

Summary of the POPs Toolkit

The Regional Capacity Building Program for Health Risk Management of Persistent Organic Pollutants (POPs) in South East Asia Project, referred to as the "POPs Project", was developed to complement the National Implementation Plans for the Stockholm Convention on Persistent Organic Pollutants (POPs). The POPs Project is designed to respond to the needs for enhancing the capacity, understanding and use of a risk-based approach to manage POPs and POP-like chemicals in Cambodia, Lao PDR, Malaysia and Thailand. Improved regional cooperation on a broader list of pollutants, including persistent toxic substances (PTSs) is a secondary objective of the program.

Funding for the POPs Project is provided by the Canadian International Development Agency's (CIDA) POPs Fund, and is coordinated by the World Bank. Hatfield Consultants was commissioned by the World Bank to implement the technical components of the Project. Complementary program activities are also implemented by national consultants and World Bank staff.

1.0 OBJECTIVES

The toolkit is the main output of the health risk management component (component 2) of the POPs project. The goal of this component is to enhance the capacity of key decision makers to apply the understanding gleaned from risk assessment (RA) component in order to set risk management strategies and identify priority interventions to reduce risks to an acceptable level. The component's focus is on development of a **health risk management toolkit** to provide guidance on:

- (i) evaluating health risks from exposure to chemicals in locally relevant sectors based on standardized guidelines; and
- (ii) developing strategies for the management of human health risks through regulation, monitoring, and evaluating alternative scenarios.

The toolkit is also used as a repository of the training materials for the National Training Workshop organized in Cambodia, Malaysia, Thailand and Lao. The training is intended to provide general knowledge on the risk assessment process and management for POPs and other hazardous chemical substances, and also to raise awareness of information and tools available on the POPs Toolkit.

2.0 MAIN CHARACTERISTICS

The purpose of the POPs Toolkit is to provide basic information for managing POPs (and other hazardous chemical substances) contaminated sites using a human-health risk assessment process. The POPs Toolkit has been implemented as a website - located at www.POPsToolkit.com and on a CD-Rom - which allows for all content and tools to be accessed past the term of the POPs Project.

The POPs toolkit has been designed for an audience with diverse backgrounds and levels of experience; hence the toolkit has to accommodate readers with a variety of educational backgrounds, English language skills, and differing levels of experience in the use of e-learning tools. The navigation, interactivity, contents and appearance of the application have been developed with these key points in mind.

3.0 ARCHITECTURE

The content in the toolkit is presented using a combination of HTML, JavaScript and Adobe Flash. Interactive tools have been developed using web based scripting technologies. The use of these technologies ensures compatibility with all web browsers used by toolkit users.

To ensure that the final product is of the highest possible quality, a quality assurance protocol was defined at the beginning of the content development phase. Throughout the content development process, all text and other content units have been reviewed by the production team in order to assess what types of supporting elements might be developed.

Following internal quality control steps, the final phase of quality assurance is client and end-user review of all contents. This client and end-user review has included three actions:

- The Review Mission by the World Bank and Hatfield Project Team to four countries in October and November 2008;
- Toolkit Consultation Meetings in all four countries in December 1 - 19, 2008; and
- On-line discussion using the discussion board in the knowledge sharing and collaboration section of www.popstoolkit.com.

4.0 TOOLKIT CONTENT

Major toolkit themes/sections include:

- POPs Toolkit Process for Managing Contaminated Sites
- About Persistent Organic Pollutants;
- Site Prioritization for Risk Assessment;
- Field Sampling Procedures;
- Human Health Risk Assessment;
- Risk Management;
- Economic Valuation of Risk Management Measures;
- Case Studies; and
- Project Reports.

