# Toxics-Free SDGs: Documenting DDT Spraying, Production, Pollution and Alternatives in Mozambique


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## List of acronyms

| | |
|---|---|
| AFSD | Foundation for Sustainable Development |
| CSO | Civil Society Organization |
| DDT | Dichloro-Diphenyl-Trichloroethane |
| HHPs | Highly Hazardous Pesticides |
| IRS | Indoor Residual Spraying |
| ITNs | Insecticide-Treated Nets |
| LLINs | Long-Lasting Insecticidal Nets |
| MASA | Minister of Agriculture Seguranca Alimentar |
| MINAG | Ministerio da Agricultura |
| MISAU | Ministry of Health (Ministerio de Saude) |
| NGO | Non-Governmental Organization |
| NIP | National Implementation Plan |
| NMCP | National Malaria Control Program |
| PFSCM | Partnership for Supply chain Management |
| POPs | Persistent Organic Pollutants |
| SEA | Supplemental Environmental Assessment |
| USEPA | United States Environmental Protection Agency |
| WHO | World Health Organization |

# 1. Introduction

The Stockholm Convention on Persistent Organic Pollutants (POPs) is a living treaty that recognizes the need to take global action on chemicals of concern because of their persistence, bioaccumulation, long-range environmental transport, and toxicity. The Convention established a science-based process for evaluating candidate POPswith the understanding that lack of full scientific certainty shall not prevent a candidate substance from proceeding in the evaluation or listing.Mozambique is characterized by perennial malaria transmission, and indoor residual spraying (IRS) has been used to reduce malaria incidence in the seasons of highest transmission. Another aspect of malaria vector control supported by the Ministry of Health (Ministerio de Saude, henceforth referred to as MISAU) includes insecticide-treated nets (ITNs) and long-lasting insecticidal nets (LLINs). The government has shown that in the long-term, larvicide and environmental management should be pursued to provide an integrated malaria vector control strategy. Dichloro-diphenyl-trichloroethane (DDT) insecticide was used to prevent deaths from malaria in African countries. DDT is an organochlorine pesticide that was also used as an insecticide in agriculture and to combat insect vectors of diseases such as malaria and typhus. Because of its effectiveness at killing insects, DDT had been a mainstay to fight malaria, a parasitic disease that is a growing health threat in Mozambique and other parts of the world. It was believed to helping to lower the number of malaria deaths in Mozambique.

DDT was globally banned by the Stockholm convention in 2001 with specific exemption only for use in disease vector control. After affirmation by the World Health Organization (WHO) that DDT could still be used for malaria control programsin the absence of longer lasting insecticide formulations in some malaria endemic settings, DDT was reintroduced as a major malaria control intervention in Mozambique. Indoor residual spraying (IRS) with DDT was reintroduced into Mozambique for malaria control in 2005, and became the main insecticide used for malaria vector control in the county until 2017 when Acteclic 300 and Deltamethrin started to be used. The selection of DDT in Mozambique was evidence-based, taking account the susceptibility of *Anopheles arabiensis* to other available insecticide choices, as well as relative costs of the insecticide and the logistical costs of spraying. In Mozambique, DDT was replaced by lambda-cyhalothrin in 1993. Resistance occurred quickly to this insecticide, and in 2000 the pyrethroid was phased out and the carbamate benthiocarb was introduced until DDT was reintroduced in 2005.

Low-level resistance was detected by biochemical assay to bendiocarb in 1999 in both *Anopheles funestus* (giles) and *Anophelesarabiensis*, although this was not evident in WHO bioassays of the same population. In the 2000-2006 surveys, the

level of bendiocarb resistance was detected to be in higher level in *Anophelesarabiensis*, with resistance detectable by both biochemical and WHO bioassay (Giles, https://academic.oup.com/jme/article/45/5/885/942718). The insecticide resistance monitoring program included assessment of field populations by standard WHO insecticide susceptibility assays and biochemical assays. Monitoring was established by WHO in 1999, and it was maintained as part of an operational monitoring and evaluation program thereafter.

Stockholm Convention banned the use of DDT; but eliminating it was a major challenge for Mozambique due to the prevalence of malaria. In 2017 the country started to use Acteclic 300 and Deltamethrin for control of malaria vector, totally replacing DDT. However, there are still DDT contaminated storage areas in the country, where more work should be done and mapping of all the affected areas is required.

