In case of water shortage, a backup supply should be kept in drums"

2.30 Facilities

By law, the structure must have washing facilities, showers, and separate change rooms for men and women. Related materials such as bath soap, washing powder, and towels must also be supplied.

2.31 Spraying

Personal protective equipment (PPE)
Each spray operator should be provided with PPE that they are required to wear whilst working. PPE consists of the following:

- A hard hat
- Clear goggles
- A respirator
- A mutton cloth
- Cotton overalls
- Elbow-high poly vinyl chloride (PVC) gloves
- Stockings
- Gumboots
- Towels

The spray operator, supervisors, and support staff, will be provided with the following cleaning materials for bathing and washing of PPE:

- Washing powder
- Bath soap
- Petroleum jelly

All washing should be done at the wash bay and water drained into the soak pit.

2.32 Food

Spray operators should eat and drink lots of water before putting on their PPE. They should not eat or drink whilst working.

2.33 Waste management

Legislation
IRS activities generate hazardous waste to the environment and public health. Therefore, legislation has been passed to regulate its disposal in an environmentally friendly manner.

Wastewater disposal
There are two types of wastewater disposal facilities and these are:

Static waste water facilities
These are immovable wastewater disposal facilities constructed at the IRS base. The IRS operation base should be equipped with an evaporation tank (dry pan) and soak pit where all water used for IRS activities should be disposed of. Water should never be disposed of via the main drainage system or the environment. The drainage system should be designed according to:

- PCV pipes should channel all water to the evaporation tank or soak pit.
- The base of the evaporation tank should be lined with concrete and inclined to facilitate sedimentation.
- The top of the evaporation tank should be covered with wire gauze.
- The evaporation tank should be raised at least 1 m above the ground.
- The evaporation tank itself should be 2 m long, 1 m wide and no more than 30 cm deep. Such a shallow depth is critical for effective evaporation.
- There should be grating where water enters the evaporation tank.
- The evaporation tank should be secured under lock and key.

"Water should never be disposed of via the main drainage system or the environment"

Mobile soak pit
This is the wastewater management facility for teams that are used during camping for IRS and is constructed as described below:

- 7 cm (20 percent of height) of wood shavings or form.
- 17 cm of granulated activated carbon (50 percent).
- 11 cm (30 percent) of gravel or form. This will provide a deep bed of granulated activated carbon and greater capacity for pesticide adsorption.
- Drill one 1.5 cm hole in the center of the bottom of the bucket before adding any materials.
- Fine nylon window screening at the bottom of the bucket, in between the wood chip and the granulated activated carbon layers.

2.34 Spray pumps

Spray pumps should be washed in the wash bay and the water used should be piped to the evaporation tank/soak pit. They should be kept separate from insecticides and hanged upside down at the end of each exercise.

2.35 Empty insecticide sachets and containers

Empty containers and sachets should be kept in their designated area in the storeroom, preferably in the boxes. They should not be reused for any purpose.

CHAPTER 3: TRAINING OF SPRAY OPERATORS

The MOH through the NMEC is deploying IRS as one of the key vector control interventions in the malaria elimination agenda using WHO-approved insecticides. According to WHO, IRS is a proven and effective way to control the malaria vector and substantially curtail malaria transmission, morbidity, and mortality as long as it is implemented well. A requisite for such successful implementation is a well-trained and motivated IRS spray operator.

"According to WHO, IRS is a proven and effective way to control the malaria vector and substantially curtail malaria transmission, morbidity, and mortality as long as it is implemented well."

3.1 Purpose

This chapter is intended as a guide for trainers at both national and district level, such as district managers, supervisors, and others intending to implement IRS, to ensure the quality and standardisation of all IRS spray operator trainings in Zambia.

3.2 Recruitment of spray team members

Spray operations involve recruitment of various cadres to carry out specific activities as spray team members. These include supervisors, team leaders, and spray operators. Prior to being engaged, recruits need to meet the following recruitment criteria.

Spray operators and team leaders:

- Active community-based volunteers.
- Must be able to read and write.
- Must not be pregnant and lactating mothers.
- Must be in possession of a green national registration card.
- Must be at least 18 years of age.
- Height must be at least 1.5 meters.
- Must weigh at least 50 kg.
- Must have no respiratory tract infection.
- Must not be allergic to insecticides.
- Must not have any criminal or disciplinary records.
- Must be physically fit.
- Needs minimum supervision.
- Must not have worked in the spraying programme for **three years** consecutively**.**
- Must be ready to being work at 06:00.
- Must not be a health centre member or staff.
- Must be ready to perform x-rays graphs and pregnancy tests.

Supervisors:

- Must be a qualified environmental health staff.
- Must be ready to undergo full IRS supervisors training.
- Must be fully committed and dedicated to the programme.
- Must be able to work with minimum supervision.
- Must have quality personal and public/community relations.
- Must be ready to undergo additional trainings to improve efficiency.
- Must not be a pregnant or breast feeding mother.
- Must not be allergic to insecticides.

- Must have no respiratory problems.
- Must be physically and mentally fit

3.3 Training of spray operators

Spray operators must be trained in accordance with specifications outlined in this chapter to ensure quality and standardisation. Districts must conduct the training of spray operators with technical assistance from the NMEC and provincial health offices. The duration of the training should be six (6) full days (two days for theory and demonstrations and four days for practical training, mobilisation, and field practice).

IRS training in full personal protective equipment

3.4 Training of trainers

The officers that train spray operators must be trained by the NMEC prior to conducting the spray operator training in their districts. The aim of this training of trainers is to produce a cadre that will be able to train spray operators in line with the IRS guidelines. All spray operator trainers should be certified by the NMEC. The duration of the training of trainers should be five (5) days (three days for theory and two days for practicals).

3.5 Spray operators training overview

Contents

The training outlined in this chapter covers general, theoretical, and practical IRS knowledge. This is a six (6)-day training as outlined in the schedule attached at the end of this chapter. At the end of the training, trainees should know the vision and goals of the NMEP, the reasons why vector control is a means of combating malaria, IRS practical skills, the theory behind IRS practical skills, and strategies for various real work situations. Some of the specific training areas and activities are:

- General knowledge on malaria.
- Preparation and maintenance of the sprayer.
- Handling and transporting the sprayer.
- Care and cleaning of the sprayer.
- Insecticide handling and safety.
- Preparation of insecticides solution.
- Sprayer pressurisation.
- Spray pattern and spray swathes.
- Spray rhythms.
- Spraying with a stick; on the rope and later with water without a stick.
- Spraying in difficult situations.
- House preparation.
- Communication skills.
- First test: knowledge of theory, methods, and procedures.
- Final test: hands-on troubleshooting and spraying.

These, and others, are detailed below. It must be emphasized that trainers should be directly and actively involved during the entire training and follow the schedule provided at the end of this document strictly.

Goal

The goal of the training is to equip trainee spray operators with the necessary knowledge to implement quality IRS services.