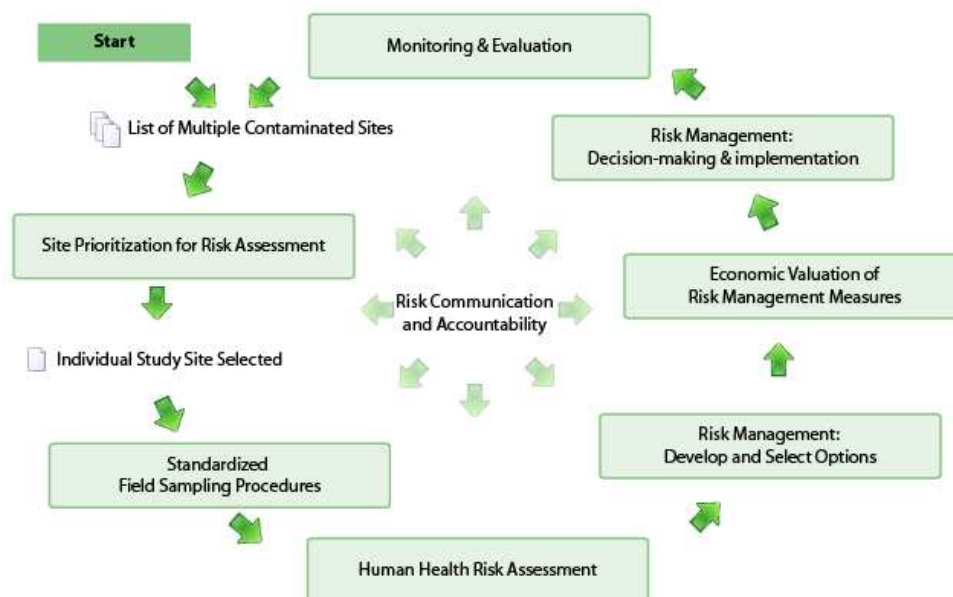
Each main theme/section is accompanied by a sub-topic menu that contains interactive tools and training material.

The followings are brief description of each section and its sub-sections:

4.1 POPS TOOLKIT PROCESS FOR MANAGING CONTAMINATED SITES

The home page of the POPs Toolkit shows the recommended process for managing contaminated sites. This diagram is clickable on the Toolkit which allows for the training and tools available for each step to be easily accessed.

Figure 1 The POPs Toolkit Process for Managing Contaminated Sites.



4.2 ABOUT PERSISTENT ORGANIC POLLUTANTS

This section contains information about the persistent organic pollutants (POPs), and their health and environmental impacts, about the Stockholm Convention on POPs, profiles of various POPs, and links to major POPs related web-sites.

The reader may find more useful information by clicking on relevant links such as:

- The Concern About POPs
- Human Health Implications
- Possible Human Exposure Pathways
- The Stockholm Convention

- POP Substance Profiles
- POPs Use in South East Asia
- Articles about POPs
- Links to POPs Websites

4.3 SITE PRIORITIZATION FOR RISK ASSESSMENT

The Site Prioritization for Risk Assessment section of the toolkit aims to provide countries with the tools to prioritize contaminated sites for further investigation among multiple sites in a country.

In this section, two semi-quantitative tools – a *Site Pre-Screening Tool* and a *Site Prioritization Tool* - are provided that allow the user to determine which sites should be assessed, and then to prioritize sites based on their potential for causing unacceptable risks to humans and/or the natural environment. The tools leads the user through a series of questions regarding: contaminant characteristics, off-site migration potential, exposure and socio-economic factors. Based on the user's answers, a semi-quantitative score for a site is given which indicates the site's priority for proceeding to the data gathering and risk assessment stage.

4.4 FIELD SAMPLING PROCEDURES

The section “**Field Sampling Procedures**” contains important guidance and key steps in collection and analysis of samples for selected risk assessment sites. The use of Standard Operation Procedures (SOPs) facilitates sampling and analysis in a consistent and coordinated manner which helps ensure quality and comparability of the laboratory analytical results. The SOPs provided in the Toolkit were developed based on the 2007 UNEP Guide Guidance for Analysis of Persistent Organic Pollutants (POPs) and Hatfield's Standard Operation Procedures Manual (2008), and Hatfield's first-hand knowledge and experience with similar field assignments in the South East Asia.

In addition to striving for simplicity and clarity of the sampling program design, and establishing clear expectations for analytical performance and QA/QC, the SOPS help foster continuity, inclusiveness and transparency during data collection and analysis

The section covers a wide-range of sub-themes:

- Objectives of Standard Operating Procedures and General Principles
- Field Sampling Design
- Quality Assurance and Quality Control (QA/QC)
- Field Sampling Organization

- Field Equipment
- Example Field Data Sheets
- General Sample Collection and Analysis
- Sample Handling
- Number of Samples Needed
- Data Quality Analysis and Management
- References for further reading.

The following sampling methodologies are presented using step-by-step instructions that are illustrated using photographs:

- Soil
- Sediment
- Fish Tissue
- Human Blood
- Bird Tissue
- Indoor Dust
- Oil Testing
- Human Exposure Survey
- Socio Economic Study
- Human Breast Milk
- Air Quality

4.5 HUMAN HEALTH RISK ASSESSMENT

This section of the POPs Toolkit provides an introduction to Human Health Risk Assessment (HHRA) as well as several interactive tools – a *Problem Formulation Tool* and *Risk Calculation Tools*.