This project is therefore important to document the pollution as a result of DDT spraying and to share the alternatives used after the country stopped using DDT 2017.

# 2. Sources and levels of pollution, import/export, human exposure, possible damages, storage, alternatives and waste

## 2.1 Sources of pollution

As part of a new malaria control program, Mozambique was advised to implement an IRS program using carbamates, pyrethroids, and DDT for malaria vector control. DDT continued to be used because of the potential for a significant impact of bendiocarb on the environment and its registration and use was cancelled by USEPA and the registrtion in the US was voluntarily stopped by manufactures.[1]

### Contaminated Sites

DDT was used in the past to control malaria causing mosquitoes.Tackling malaria has being considered as part of special development initiative of infectious diseases prevention that used to be undertaken jointly by the health departments of three countries: South Africa, Mozambique and Swaziland. DDT is hydrophobic, travel within 54 waterways either adsorbed to sediment or with biota. Previous studies have confirmed 55 contaminations of freshwater fish with the Photolog

[1]http://documents.worldbank.org/curated/en/770921468060916061/pdf/E17060EA0Report0P099930.pdf

floodplain[2].Human health risk from consumption of marine fish contaminated with DDT and its metabolites in Maputo Bay, Mozambique was the first studyto estimate the human health risk associated with consumption of marine fish from Maputo Bay contaminated with DDT. The median for ∑DDTs was 3.8 ng/g ww (maximum 280.9 ng/g ww).The overall hazard ratio (HR) for samples was 1.5 at the 75 percent concentration and 28.2 at the 95 percent. These calculations show increased potential of cancer risks due to contamination by DDT, data which will help policy makers perform a risk-benefit analysis of DDT use in malaria control programs in the 34 regions of Mozambique. DDT was imported from India.

Inventory of DDT in Mozambique was conducted by NMCP in 2016 and part of the waste collected by Partnership for Supply chain Management (PFSCM) under Global Fund Grant. However, due to the lack of measuring tools, it was not possible to measure the levels of pollution in the field.

**Sites and impact observed**

The project team visited Maputo, Mahotas, Boane, Moamba, Namaacha and areas located nearby Maputo bay including Matola river area. The National Malaria Control Program in Mozambique (NMCP) has using insecticides for the control of malaria vectors *Anopheles Arabiensis* (patton) and *Anopheles gambiae.* In addition to its public health applications, in the past enormous tonnages of DDT were used for agricultural purposes.[3]

## 2.2 Site observation of DDT using areas

Site observation and interview for DDT use/spray, pollution and alternatives was done in six areas which are Namaacha, Mahubo, Mafuiane, Mahotas, Boane and Moamba. The consultation involved meeting stakeholders including farmers, schools, MINAG, Minister of Environment (Mitader) and MASA.

**Interviewees:** Specific interview was conducted with two men and two women farmers.

During the interview and conversations it was revealed that during the IRS there were children under 18 years old around the spraying of DDT. The hose owners were only informed that the spraying was for malaria control, and one could still smell it four hours after spraying. The spraying was done once a year between September and October. After the spray they can stay for some months without seen mosquitoes, but they were also using mosquito nets.

There were no any complaint from the villagers as they were not informed of dangers of DDT, they knew it is for killing mosquitoes. There was no any information provided

[2]https://eprints.lib.hokudai.ac.jp/dspace/bitstream/2115/73891/1/BECT_DDTs_in_fish_LT_REVISIONS_20180209_clear.pdf

[3]https://academic.oup.com/jme/article/45/5/885/942718

during the spray other than been asked to take all important household items from the house and close it for four hours before re-entry. In the farm they use other pesticides and the know pesticides are dangerous.

They reported to only visit heath centres when they are sick and mostly do so due to malaria. Nearby health centers were at Maholane and Mahotas.

In responding on the possibility of DDT finding its way into agricultural use as a pesticide, two respondents claimed to know farmers in Machava using it illegally. (The questionnaire is annexed).

**Pictures from the field survey**

Photo 1. Matola river

Photo 2. Farmers in Namaacha at the obsolete POPs store

Photo 3. Primary school after rain at Dondo and Moamba

Photo 4. Moamba DDT Storage

Photo 5. Maputo

Photo 6. Mahotas farm

## Malaria spraying campaign in Mozambique

The Ministry of Health together with the Ministry of Environment and Land conduct once a year a malaria spraying campaign throughout the country.