'The training should give trainee spray operators the capacity to conduct safe and correct IRS'

Objectives

At the end of the training, spray operators should be able to:

- Recount general knowledge about malaria and IRS.
- Recount general knowledge about the NMEP in Zambia.
- Handle, use, and dispose of IRS insecticides safely.
- Handle, use, and maintain IRS equipment.
- Spray insecticides using proper technique.
- Sensitize households and prepare houses for spraying.
- Complete daily report forms accurately.

Methodology

The training should incorporate a variety of interactive teaching methods such as:

- Small group work
- Demonstration
- Role play
- Practical drills
- Brainstorming
- Discussion
- Pre- and post-tests (use score chart)
- Post evaluation

3.6 Training: theory and procedure

Introduction to IRS

The trainee should be informed of the vision and goals of the NMEP. Furthermore, the trainee should be given basic knowledge concerning IRS and vector control and up-to-date evidence supporting its efficacy. The following should be covered:

- Definition of IRS
- Objectives of IRS
- Indicators of IRS
- Expected outcomes when implemented appropriately

Insecticides and safety

Trainers should go through and explain each of the various types of insecticides used for IRS and the risk they pose to spray operators, households, and the environment if not properly used. They should also emphasize the importance of proper insecticide storage and accountability. In addition, trainees need to have basic knowledge of the following:

Insecticide management safety

- Introduction to types of insecticides
- Mixing and handling of insecticides
- Insecticide storage and field accountability
- Insecticide transportation

Spray operator safety

- Potential harm in case of accident
- Importance of full PPE
- Modes of insecticide exposure: dermal, mouth, and lungs
- Measures taken to mitigate harm when exposed

Household safety

- Preparation of houses for spraying
- Removal of pets and domestic animals during spraying
- Removal and covering of food and water
- Procedures followed after spraying

Environmental safety

Trainers should refer to the Environmental Management Act No. 12 of 2011 and IRS Guidelines for the Safe, Lawful, and Environmentally Sound Management of IRS Insecticides:

Modes of transportation

- Modes of disposal
- Procedures followed during spraying
- Mitigation measures taken in the event of a spillage, exposure to the insecticide, contamination of food etc.

Public relations

Trainees should be trained on how to communicate with households. They are required to be courteous and patient and should ensure that each household understands the programme. Trainees need to have basic knowledge of how to communicate the following to households:

- The reasons for their visit
- The importance of spraying
- The steps that will be taken to prepare the house for spraying

- What to expect after spraying
- The “dos and don’ts” for the household after spraying
- The time to wait before entering the house after spraying (the walls should be completely dry and the rooms aerated)

Field forms
Trainees are expected to already have a basic education that enables them to read and write well enough to properly fill in IRS forms. After training, they should know how to:

- Gather accurate information
- Complete forms correctly
- Submit forms to team leaders or supervisors at the end of each work day

3.7 Training: practical skills

Overview
The exercises below are designed to teach trainees to how to operate the spray pump and how to maintain a proper spray pattern and rhythm to apply the correct amount of insecticide on a spray surface. Trainers should remember to check the following during the practical sessions:

- Sprayers should be filled with water at all times so that trainees get used to carrying full sprayers.
- Trainees should agitate the sprayers at regular 15–20 minute intervals (explain that this keeps the insecticide suspended in the water).

Spraying swathes

Training wall preparation

The wall used for practice should be prepared beforehand by trainers. It should be vertical, smooth (preferably plastered), and at least 2 m high and 10 m long.

It should be divided visually into vertical sections each 75 cm wide. Within each section, a dotted line should run vertically 5 cm from the solid line. The centre of each section should be marked with an arrow; each arrow should indicate the proper path of each successive swathe of insecticide intended to cover each section of wall. Starting from the left, the arrows should alternate pointing—first down, then up, then down again, and so on until the end of the wall.

Demonstration on wall preparation

Participants practicing wall preparation.

Exercise

For each practical exercise, between 5 and 10 spray pumps should be used. An equal number of trainees, in rotation, should practice spraying following the prepared pattern.

Spray pump maintenance
After the training, trainees should be able to:

- Inspect spray pumps to see whether they were cleaned after their previous use.
- Explain the importance of maintaining clean and dry pumps.
- Demonstrate the proper cleaning procedure with clean, uncontaminated water.
- Explain the importance of keeping pumps in good, working condition at all times.

Filling the spray pump
Trainers should demonstrate how to properly fill a spray pump and then have trainees follow suit filling their pumps and compare results. After the training, trainees should be able to explain the importance of correct dilution and fill sprayers accurately to the correct 10 litre level.

Carrying and handling the spray pump
Trainers should show how trainees should carry spray pumps, explain why, and give the dangers of not doing so.

They should show trainees how to adjust their shoulder straps for comfort and emphasize that they should never carry their pumps using the cover handles, or anything for that matter, apart from the shoulder straps.

Trainees should learn that when not spraying, they should carry their spray pumps on their backs because it is less tiring.

When spraying, however, they should carry their spray pumps under left shoulders (apart from spray pumps with double shoulder straps) because then:

- The pressure gauge can be easily checked.
- The pump can be easily handled in low or narrow spaces.
- The pump will not interfere with protective headgear.
- The pump can be easily unloaded and re-pressurized.
- The lance will not hook onto other things or materials when moving around

Nozzle discharge rate and nozzle wear
Trainers should show trainees how to calibrate spray pumps, demonstrating on nozzles with variable discharge rates due to variable wear and tear.

Using five spray pumps in total, they should:

1. Replace the nozzle of one spray pump with a new 8002 nozzle.
2. Pressurize the pumps to 45 PSI and spray each for 30 seconds into different measuring cylinders.
3. Compare the volumes collected in each cylinder filled by the various nozzles amongst themselves; the new nozzle should have discharged 380 ml (for a new 8001 nozzle, the volume of the discharge should be 190 ml).
4. Compare these volumes against those found on the standardized chart.
5. Replace nozzles that are too worn (discharge volume 10 percent over normal).
6. Explain that the discharge of a nozzle increases as it gets worn out and decreases if it is blocked


Nozzle calibration

Pressure and the operation of the sprayer

Trainers should explain how each of the following work:

- Air cushion
- Pressure gauge
- Discharge of liquid
- Pressure release valve (pressure regulator)

Trainers should then teach trainees that they should:

- Pressurize the spray pump by pumping with full, even strokes from top to bottom (short, irregular strokes are less efficient so more would be required).
- Never pump the plunger more than 55 full strokes if the tank is ¾ full.
- Always release the pressure when the sprayer is not in use especially if it standing in a warm place or being transported to and from a spray site

Practicing how to pressurize the spray pump.