AFTER REVIEWING THIS SECTION THE READER SHOULD:

1. Know the components of a risk assessment;
2. Know how risk assessments are conducted;
3. Be able to use some basic equations to calculate human exposure to contaminants via ingestion, inhalation and dermal contact;
4. Be able to make screening level risk estimates using exposure data; and
5. Understand the difference between threshold and non-threshold contaminants

4.5.1 Human Health Risk Assessment Overview

In this sub-section, the reader is lead through an iterative process leading to the quantification of potential risk due to POPs (and other hazardous chemical substances) on a contaminated site.

The main components of a risk assessment are:

- *Preliminary data collection* - to choose data quality objectives and to gather data;
- *Problem formulation* - to define the problem by identifying the three **components** of risk (chemical hazard, pathway and receptors) and developing a conceptual exposure model to illustrate and explain how these three components form the potential for health risk;
- *Exposure and toxicity analysis* - to quantify exposure (or dose) as well as the toxic potency of the chemical hazard(s); and
- *Risk characterization* - to integrate the information from the exposure and toxicity analysis to derive a quantitative estimate of human health risk.

4.5.2 Preliminary Quantitative Risk Assessment (PQRA)

Risk assessments start off simply, using a minimum of data, making simple assumptions and using simple calculations. At this initial stage, the methods and assumptions prescribed in a Preliminary Quantitative Risk Assessment (PQRA) are conservative and generally ensure that risks are not underestimated. Thus, if acceptable or negligible risks are predicted, then it is almost certain that risks are either acceptable or negligible. If the earliest iterations of the risk assessment predict high potential of risk, it doesn't necessarily mean that there is elevated risk, but additional work needs to be done to refine the risk assessment.

4.5.3 Risk Assessment Problem Formulation Worksheet Tool

In the Risk Assessment Section a tool has been provided that helps the risk assessor to identify the components of the risk assessment. The reader may use this worksheet to think through all parts of the problem formulation.

4.5.4 Risk Calculation Tools

Two quantitative risk calculation tools are provided that help to calculate contaminant exposure (i.e., dose) via ingestion, inhalation and dermal contact. Because of their differing characteristics, two calculation tools are provided based on the chemical of concern:

- **RISK CALCULATION TOOL FOR A NON-CARCINOGEN (THRESHOLD) CONTAMINANT - FOR A NON-CANCER CAUSING SUBSTANCE OR AGENT; AND**

- **RISK CALCULATION TOOL FOR A CARCINOGEN (NON-THRESHOLD) CONTAMINANT - FOR A SUBSTANCE OR AGENT THAT IS CAPABLE OF CAUSING CANCER IN HUMANS OR ANIMALS.**

4.5.5 Ecological risk assessments and other references

The Risk Assessment Section also provides background information on the ecological risk assessments, and key references for further reading.

5.0 RISK MANAGEMENT

The Risk Management section of the POPs toolkit leads the reader through the process related to managing unacceptable human health risks at POP (and other hazardous chemical substances) contaminated sites. After reviewing this section the reader should:

- be familiar with the process leading to the choice of risk management strategies; and
- be able to identify priority interventions to reduce risks to an acceptable level.

5.1 RISK MANAGEMENT LINKAGES WITH RISK ASSESSMENT AND ECONOMIC VALUATION

Quantitative Risk Assessment results, and the results from the first stream of the economic valuation (where the cost of impacts are calculated) feed directly into the Risk Management phase. With this information, the Risk Management process is used to:

- Decide whether a level of risk is acceptable in a larger context (socially, economically and politically);
- Select risk reduction options (i.e., either technical or policy-based solutions);
- Then return to the Economic Valuation to calculate the cost-benefit of selected remediation or risk management options; and
- Risk management actions continue through implementation, risk communication and monitoring/evaluation stages.

5.2 KEY CHARACTERISTICS OF EFFECTIVE RISK MANAGEMENT

In order to be effective and successful, risk management strategies need to remain *up to date*, be *participatory*; *be well informed and be contextual (i.e. be appropriate to the local* political, cultural and socio-economic context).

5.3 RISK MANAGEMENT PROCESS

The Risk Management training module is given in five major steps:

- (i) Baseline Review;
- (ii) Setting Risk Reduction Goals;
- (iii) Developing and Evaluating Management Options;
- (iv) Risk Communication and Policy Making; and
- (v) Monitoring and Evaluation.