## Malaria control spraying campaign

Photo 7. Preparation for spraying

Photo 8. Preparation for spraying 2

Photo 9. DDT sachets

**Table 1. Number, estimated amount and location of sites with *known* DDT stockpiles (stores and/or landfills):**

| Province | Quantity (metric tonnes) | Description |
|---|---|---|
| Maputo city | 40 litres | Liquid waste |
| Maputo province | 970 sachets | Empty |
| Gaza | 136901 sachets | Empty |
| | 42 drums | Liquid waste |
| | 10000 sachets | Empty |
| | 8 drums | Liquid waste |
| | Not quantified still in evaporation tank | Solid waste |
| | Not quantified still in evaporation tank | Solid waste |
| Sofala | 2 drums | Solid waste |
| | Not quantified still in evaporation tank | Liquid waste |
| Cabo Delgado | 20 kg | Solid waste |

## 2.3 Challenge and gaps identified

There are a number of challenges and gaps in chemicals management including DDT which were observed during the project. These include:

i) Inadequate information and environmental awareness on the sound management - use, handling, transport and packaging.

ii) Lack of appropriate storage facilities and lack of adequate disposal of waste and obsolete stocks /materials.

iii) Contamination of soil, water and air due to poor management likely affects fertility of soils hence quality of products, and contamination throughthe food chain.

It was noted that the following procedures were established for insecticide sachets at the warehouse:

a). On arrival at the warehouse, lot numbers and quantities of insecticide were registered on a shelf inventory card.

b). Requisition goes to the warehouse where distribution takes place and signed for, based on sachet numbers.

c). Five to six (5-6) sachets are issued to each spray operator, with their code written on the sachet.

d). At the end of the day, empty and full sachets were returned and number checked against what was signed for.

e). The next day all previously signed but unused sachets were re-issued and again signed for by the relevant spray operator.

f). At the end of the spray round, remaining stock was checked if less or equal number of sachets distributed.

The process needed monitoring to ensure proper implementation and compliance to WHO guidelines which however was not usually fulfilled.

## 2.4 Addressing challenges and gaps identified

Results of the stakeholder consultation meetings indicate that the following issues are critical to the malaria control program and need to be addressed:

i) It is necessary to involve all stakeholders, particularly the community in planning malaria interventions.

iii) It is imperative to conduct training, not only for spraying team, but also supervisors and communities involved.

iii) There is a need to develop or identify possible mitigation measures for the malaria incidence and its control measures.

iv) The need to create strong social mobilization and participation for malaria prevention.

v) Current infrastructure is inadequate for appropriate storage of insecticide (Boane and Moamba), need to be upgraded. Storage facilities need to be standardized.

vi) Need for institutional collaboration for example between MINAG, Minister of Environment and MASA.

**Policy requirements**

There is a need for the country to comply with the reporting requirements according to the Stockholm Convention.

a. Avoid DDT use in communities to protect their health and export agriculture.
b. Continue to develop mechanisms to ensure that DDT use is restricted to disease vector control (in this case malaria control only when there is no other option).

## Alternatives

The following pesticides are registered in Mozambique, and available for use for IRS, and covered by the the Supplemental Environmental Assessment (SEA). They are Alpha-cypermethrin WP, Bendiocarb WP, Deltamethrin WP and WG, Etofenprox WP, Lambda-cyhalothrin WP and CS. However. in the long-term, larviciding and environmental management should be pursued to provide an integrated malaria vector control strategywith participation of all stakeholders. These interventions are not covered by the SEA.

**Table 2. DDT alternatives and malaria control measures used in Mozambique**

| Alternative control interventions | Disease targeted | Product, formulation, % a.i., quantity per year per year applicable | Source (country) (import/local) |
|---|---|---|---|
| Microbial larvicides & biological control | | | |
| | | | |
| Indoor residual spraying with insecticides other than DDT | Malaria | Deltamethrin, WG, 25%, 6153 | India |
| | Malaria | Pirimiphos-met, 300CS,111424 | Switzerland |
| | | | |
| Insecticide-treated nets | | | |
| | Malaria | Permethrin 20g/kg, 16557818, | India, China, Tanzania |
| | | | |
| Others (specify) | | | |
| | | | |
| Others (specify) | | | |
| | | | |
| Others (specify) | | | |
| | | | |