Maintaining operational pressure

Trainers should follow these steps to teach trainers how to maintain operational pressure:

- Fill five sprayers to 10 L and pressurize them as follows:

	Pressure	Expected discharge
Sprayer 1	10 psi	230 ml
Sprayer 2	20 psi	320 ml
Sprayer 3	25 psi	325 ml
Sprayer 4	45 psi	360–380 ml
Sprayer 5	55 psi	400–450 ml

1. Spray each pump for 30 seconds into a different measuring cylinder.
2. Compare the volumes discharged from each pump.
3. Spray swathes from each pump on a practice wall and observe, compare, and contrast each swathe's width and appearance; use food colors to show the difference in discharge and in the swathe size.
4. Explain the importance of maintaining correct pressure and distance away from the surface being sprayed.

Effects of pressure and volume in the spray pump

Trainers should follow the steps below to demonstrate that as the aircushion inside the sprayer grows (that is, the level of the liquid drops), more pumping is required to pressurize the sprayer to a certain level.

However, the pressure then lasts longer:

1. Fill five sprayers to 10 L and pressurize them to 55 psi.
2. At the practice wall, with the lance in middle position, operate the sprayers in turn until their pressure gauges register 25 psi (note the time in seconds it takes for the pressure to drop from 55 psi to 25 psi and calculate the rate).
3. Open them and note the level of the liquid inside (also, calculate the volume discharged and the size of the aircushion).
4. Re-pressurize and repeat several times, comparing the volumes and times recorded each time

Due to this phenomenon, pressure cannot be accurately estimated.

Trainers should emphasize to trainees that they should depend solely on the pressure gauge to assess the pressure.

Alternatively, trainers can also follow these steps and demonstrate the same:

1. Fill two sprayers, one with 10 L of liquid and the other with 5 L.
2. Count and compare the number of strokes needed to pressurize each to 55 psi.
3. Note and compare the time taken for each sprayer's pressure to drop to 25 psi.

Nozzle distance from sprayed surface

Trainers should demonstrate the following spraying skills and trainees should practice them until trainees can consistently keep an even distance (recommended distance of 45 cm) from the wall while spraying smoothly:

1. Pressurize the spray pump to 45 psi.
2. With the nozzle at 30 cm from the wall, swath will be narrow.
3. With the nozzle one (1) m from the wall, the swath will be wide.

4. Attach a 45 cm wooden extension rod to the sprayer and spray at middle, upper, and lower positions all while maintaining the 45 cm distance.
5. At a distance of 45cm, the discharged flat fan will cover a width of 75 cm.

Speed and rhythm of spraying

1. Trainees should be able to spray at a rate of five (5) seconds to complete a two (2) metres wall.
2. They should practice by counting seconds out loud—one kwacha, two kwacha, three kwacha up to five kwacha while spraying 2 metres swathes. The trainees should also observe fellow trainees do the same.
3. Trainees should continue practicing until a sense of timing is achieved and observed by trainers.
4. Optionally, one or two swathes on the practice wall could be marked at 3 m in height; while spraying these, trainees should observe a 7.5-second count.

Successive swathes

To practice spraying successive swathes, trainees should space themselves three (3) swathes apart on the practice wall and ready their spray lances in the middle position. After spraying one swathe trainees should move sideways to centre of next swathe and spray it as well. This side step should be sufficient to position the trainee at the centre of the second swathe. As the trainee moves from one swathe to another, they should make an overlap of five (5) centimeters as shown in Figure 4.

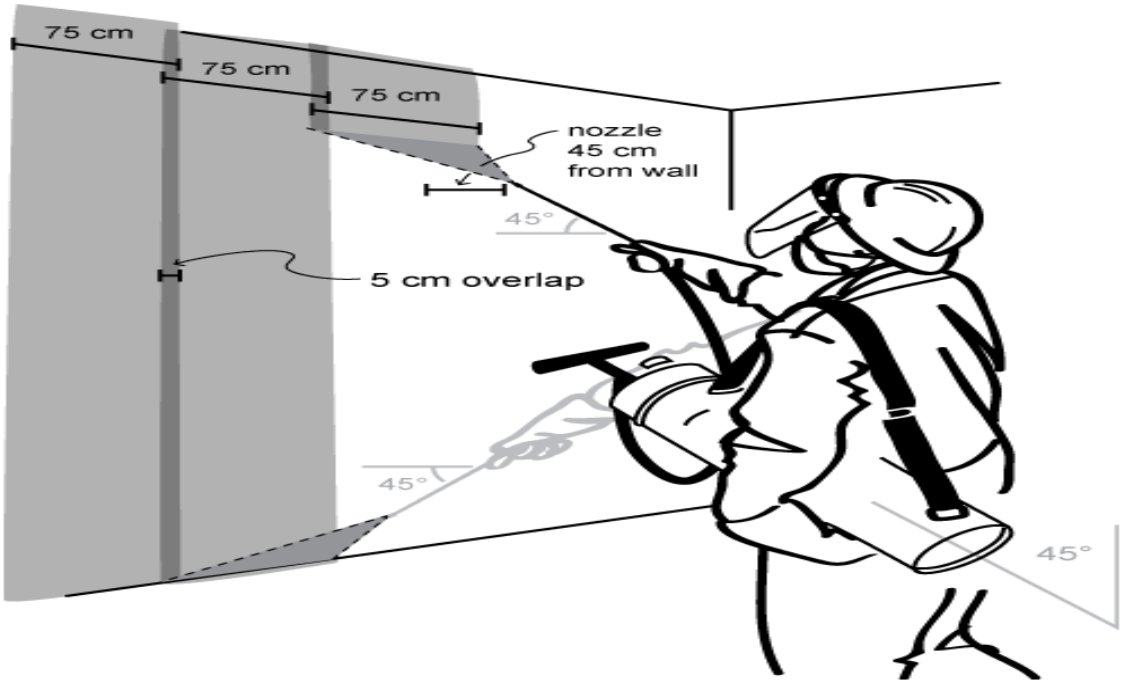


Figure 4. Overlapping during spraying

Spraying with water

Combining all skills learned, the trainees should practice taking one (1) minute to spray 10.7 swathes of wall (an equivalent of 15 m^2). Trainers should observe and time them.

3.8 Training: obstacles to spraying and special cases

Overview

All potential mosquito resting sites in houses need to be sprayed even when obstructed. Trainers should explain the need for such thorough coverage and go over many of the special or difficult situations detailed below to better prepare trainees for what they may encounter in the field.

'All potential mosquito resting sites in houses must be sprayed even when obstructed'

Difficult-to-reach areas
Trainees should know that:

- Obstacles, such as chairs, boxes, or any sort of wood, placed along the wall should be sprayed; they should not impede progress or break the normal spraying rhythm.
- They will sometimes need to adopt difficult stances in order to reach the wall while still maintaining distance and speed.

Pictures and calendars
There are two types of pictures and calendars: one that is fixed on all four corners and another that simply hangs. Trainees should know that for fixed pictures and calendars they should just spray over the top, whereas for hanging pictures and calendars, they should lift and spray both the underside of the picture or calendar and the wall behind it.