This process can be used for planning risk management activities on either a site-specific or a nation-wide basis.

5.3.1 Baseline Review

Doing a baseline review includes developing two items:

- The **situation statement** that assesses: i) where challenges and opportunities may exist; ii) strengths and weaknesses of the legal, technical, administrative or institutional aspects, and knowledge; iii) why exposure to a chemical is occurring; and iv) the broader environmental and socio-economic context of a chemical-related problem; and
- The **Problem Statement** which: i) relates the main conclusions of the situation analysis to the broader chemicals management context; ii) develops the problem statement, i.e. the main reasons for risk reduction measures (magnitude of severity; persistence; reversibility; current or potential etc.); iii) characterizes associated main environmental and human health risks; and iv) specifies particularly vulnerable target groups or stages in the chemical's life-cycle.

5.3.2 Setting Risk Reduction Goals

Setting clearly defined goals that protect human health and/or the environment from POPs (and other hazardous chemical substances) related risks provide the framework and benchmarks for monitoring and evaluating Risk Management Options. Setting Risk Reduction Goals involves the following sub-tasks:

- Develop a well-defined risk reduction goals to address the chemical problem through a transparent and participatory process;
- Prioritize problem-solving sub-goals in order to reduce risks to human health and the environment in order of importance;

- Link the selected goal and/or sub-goals into the wider national chemicals forum; and
- Establish qualitative and quantitative indicators to benchmark progress towards attainment of the goal and/or sub-goals.

5.3.3 Developing and Evaluating Management Options

The main output of the *Developing and Evaluation Management Options* step is an evaluation of the advantages and drawbacks of various risk reduction options that can be used to prevent, reduce or mitigate the risk of concern. This involves:

- Compiling an open-ended list of known risk reduction measures as options, technology and process to address the identified POPs (and other hazardous chemical substances) risk;
- Identifying the options that make existing measures more effective and outlined new initiatives;
- Considering whether all the options listed will achieve the required risk reduction goal, bearing in mind risk factors;
- Obtaining key stakeholder agreement on which decision-criteria to use in order to select management options; and
- On the basis of the decision-criteria, evaluating strengths & weaknesses of each option.

5.3.4 Risk Communication and Policy Making

The main purpose of the *Risk Communication and Policy Making* step is to discuss how Risk Management strategies can be communicated to the public, and be mainstreamed into the national political agenda.

This step involves:

- Identifying the decision-makers who need to endorse/adopt relevant documents (policy, strategy, program, project etc.) and provide them with relevant knowledge and information product;
- Selecting and conducting appropriate communication approaches and activities for different stakeholders;
- Identifying whether any initial steps are needed to ensure effective implementation, e.g. training of those involved in implementation; and
- Involving interested and affected parties and identifying milestones and other important timelines.

5.3.5 Monitoring and Evaluation

Monitoring and evaluation are integral parts of the risk management decision-making process. Monitoring and evaluating involves looking at how management measures were implemented in order to check for any deviation from the plans, and documenting the reasons for these deviations.

This step involves:

- Assessing if the agreed-upon goal and sub-goals were met or achieved, and, if the actions were cost-effective;
- Evaluating if further action is required to modify the strategy and/or to continue with the implementation; and
- Evaluating what lessons can be learned regarding the basis for the strategy, i.e. a review of adverse problems, unexpected effects, and institutional cooperation.

5.4 RISK MANAGEMENT OPTION EVALUATION TOOLS

The Risk Management section also contains two tools:

- I. A Tool to Develop Long List of Risk Management Options that helps user's long list of risk management options for his/her site to address components of risk – chemical hazards; pathway; and receptor; and
- II. A Tool to Evaluate Risk Management Options that helps users to assess and prioritize risk management options against selected criteria/balancing factors including:
 - Effectiveness;
 - Long term Reliability;
 - Ease of Implementation;
 - Implementation risk;
 - Cost for implementation; and
 - Cost for operation and maintenance.

6.0 ECONOMIC VALUATION OF RISK MANAGEMENT MEASURES

In order to provide guidance on managing contaminated sites, it is useful to provide a cost-benefit analysis of these management efforts.

The overall goals of an economic analysis are:

- to develop and implement a simplified economic evaluation process to help decision-makers assess whether implementing risk management measures at POPs (and other hazardous substance) contaminated sites represents a sound allocation of public resources; and
- to assess whether the benefits expected from such mitigation measures would, at a minimum, cover the costs.