## 3. Project Outcome

### 3.1 Activities conducted

The following Table 3 indicates the activities conducted by the project
Table 3. Activities conducted during the project time

| | What / activity | Responsible | Observation/ purpose |
|---|---|---|---|
| 1 | DDT field data collection | AFSD | Site observation, access to spray and contaminated areas |
| 2 | DDT desktop research | AFSD | Literature review |
| 3 | Meeting with relevant stakeholders | AFSD / Mitader/Masa / MISAU | Consultation and fact finding. |
| 4 | Meeting agro-chemicals providers | TM, Lucia SDAE / Suppliers | Consultation meeting, chemicals stock control systems |
| 5 | Meeting with the Provincial officers | AFSD/ Namaacha Administrator M. Suzete Danca and other stakeholders and farmers | Discussed on DDT and possible partnership to disseminate more information on DDT within other communities:<br>a.Discussion on the POPs, DDT and HHPs situation in the country<br>b. Develop a new agriculture campaign for 2019 |

### 3.2 Outreach to Stakeholders: Stakeholders and sectors engaged and follow-up plan

The table 4 below indicates the list of stakeholders engaged in following up of the plan.

Table 4. List of stakeholders and actors engaged in the project follow up

| Targets | Responsible | Follow up |
|---|---|---|
| Political decision makers | Regional governments, Regional economic bodies, Government (cabinet), Local government and Councilors | Political decisions are made that support implementation of DDTuse and alternative-related activities in Mozambique including legal and financial decision. |
| Donors/ Development Partners | Donors in the healthsector | Funding research and use of safer alternatives to malaria control. |
| Natural Resources Managers (national level) | Local and International NGOs, Community Based Organizations | Being able to integrate DDT use and alternatives in the country and support activities undertaken by civil society. |

| | | |
|---|---|---|
| National / Local public authorities | National Environment Management Authority<br>Ministry of Industry and Energy<br>Ministry of Agriculture | Increased awareness on DDT and alternatives |
| Public and private Sector | Environment Committees<br>Public Health Department<br>Local Councils and Police<br>Community Development Office<br>Own council/ Municipal/District Assemblies | Awareness raised for better resource utilization – change in behavior to prioritize environment and human health and safety. |
| Informal sector business operators | Vendors, retailers, customers | Awareness raised for better resource utilization – change in behavior to prioritize environment and human health and safety. |
| Research and Academia | Research Institutions<br>Schools and other learning/ teaching institutions | Awareness raised for better resource utilization – change in behavior to prioritize environment and human health and safety. |
| Media houses | Journalists (as individuals)<br>Managers of Media houses | Improved coverage on POPs (DDT) issues in the media |
| Communities | Local dealers/ stockiest<br>Chemical dealers<br>Women, Children and the youth<br>Vulnerable groups | Awareness raised for better resource utilization – change in behavior to prioritize environment and human health and safety. |
| Health care providers | Hospitals<br>Health centres<br>Local Clinics<br>VHTs | Capacities built to appreciate the dangers of DDT and POPs general. |
| Other partners | Regional Working Group Committees (Steering Committee, Technical Committee, National Working Group)<br>The general population,<br>Cross-border initiatives,<br>Representatives of vulnerable groups e.g. disabled | Capacities built to appreciate the dangers of DDT and POPs general |

### 3.3 Communication efforts with national or local authorities

The level of knowledge on DDT is different for the different categories of audiences, while the capacity for assimilation of knowledge and change of behaviors also varied. Knowledge, awareness and communication canbediversified in different forms and combinations depending on the target group.

Key messages –They were developed through a participatory approach with the beneficiaries during the field survey.

Table 5 below is a summary of priority areas/ themes, information needs, appropriate messages related to DDT and appropriate channels for communicating the messages to the different target audiences:

Table 5. Summary of priority areas for communication

| Message | Information needs | Key messages |
|---|---|---|
| Understanding DDT | Introduction of DDT<br><br>Characteristics of DDT -<br>High persistence in the environment, bioaccumulation, long-range transport.<br><br>High toxicity with serious human and environmental effects<br><br>The Stockholm Convention on POPs aims at protecting human health and the environment from these hazardous chemicals through the elimination or reduction of their emissions and releases. | Characteristics of DDT<br>High persistence in the environment and<br>High resistance to degradation<br>Environmental pollutant.<br><br>DDT is toxic chemicals that cannot be decomposed<br><br>DDT is banned for any other use except for specific exemption for disease vector control i.e. malaria control. |
| Women empowerment in POPs related issues (majority of women are involved in agricultural production) | Information on exposure to DDT and related chemicals and how it exposes women and the unborn babies to health disorders | Exposure to DDT andrelated chemicals is harmful to expectant women and nursing mothers, and children |
| Information on proper handling, storage, application anddisposal of chemicals | Information on proper handling, storage, application and disposal of chemicals.<br><br>Information on safety procedures about use of chemicals including DDT.<br><br>Information on affordable safety wear/ protective gear, availability and access of safety wear.<br><br>Information on where to purchase genuine products when needed.<br><br>Appropriate disposal mechanisms forDDT and other POPs chemicals | Keep children, expecting and nursing mothers far from spraying areas (targets farmers and community).<br>Buy chemicals from approved dealers – do not buy from hawkers and open market dealers who might be selling fake and sub-standard chemicals.<br><br>Wear protective gearswhen applying toxic pesticides and other chemicals.<br><br>Seek professional /extension officers advise<br><br>Seek professional /extension officers advise |

# 4. Recommendations

The objective of the Stockholm Convention is to protect human health and the environment from persistent organic pollutants which started with the initial list of 12 chemicals including DDT.

Article 7 of the Convention obliges each Party to develop and implement national implementation plan (NIP) of its obligations under the Convention. However, current global chemicals and waste management is still weak due to lack of adequate funding to implement the existing instruments and the NIPs with limited stakeholders involvement.NIP development/ update has to be coupled with effective communication strategy tools. The following are recommendations for effective communication:

1. Identify and empower key target groups including women, children and workers with adequate knowledge, positive attitudes, skills and techniques to address issues of POPs in particular on DDT and alternatives.
2. Lobby and advocate for involvement of all potential partners in awareness campaigns including NGOs, CSOs, the private sector, religious institutions, research and training institutions and mass media among others.
3. Training of active local community-based organizations andother stakeholders and players at the community levelon community monitoring and documentation of chemical incidences, information exchange, dissemination and networking.
4. Develop awareness raising materials, communication messages related to POPs (especially DDT), translations of key information materials into local languages and disseminating them through appropriate channels.
5. Carrying out periodical monitoring and evaluation of the malaria control programs.
6. Develop and or review policy requirements for the spray before the next spray season to identify its need [4]

**Recommendations in removing the existing DDT stock**

In order to safely remove and dispose of the remaining DDT stock, it is proposed to develop a precise terms of reference for planning and resolving logistics related to environmental monitoring, resource mobilization (financial, human/technical), and training of relevant actors. It is also necessary to compile and quantify evidence of unintended socio-economic costs of DDT use, and appropriate disposal options.

[4]http://documents.worldbank.org/curated/en/770921468060916061/pdf/E17060EA0Report0P099930.pdf

## 7. Resources


1. https://eprints.lib.hokudai.ac.jp/dspace/bitstream/2115/73891/1/BECT_DDTs_in_fish_LT_REVISIONS_20180209_clear.pdf
2. https://academic.oup.com/jme/article/45/5/885/942718
3. https://scienceblogs.com/deltoid/2006/04/23/mozambique-and-ddt
4. http://documents.worldbank.org/curated/en/770921468060916061/pdf/E17060EA0Report0P099930.pdf
5. http://www.pops.int/

# Annexes

## Field survey questionnaire

1. Name:
2. Gender:
3. Area:
4. Were there children in the household during DDT spraying?
5. How many children under the age of 18 in your household when it was sprayed with DDT?
6. How would you describe the adequacy of information shared with you on the safety of the insecticides used for indoor residual spraying?
7. How many times over the past 5 years has the home in which you live has been sprayed with DDT?
8. How satisfied are you with the use of DDT to protect your household from malaria causing mosquitoes?
9. Have you ever complained with reference to DDT application for malaria mosquito control in your home?
10. Have you ever refused to allow the spray of DDT into your home? Why?
11. Were you provided with information on the safety of the material / chemicals used to spray your home?
12. In which ways have you been exposed to DDT or other pesticides?
13. Have you had to visit a local health clinic for the reasons stated above?
14. Which Clinic have you visited for treatment?
15. How many days of work did you miss, as a result of these symptoms.
16. What is the likelihood that DDT finds its way into agricultural use as a pesticide?