Large furniture and other objects difficult to move from the wall
Trainers should explain the importance of spraying the backs of furniture and other objects that rest against the wall as well as the wall behind them. These are resting sites. Trainees should know that to spray in this situation they need to reduce the distance between their nozzle and the spraying surface. They need to spray in concentrated narrow swathes, which, to achieve correct deposition, requires greater speed and an increase in the number of swathes.

Tables, desks, and beds
To spray surfaces low to the ground, trainees should know that the sprayer should be placed on the floor and that it may be necessary for them to lie or kneel down in order to spray. Trainees should practice spraying the undersides of beds, tables, etc. until they can consistently obtain a uniform deposit on such surfaces.

Boxes, bottles, and other movable objects against the wall
Since it is not known which side of a movable object will be in contact with the wall, a trainee should know that all sides of such an object should be sprayed along with the wall behind it. Also, boxes, cupboards, and other objects that open should be sprayed both inside and outside.

Ceilings and roofs
For ceilings and roofs, even those that are not horizontal, trainees should know that:

- Ceilings and roofs should be sprayed only after all walls are sprayed (swathes should not be continuous between wall and ceiling or roof).
- The same speed, timing, and distance of spraying should be maintained, if possible, for walls, ceilings, and roofs.
- Horizontal beams should be sprayed last.
- Spray fallout must be avoided.

Doors and windows
Trainees should know that if a door or window opens inwards, both its inside and outside surfaces need to be sprayed. If it opens outwards, however, only it's inside surface needs to be sprayed.

3.9 Training: other topics

Leftover spray pump contents
Trainers should emphasize that if there is any leftover insecticide in the pump, it should be poured into drum 1 at the triple rinsing bay and be reused as the first refill of water the following day.

Infield and refresher trainings
At the end of their training, trainees should practice spraying real structures in the field similar to those that they would encounter as a spray operator. Trainers must be present to supervise, give advice, and correct mistakes.

Refresher trainings should be carried out every year prior to the annual spray programme.

3.10 Trial spraying exercise
At the end of the practical training, trial spraying exercise should be done in a small selected area. This is where the real spraying is actualised by using all the guidelines starting from interaction with community mobilisers and real householders. The real chemicals will be used and spray operators will be in full PPEs. Public relation skills are also practiced.

3.11 Trainees evaluation

Practical test checklist
Trainers should use the checklist below to evaluate trainees during both practice wall and infield tests. For both tests, they should have trainees to do the following:

- Fill their spray pumps to 10 litres and pressurize up to 55 psi.
- Perform three (3) consecutive sprayings; each in no less than 58 seconds and no more than 62 seconds of 10 swathes 2 m in height

As they work, trainers should check and note the following (mark out of 10):

	YES	NO
Was the sprayer filled correctly? (i.e., to 10L)	☐	☐
Was the correct pressure applied to start?	☐	☐
Did the trainee agitate the sprayer before spraying?	☐	☐
Did the trainee address the wall correctly (i.e. upper, middle and lower)?	☐	☐
Did the trainee check the pressure gauge frequently?	☐	☐
Did the trainee take proper steps from swathe to swathe?	☐	☐
Was the pressure maintained within the operational limits?	☐	☐
Was the correct distance maintained (45 cm)?	☐	☐
Did the trainee take between 58 and 62 seconds to cover 10 swathes (judge two best times)?	☐	☐