6.1 THE IDEAL COST-BENEFIT ANALYSIS APPROACH

In the ideal case, a 4 step method could be applied to do a cost-benefit analysis:

1. Do an inventory of Project Benefits (including health and environmental benefits)
2. Assign a value of project benefits using a Total Economic Value (TEV) analysis
3. Assess project costs
4. Compare costs and benefits using standard economic measures of project viability

However, several limitations prevent the implementation of the ideal cost-benefit analysis process where data is limited:

- Difficulty of establishing a dose-response or exposure-response function for health impacts due to POPs (and other hazardous chemical substances);
- Difficulty of estimating the reduction in exposure achieved through a risk management scenario; and
- Limited data and knowledge gathering: in most developing countries, data is not available and the cost of data collection is economically prohibitive.

In consideration of these points, the ideal approach needs to be redefined or adapted. Therefore a refined and simplified methodology was developed in order to proceed with the economic analysis.

6.2 MODIFIED METHODOLOGY

Due to lack of data and knowledge, the economic analysis problem statement was reformulated to address the following:

Given the costs of the various risk management scenarios, how significant do the positive health impacts need to be to ensure the scenario would pass the cost-benefit analysis test where Net-Present-Value (NPV) > 0?

In order to fulfill this statement, three key steps are employed:

1. Risk Management Scenario Development;
2. Benefit Valuation; and
3. Forming Conclusions.

6.2.1 Risk Management Scenario Development

Risk management scenarios are developed using the methodology found in the Risk Management section of the POPs Toolkit. The selection of the best approach can be complicated and may depend on numerous factors (i.e., scientific, economic, social, political etc). Information required for the risk management comes largely from the human health risk assessment, but also considers cost, effectiveness and acceptability.

Unit costs for the risk management scenario need to be gathered using the best information possible and be adjusted to local conditions.

6.2.2 Benefit Valuation

In order to calculate yearly project benefits, the following assumptions are made:

- The time horizon over which benefits occur is set at 20 years;
- Benefits start in Year 2 (benefits are zero in year 1); and
- The benefits are the same each year from Year 2 to 20.

The benefits calculated are then translated into human health terms by the use of Disability Adjusted Life Years (DALYs). The DALY is an economic parameter which extends the concept of potential years of life lost due to premature death to also include equivalent years of “healthy” life lost due to poor health or disability (WHO, 2008). The DALY combines in one measure the time lived with a disability, and the time lost due to premature mortality, both of which are plausible outcomes of contaminant exposure.

Using Mrozek & Taylor’s Value of a Statistical Life (VSL) study, the value of a DALY in the US, in 2008, is estimated to be US\$ 120,000.

This estimate needed to be adjusted to reflect the present day situation in the local country. In order to accomplish this, the per-capita gross national product indicator is used to translate the value of a DALY in the US to the local country.

6.2.3 Forming Conclusions

At the completion of the benefit quantification step, the benefits of the risk management scenario have been quantified in terms of health impacts and as a percentage reduction in the total DALYs at the site.

Based on various sources, it is reasonable to expect that an investment in reduced chemicals exposure may be expected to result in a decrease in DALYs in the range of 0.06% - 0.25%.

As such, the percentage reduction in the total DALYs at the site can be compared to this 0.06% - 0.25% range. (Values falling below 0.06% are deemed to be economically feasible, those between 0.06% and 0.25% are probably feasible, and those above 0.25% are not feasible).

6.3 ECONOMIC VALUATION TOOL

The Risk Management Valuation Tool has three data input screens:

1. Unit cost worksheet;
2. Risk Management scenario worksheet; and a
3. Site information worksheet.

The steps involved with this tool follow the methodology described in the training module.

Using the Unit cost worksheet together with the Risk Management scenario worksheet, the costs of your risk management scenario are developed. Then, using the Site information worksheet, various site specific data is entered so that the health impacts of the risk management scenario can be determined. These results are compared in a resulting report provided by the tool.

7.0 CASE STUDIES

The Case studies Section contains the risk assessment and economic valuation reports for sites selected in Cambodia, Lao PDR, Malaysia and Thailand. These case studies present the results of human health risk assessment and risk management techniques applied to each case study site.

8.0 PROJECT REPORTS

All reports created in the POPs Project, including progress reports and workshop reports are made available in PDF format in the Project Reports section.