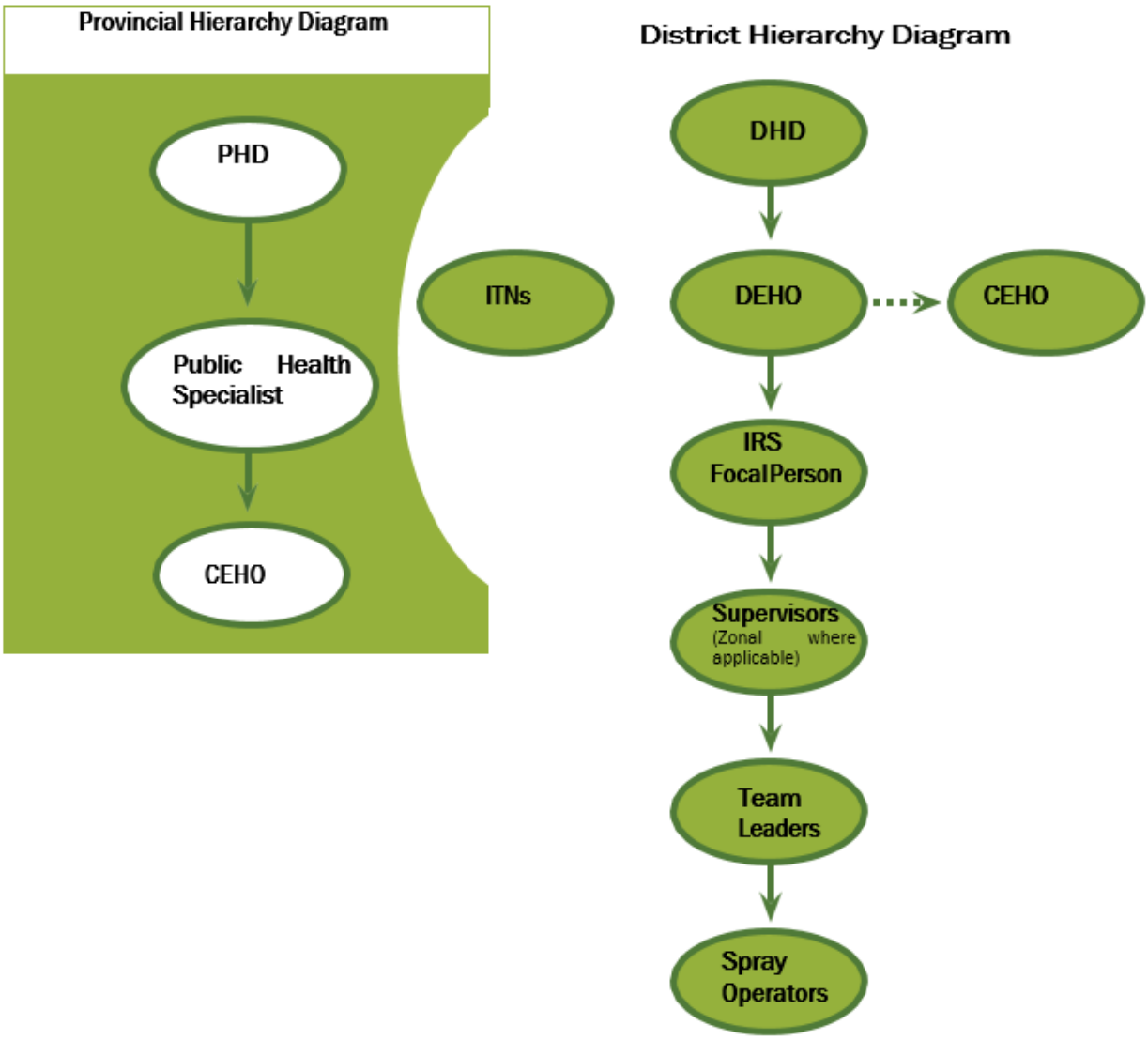
Annex 1. Training materials required

1. IRS Guidelines on training of spray operators
2. WHO recommended hand operated compression sprayers (at least 1 for 2 trainees)
3. Bucket and a piece of mutton cloth (for filtering water into the sprayer)
4. Toolkit for each team of trainees that includes a pair of 6-inch pliers, an 8-inch adjustable wrench, and screw drivers
5. Sufficient portable water to fill each sprayer at least twice
6. At least two different food colors (for spray pattern demonstrations)
7. Prepared solid practice wall at least 2 m in height
8. Stopwatch
9. Tape measure
10. Ball of building line
11. 50 cm straight extension sticks
12. Practice obstacles, e.g. chairs, boxes, pictures
13. Measuring cylinder
14. Teaching aids (documents outlining processes and procedures)
15. Handouts
16. x 2 m white calico materials
17. x 2m transparent polythene sheet
18. Triple Rinsing drums (7) and water buckets.
19. Room spacious to accommodate at all participants
20. Rubber bands
21. Note books
22. Chalks
23. Transport /refunds
24. Teas and lunch
25. Pens
26. Personal Protective Equipments (PPEs)
27. Measuring cylinders

Annex 2. Spray operators training schedule

Timing	Training Day 1	Training Day 2	Training Day 3	Training Day 4	Training Day 5	Training Day 6
8:30-9:00	Welcome remark Introductions Housekeeping issues Administrative issues Official Opening -	Recap of Day 1	Recap of Day 2 Practicals Start	Recap of Day 3	Recap of day 4	Recap day 5
9:00-10:15	Expectations Pre- test Objectives of the training/IRS	Introduction to spray techniques Factors that govern insecticide application	Field Demonstration: Training wall (Counting to get speed)	Establishing correct spraying technique: Distance, speed, pattern & rhythm)	Establishing correct spraying technique: Distance, speed, pattern & rhythm)	Establishing correct spraying technique: Distance, speed, pattern & rhythm)
10:15-10:30	BREAK			BREAK		
10:30 - 11:30 11:30 – 12:30	Overview of IRS Malaria Prevention Spray Operator: safety procedures	Preparing to spray mixtures (mixing insecticide) Triple rinsing of bottles and spray pumps	Establishing correct spraying technique: Distance, speed, pattern & rhythm)	Establishing correct spraying technique: Distance, speed, pattern & rhythm)	Establishing correct spraying technique: Distance, speed, pattern & rhythm)	Establishing correct spraying technique: Distance, speed, pattern & rhythm)
12:30- 13:30	LUNCH			LUNCH		
13:30 - 15:30 14:30 – 15:30	Home Preparation for IRS Public Relations and IEC Filling the SOPs forms	Safety to SOPs, Household and Environment	Establishing correct spraying technique: Distance, speed, pattern & rhythm)	Establishing correct spraying technique: Distance, speed, pattern & rhythm)	Establishing correct spraying technique: Distance, speed, pattern & rhythm)	Role play on Public Relations
15:30-15:45	BREAK			BREAK		
15:45 – 17:00	Using the equipment: (Pumps &PPE) Pump pressurizing, carrying and transportation Handling and cleaning sprayers	Demonstrations: Obstacles and Hard to reach spraying	Establishing correct spraying technique: Distance, speed, pattern & rhythm)	Establishing correct spraying technique: Distance, speed, pattern & rhythm)	Establishing correct spraying technique: Distance, speed, pattern & rhythm)	Post Test Announcements Closing

Annex 3. IRS hierarchy, roles, and responsibilities



Roles and Responsibilities of Personnel

National Principal IRS Officer

1. Facilitate planning, coordination, implementation, and monitoring (including quality control) of IRS activities
2. Supervise national IRS activities
3. Generate reports (weekly, monthly, quarterly, and annually)
4. Facilitate procurement and distribution of IRS supplies
5. Facilitate IRS TOTs
6. Ensure regular review of IRS implementation
7. Ensure coordination of IRS in the NMEC
8. Facilitate development of standards and guidelines

Chief Environmental Health Officers (CEHO – Provincial Level)

1. Conduct performance assessments
2. Provide technical assistance
3. Serve as link between districts and the NMEC
4. Support development of standards and guidelines

District Environmental Health Officers (DEHO)

1. Conduct IRS planning in collaboration with NMEC and partners

2. Ensure IRS activities are part of district work plans
3. Supervise IRS focal person
4. Mobilise IRS resources (e.g., funds)
5. Support development of standards and guidelines

IRS Focal Persons

1. Plan, coordinate, implement, and monitor (including quality control) IRS activities
2. Supervise IRS activities
3. Generate reports (weekly, monthly, quarterly, and annual)
4. Manage IRS supplies
5. Conduct spray operator and supervisor trainings and identify training needs
6. Support development of standards and guidelines
7. Collaborate on development and dissemination of IECs
8. Ensure conduct and quality of day-to- day operations in the field
9. Coordinate aspects of Geographical Information Systems (GIS) field components, intervention assessments, and section control programmes

Supervisors (Zonal Where Applicable)

1. Report to IRS Focal Person
2. Ensure conduct and quality of spraying teams' activities
3. Supervise spray operators
4. Ensure distribution of insecticides and spray pumps
5. Organize reports on IRS
6. Assist in recruitment of spray operators
7. Ensure proper use of insecticides and proper management of waste in the field and at station

Districts with high numbers of target structures may have more than one supervisor, in which case each supervisor is given responsibility of a zone rather than an entire district. In addition to the roles and responsibilities above, a Zonal Supervisor must also implement, manage, coordinate, monitor and evaluate all IRS control activities in his zone.

Spray Operators and Team Leaders

Spray Operators are temporary contracted workers hired only during spraying campaigns. Spray Operators:

1. Spray structures
2. Number structures and note sizes of households
3. Record types and amounts of insecticides used in each house sprayed

From among Spray Operators, a Team Leader is selected and, in addition to the roles and responsibilities above, must assist supervisors in supervision

Stores Officers

1. Issue, care for, and manage insecticides, PPE, spray pumps, and accessories at storage facilities

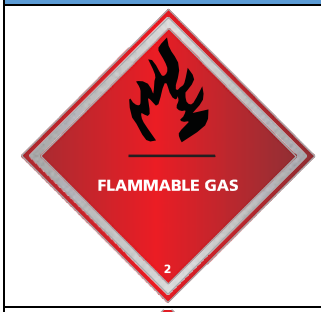
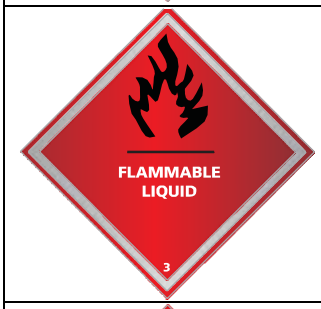
Partnership

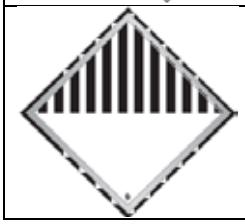
Districts should facilitate the formation of suitable IRS teams: committees, commissions, or task forces. They should ensure the teams' smooth operation and nurture their sustainability.

Annex 4. Essential storeroom materials

- Wooden pallets
- Entrance ramps or banding to contain spills and water
- Door locks to prevent unauthorized entry
- Bars to bar windows and ventilators to prevent unauthorized entry
- Sand
- A long-handled brush with stiff bristles
- A short-handled brush and pan
- Water
- Soap
- A shovel
- Detergent
- Fire extinguishers
- Fire proof blankets
- Protective clothing
- Self-adhesive warning labels
- First aid kit
- Eye wash set
- Stretcher
- Blanket
- Stock record sheets
- Stock control cards for each of the commodities (insecticides, sprayers, PPEs, Food, detergents, soap etc)

Annex 5. Hazard warning signs

Hazard label	Hazard class	Method of storage
	**Class 2: Flammable Gas** Gases which ignite on contact with an ignition source (Red background)	Segregate Explosion-proof equipment or open-air storage required
	**Class 3: Flammable Liquid** Liquids with a flashpoint no higher than 55°C (Red background)	Quantity stored should not exceed 250 tonnes unless fire-protected
	**Class 4.1: Flammable Solid** Solid substances that are easily ignited and readily combustible (Vertically striped red and white background)	Quantity stored recommended not to exceed 250 tonnes
	**Class 4.2: Spontaneously Combustible** Solid substances that ignite spontaneously (Red lower half, white upper half)	Segregate Open-air storage recommended
	**Class 4.3: Dangerous When Wet** Solid substances that emit a flammable gas when wet or react violently with water (Blue background)	Segregate No sprinkler Protect from rain

	**Class 5: Oxidizing Agent** Substances that yield oxygen and enhance the combustion of other substances (Yellow background)	Separate from flammables and combustibles
	**Class 6.1: Poison** Toxic substances which are harmful to human health (White background)	Legally, may demand segregation if highly toxic (LD50 oral < 25 mg/kg)
	**Class 8: Corrosive** Corrosive substances are substances that can dissolve organic tissue or severely cor- rode certain metals (Black lower half, white upper half)	Separate from insecticides packed in metal
	**Class 4: Harmful Material** Substances to be kept away from foodstuffs (White background)	Stow away from foodstuffs
	**Class 9: Miscellaneous** Hazardous substances that do not fall into the other categories (White lower half and vertically striped black and white upper half) No guidelines If non-combustible, use as a barrier for separating other materials.	

Annex 6. Table of dosages and duration of action

Below are the WHO prequalified insecticides for Indoor Residual Spraying against malaria vectors.

Insecticide compounds and formulations (1)	Class group (2)	Dossage (g a.i./m^2)	Mode of action	Duration of effective action (months)
DDT WP	OC	1-2	Contact	>6
Malathion WP	OP	2	Contact	2-3
Fenitrothion WP	OP	2	Contact and airborne	3-6
Pirimiphos-methyl WP & EC	OP	1-2	Contact and airborne	2-3
Bendiocarb WP	C	0.1-0.4	Contact and airborne	2-6
Propoxur WP	C	1-2	Contact and airborne	3-6
Alpha-cypermethrin WP & SC	P	0.02-0.03	Contact	4-6
Bifenthrin	P	0.025-0.05	Contact	3-6
Cyfluthrin WP	P	0.02-0.05	Contact	3-6
Deltamethrin WP, WG	P	0.02-00.025	Contact	3-6
Etofenprox WP	P	0.1-0.3	Contact	3-6
Lambda-cyhalothrin WP, CS	P	0.02-0.03	Contact	3-6
Pirimiphos Methyl 300CS	OP	1	Contact and airborne	4-6
Sumishield 50WG	N	300 mg	Contact	>6
Fludora Fusion	N	200mg/25 mg	Contact	>6

CS: capsule suspension; EC = emulsifiable concentrate; WP = wettable powder;
WG=Water dispersible Granules
OC: Organochlorines; OP = Organophosphates; C = Carbamates; P = Pyrethroids;
N= Neonicotinoids

Source: www.who.int/pq-vector-control/prequalified-lists/PQT_VC_17July2018.pdf?ua=1

Annex 7. Spray operators recruitment criteria

The following criteria must be strictly followed when recruiting Spray Operators for the Indoor Residual Spraying programme.

All recruitees must meet the following:

1. Must be an active Community Based Volunteer (eg CHW, NHC, Malaria Agents etc)
2. Must be able to read and write
3. No pregnant and lactating mothers. (Pregnancy test must be done)
4. In possession of a green national registration card.
5. Should be between 21 – 45 years (kindly bring along NRC)
6. Height to be at least 1.5 meters and above.
7. Weight to be 50 Kg and above
8. No History of respiratory tract infection
9. Must not be allergic to insecticides.
10. Must not have been previously charged under disciplinary action.
11. Must be physically and mentally fit.
12. Must be presentable and must need minimum supervision.
13. Spray operators who have not worked consecutively for **3 years.**
14. No criminal record.
15. Must be ready to work from 06:00 during working days
16. Please do not recruit health centre members of staff.
17. Selected members to be ready financially to do **X- Rays graphs** and **pregnancy tests**.

Annex 8. IRS mobilisers job aid

- **Malaria** is a preventable disease caused by the infected female anopheles mosquito. It is one of the leading causes of illness and death in Zambia. Allowing your house to be sprayed by trained people from the Ministry of Health every year is one of the most effective ways to kill mosquitoes. This protects your family and your community from malaria.

- **To protect** your family and your community from malaria, it is everybody's responsibility to allow the houses to be sprayed.

- **IRS is FREE.** Members of the community should not pay anything to have their house sprayed.

- **IRS is SAFE.** Only a small amount of chemical is sprayed onto your walls and this is enough to kill mosquitoes when they rest on it. The chemical is effective for 6 months.

Steps households should take before the house is sprayed

- Remove stored water, food and cooking utensils and keep them away from your house.
- Move any furniture or items (that are difficult to move out of the house) to the centre of the room and cover them with plastic sheet (this allows for easy access to the walls by spray operators when spraying)
- Keep sick people, new born babies, domestic animals and pets away during spraying.
- Personal items such as toothbrushes, combs, children's toys, school bags and all clothes should be kept in a secure place or removed from the house.

Steps households should take after the house has been sprayed

- After spraying is complete;

i. Wait for two (2) hours before entering your house (only enter when the walls are completely dry)
ii. When you enter your house, immediately open windows and doors for another 30 minutes to allow for air circulation.
iii. Sweep dead cockroaches, bedbugs or other insects from the house and dispose them by burying (50 cm into the ground) or throwing in a pit latrine to avoid these being eaten by poultry e.g. chickens and ducks.
iv. After that, household members can then enter inside the house.

- Food suspected to have been accidentally contaminated should be buried or thrown in a pit latrine.
- In an event of any skin irritation or reactions, feel free to contact the IRS team in your area for medical advice.
- After the house has been sprayed, do not plaster, paint, or wash the walls for at least six (6) months; this renders the chemical ineffective.
- When your house is sprayed, encourage your neighbours in your community to have their houses sprayed too.

IRS is only effective when the **whole community** allows their houses to be sprayed.
Thank you for doing your part; together we can end malaria for good.

Annex 9. Budgeting for IRS activities

The following should be considered in developing an IRS budget. A budget plan, funds for operations, logistics, transportation, monitoring, supervision and community sensitisation.

Below are examples of the cascade training and an implementation budget template taking into consideration: the number of spray operators, number of days and the target structures.

CASCADE TRAINING BUDGET

Name of District.....

Number of Spray Operators		25

Item	Quantity	Days	Frequency	Unit cost	Total cost
Venue hire	1	6	1	1000	6,000
Lunch Spray Operators	25	6	1	20	3,000
Lunch Facilitators	6	6	1	85	2,805
Tea breaks	31	6	2	20	7,320
Transport refund – SOPs	25	6	1	15	2,250
Mineral water	31	6	2	5	1,830
					17,205
Training materials					
Reams of paper	10	1	1	70	700
Note books	31	1	1	10	305
Pens	31	1	1	2	61
Markers	40	1	1	5	200
Flip Chart	20	1	1	50	1,000
Bostick glue	20	1	1	20	400
Food colours (bottles)	10	1	1	10	100
White cloth (meters)	20	1	1	20	400
Pipe wrench	5	1	1	50	250
Pliers	5	1	1	20	100
Flat screw drivers	5	1	1	10	50
Measuring cylinders	2	1	1	200	400
Stop watches	5	1	1	100	500
Toners	1	1	1	1,000	1,000
					5,466
Fuel to transport spray operators	30	6	1	13	**2,250**
Lodging	10	6	1	100	**6,000**
Grand Total					**36,921**

RS IMPLEMENTATION BUDGET

Spray Operators	25
Targeted Structures	9,900
Number of days	26

Allowance for sprayers

Item	Quantity	Days	Frequency	Unit cost	Total cost
Spray Operator wages	25	26	1	40	26,400
Lunch allowance supervisors	4	26	1	85	8,976
Lunch allowance drivers	1	26	1	85	2,244
Lunch allowance store keeper	1	26	1	85	2,244
					39,864

Breakfast

Item	Quantity	Days	Frequency	Unit cost	Total cost
Bread	31	26	1	10	8,184
Drink	31	26	1	7	5,729
Milk	31	26	1	10	8,184
					22,097

Stationery

A4 Hard cover books	10	1	1	15	150
Punchers	2	1	1	50	100
Staplers	2	1	1	20	40
Calculators	5	1	1	50	250
Box files	20	1	1	30	600
Reams of Paper	10	1	1	70	700
Toners	2	1	1	1,000	2,000
					3,840

IEC and Social Mobilisations

ID cards	31	1	1	30	930
Sensitization meetings	1	26	1	400	10,560
Local adverts on radio	1	26	1	300	7,920
Local Monitoring & Supervision	5	20	1	85	8,500
Community Mobilisers	10	26	1	30	7,920
District IRS Launch	1	1	1	10,000	10,000
					45,830

Storage repair and maintenance of equipment

Fire extinguishers		1	1	900	-
Pallets & shelves		1	1	200	-
Hazadous signs		1	1	500	-
Security - buglar doors etc..		1	1	1,000	-
Thermometer		1	1	100	-
Buckets	5	1	1	50	250
Drums	7	1	1	400	2,800
shovel	1	1	1	100	100
Broom	1	1	1	50	50

First Aid Box	1	1	1	100	100
					3,300

Other commodities

Bathing soap	31	1	4	10	1,240
Washing Detergent	31	1	4	15	1,860
Tooth brushes	31	1	3	5	465
Fuel (Liters)	30	26	1	13	10,296
Polythene sheets	2	1	1	400	800
Vehicle hire	2	26	1	800	42,240
					56,901

Camping	0	26	1	100	-

Total	**171,832**

Annex 10: Mobile DDT Filtration System for Indoor Residual Spraying

The use of DDT comes with a lot of restriction due to its nature to persist in the environment in case of any contamination. As such environmental compliance must be adhered to at all times (transportation, storage, mixing, spraying, management of waste both solid and liquid etc).

In view of this, each district that will use DDT must have an evaporation tank for managing the liquid waste of DDT. However, we are aware that most of the districts do a lot of camping during the IRS campaign and management of liquid waste is a critical issue.

It is against this that a mobile DDT filtration system comes into play to help with management of DDT liquid waste during camping or while implementing IRS in areas without a static evaporation tank. The DDT filtration system is similar to the mobile soak pit with a few differences.

Requirements

- 20 litre bucket/container
- 2 X 40 litre bucket/container
- 7 cm thick of foam or saw dust
- Granulated charcoal or activated charcoal
- Tarpaulin tent or high density plastic sheet (1mm thick)
- Hoe/pick
- Shovel
- A stand

Steps in construction of the filtration system

Step 1:
Make a stand similar to that for the hand washing bucket and stand. It should be 90 cm high and wide enough to support the bucket.

Step 2: Construct the filtration system as follows:

- Get the 60 litre bucket/container and drill one 1.5 cm hole in the center of the bottom of the bucket before adding any materials.
- Then place a **7cm** thick of form or wood shavings at the base of the bucket; Followed by **20cm** of granulated charcoal or activated carbon and finally **11cm** of gravel or foam. This will provide a deep bed of granulated charcoal, and greater capacity for pesticide adsorption.
- Place a fine nylon or netting material at the bottom of the bucket, in between the wood shavings/foam and granulated charcoal layers, as well as between granulated charcoal layers and gravel or foam.

Step 3:
Mount the filtration system on stand and place the 20 litre under the stand to be receiving the filtrate as illustrated in the picture below.

Figure 1: DDT Filtration system mounted on the stand

In the field

While in the field, the team will need to set up the filtration system as follows:

1. Dig a hole the size and depth of the bucket to be used for receiving any droplets or liquids from the tarpaulin or polythene sheet.
2. Level the ground with a gradient of 1:15 towards the hole for the bucket.

Figure 2: Installation of the receiving bucket in the ground

3. Install the bucket in the hole as shown above
4. Lay the tarpaulin or 1mm thick polythene sheet or plastic and place the drum and the DDT filtration system on top as shown below. The polythene sheet should be folded in the bucket to ensure any liquid flows into the bucket and not the ground.

5. After the cleaning of the equipment, whatever liquid flows into the receiving budget should be poured into the filtration bucket.
6. The filtrate should be collected and used as water for mixing the insecticides the following day.
7. Number 5 and 6 are repeated daily

Annex 11. Members of the IRS Guidelines Review Committee

NAME	DESIGNATION	ORGANIZATION
EMMANUEL H. KOOMA	VCS	NMEC
PRESLEY MUSONDA	OPS MAN	VL-PMI
SHEILA MWACHILENGA	ECO	VL-PMI
CHRISTOPHER MULENGA	PEST CONTROL SPT	LUSAKA CITY COUNCIL
ALICK CHIRWA	SEHO	KABWE - DHO
TEDDY WAKUNUMA	CEHO	PHO-CENTRAL PROVINCE
MORGAN SANKA	CEHO	PHO- NORTHERN PROVINCE
BERNARD MWANSA	CEHO	PHO-MUCHINGA
STEPHEN L. BANDA	PEHO	PHO-EASTERN
MBANGA MULEBA	SCIENTIFIC OFFICER	TDRC -NDOLA
KENTZO M. MUMBA	CVCO	NMEC
RACHEAL MUKOSHA	EHT/IRS MANAGER	CHOMA-DHO
AVES T. HAKALIMA	SEHT/IRS MANAGER	LUSAKA DHO
MATEYO MOYO	CEHO	PHO-MANSA
ALEX CHILABI	PMCO	NMEC
JOHN BANDA	GF- FOCAL POINT	NMEC
BUSIKU HAMAINZA	EPIDEMIOLOGIST	NMEC
JAPHET CHIWAULA	PR. STATISTICS	NMEC
MEETWELL CHEELO	CEHO	LPHO
EMMAUNEL PHIRI	CEHO	WPHO
CONSTANCE A. NKHATA	ADMIN SECRETARY	NMEC/MOH
MWELEWA ESTHER	SUPPORT STAFF	NMEC
REUBEN ZULU	PRINCIPAL IRS OFFICER	MOH/NMEC
BENJAMIN MASUMBA	DRIVER	MOH/NMEC
DINGANI CHINULA	ENTOMOLOGIST	NMEC
AMU MUDENDA	SBCC	NMEC
WILLY NGULUBE	PMCO	NMEC
ANTHONY YETA	D DIRECTOR	NMEC
JENNIFER STEVENSON	SCI. DIRECTOR	MACHA
CONSTANCE NJOVU	REGIONAL COORDIANTOR	IFCBMI
NSOFWA FRANCIS	CEHO	PHO - NWP
ELIZABETH CHIZEMA	DIRECTOR	NMEC
MUTINTA MUDENDA	DEPUTY DIRECTOR	NMEC
MESELI HASTINGS	DRIVER	NMEC
FREDDIE MASANINGA	NPO-MAL	WHO
CHRISTOPHER KANEMA	PRINICIPAL INSPECTOR	ZEMA
NELSON WAITOLO	PHO	COPPERBELT
NDUKA IWUCHUKWU	COP	VECTORLINK
MAXWELL NKOYA	DOP	ZEMA
NICHOLUS SANDE	GS/REMOT	NMEC
BENJAMIN CHANDA	ENTOMOLOGIST	NMEC
MWANSA MWENYA	ENTOMOLOGIST	NMEC
TRESFORD KANIKI	ENTOMOLOGIST	NMEC
BRENDA SICHONE	SECRETARY	NMEC
DORIS BUSAKA	OFFICE ASSISTANT	NMEC

Annex 12. IRS data collection tools

Indoor Residual Spray Campaign

DAILY SPRAY OPERATOR FORM

Ministry of Community Development, Mother and Child Health & Ministry of Health

DATE: _____ PROVINCE: _____ DISTRICT: _____ CATCHMENT AREA: _____ LOCALITY: _____

NAME OF SPRAY OPERATOR: _____ CODE OF SPRAY OPERATOR: _____ TEAM NUMBER: _____ TARGET: _____ SIGNATURE: _____ INSECTIDE NAME: _____

MAIN SPRAY ☐ MOP UP ☐ POROUS ☐ NON-POROUS ☐ BOTTLES RECEIVED: _____ BOTTLES USED: _____ BOTTLES RETURNED FULL: _____

Name of Household Head	Structure Identification Number (Structures Found)	Eligible Structures										Rooms Not Sprayed					Mosquito nets				
		Sprayed								Unsprayed		Not Sprayed? (Tick for YES)	Reason for Not Spraying				Total # of Nets Available	Total # of Nets being used	Population Sleeping Under Net		
		Sprayed today? (Tick (V) for YES)	Eligible Rooms		Population Protected					Not Sprayed? (Tick for YES)	Reason		1	2	4	6			Total Number of Persons	Pregnant Women	Children <5 Yrs
			Found	Sprayed	Male	Female	Total	Pregnant Women	Children <5 years				Sick	Locked	Refused	Other					
Total											*										

Reason for not spraying: 1= Sick, 2= Locked, 3=Funeral, 4=Refused, 5= No one home/Missed, 6=Other

*DO NOT ADD this column

NAME OF SUPERVISOR: _____ Date Verified: _____ Signature: _____

Indoor Residual Spray Campaign

DAILY SUPERVISOR REPORTING FORM

Ministry of Community Development, Mother and Child Health &
Ministry of Health

DATE: _____ PROVINCE: _____ DISTRICT: _____ INSECTIDE NAME: _____

NAME OF SUPERVISOR: _____ CODE OF SUPERVISOR: _____ SIGNATURE: _____

MAIN SPRAY ☐ MOP UP ☐ POROUS ☐ NON-POROUS ☐

Name of Spray Operator	ID Number	Catchment Area	Bottles of Insecticides			Eligible Structures																		Rooms Not Sprayed					Mosquito nets				
							Sprayed								Not Sprayed															Population Sleeping Under Net		
								Eligible Rooms		Population Protected in Sprayed Structures						Reason for Not Spraying								Reason for Not Spraying							
			Received	Used	Returned Full	# Found	# Sprayed	Found	Sprayed	Male	Female	Total	Pregnant Women	Children <5 years	# Not Sprayed	1 Sick	2 Locked	3 Funeral	4 Refused	5 No One Home/ Missed	6 Other	# of Rooms Not Sprayed	1 Sick	2 Locked	4 Refused	6 Other	Total # of Nets Available	Total # of Nets being used	Total Number of Persons	Pregnant Women	Children <5Yrs
Total																																

NAME OF IRS MANAGER: _____ Date Verified: _____ Signature: _____

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