

## Rapid Environmental Assessment of POPs Pesticide Contamination Sites

A Simplified Method Developed for Vietnam



John Keith - Lead Technical Advisor  
Blacksmith Institute, New York  
29 May 2013



## Need for Rapid Environmental Assessment (REA) Method

- >800 identified POPs sites in Vietnam
  - Varying quality and quantity of data
- Limited resources – funds, qualified assessors
- Need to prioritize
  - Assessments
  - Detailed investigation and remediation work
- Focus – public health protection
- Common challenge in developing countries



## Types of POPs Sites in Vietnam



- Abandoned storage sites
- Bunkers used for storage or disposal
- Contaminated fields from spills, open storage

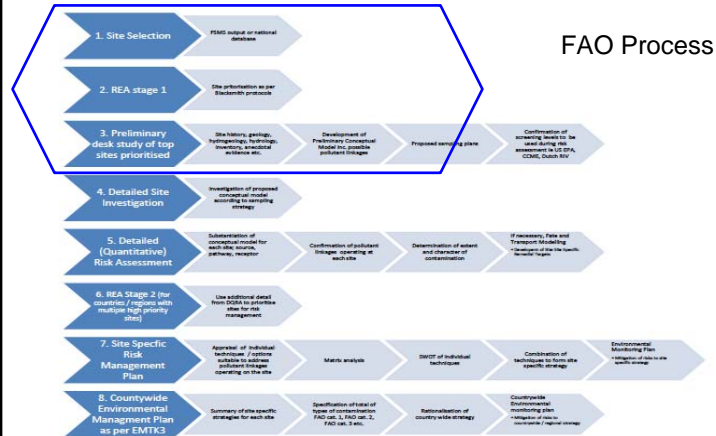


## Desires for an REA

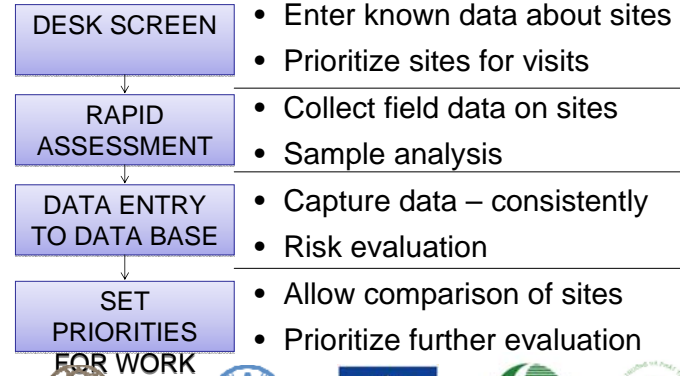
- Rapid, low resources – 1 or 2 days in field
- Doable with people with limited expertise
- Consistent methods, quality data
- Gain basic understanding of risks
  - Based on data, quality REA
  - Sufficient to set priorities for further work
- Build on FAO EMTK REA
  - Also learn from other REA processes



## Role of This REA in Investigation/Remediation Process



## REA Process



### Desk Screen

11 3846

Site Name: Province: North-Thai province

Latitude: 20.0786 Longitude: 102.280

Investigation Date (DDMMYY): The site has been used as a pesticide storage site

Suspected primary contaminant: Pesticides (including PCBCs) Sampling information

Water Stability (mg/L): 0

Soil Stability (mg/L): 0

Site Owner: [Redacted]

Site Owner Contact information: [Redacted]

When was the last data point collected used? Within 30 days

Soil Health (Score): 50

How frequently were pesticides used at the site? Frequent use

What quantity of pesticides were used at the site? Very Large

Population Density (per sq km): 20,380

Landuse: Closed to open broadleaved evergreen or semi-deciduous forest

Soil Type: Loamy sand

| Soil Texture | Clay (%) | Silt (%) | Sand (%) |
|--------------|----------|----------|----------|
|              | 273      | 234      | -141     |
|              | -154     | -146     | -69      |
|              | -33      | 17       | 1026     |
|              | 20       | 2        | -82      |
|              | -35      | -116     | -203     |
|              |          |          | -276     |
|              |          |          | -331     |

River within 2km? Yes

- Excel based system
- Capture known data
  - Location, geography
  - Population density
  - Pollutant type, amount
  - Sensitive receptors nearby – water, schools
- Use available GIS data
- Usually limited data

## GIS Data Upload for Desk Screening

- Readily available, relevant GIS data layers uploaded into desk screen data base
  - Population density
  - Land use
  - Key receptor locations
  - Rivers, streams, ponds
  - Elevation, slope
  - Soils
- Resolution an issue – 1 km in Vietnam
- Can upload through ArcGIS or Excel
  - Novel conversion of GIS data to Excel “pixels”
  - When ArcGIS not usable due to cost, expertise
- GIS data tied to site data by coordinates

## Prioritization from Desk Screen



- Data on POPs preloaded
  - Toxicity, safe levels
  - Half life, solubility, sorption info
- Conclusion - high, medium or low risk
  - Low <5, Medium = 5 – 15, High >15
  - High sites prioritized for site visits/REA

|                                      |             |
|--------------------------------------|-------------|
| Soil Type                            | 1 - 3       |
| Use Frequency                        | 1 - 4       |
| Severity                             | 1 - 3       |
| <i>(based on samples if avail.)</i>  |             |
| Half Life                            | time factor |
| Land Use                             | 1 - 3       |
| <i>(based on population density)</i> |             |

## REA Site Visit Process

- Plan visit
  - Review desk screen & other data
  - Prepare sampling supplies, arrange for labs
  - Notify local community leaders of visit
- Site visit
  - Go through evaluation questions
  - Prepare site map
  - Interview persons with site knowledge
  - Collect samples
  - Take pictures
- Brief, clear, detailed guidance provided to enable non-experts to do REA



## REA Field Questions

- Investigator led through REA by detailed questions
  - Pull down menus where possible
  - Space for text entry
  - Computer or paper
  - Excel based
- Sections for:
  - General site info
  - POP type & quantity
  - Release Risk
  - Receptor Risk

## Questions in the Field During REA

The screenshot displays the REA field data collection form. Key sections include:

- General Background:** Includes a dropdown for 'Housing / residential' and a table for 'List the number of people in the following categories'.
- Type and Quantity:** A table for recording 'Live', 'Work', and 'Visit' counts across different distances (On Site, Within 50 meters, Within 100 meters, Within 500 Meters).
- Release Risk:** Includes questions about animal access, distance to sensitive areas, and water use.
- Receptor Risk:** Includes questions about human ingestion, grazing patterns, crop production, and alternative water supply.
- Upload Site / Print Forms:** Buttons for site upload and printing.
- Language:** A dropdown menu set to 'English'.

## SOIL SAMPLING PROTOCOL FOR POPs

**HEALTH AND SAFETY**  
Follow health and safety guidelines detailed in the Investigator Handbook.

**MATERIALS REQUIRED**

- Clear polypropylene bags (15)
- Metal spoon (1)
- Labels for bags (10)
- Permanent marker (preferably Sharpie) (1)
- Nisipad (1)

**MAPPING**

A map should be made of the site that properly indicates sampling locations and key features. Key features include roads, rivers, and a pollution source. Electronic maps are preferable, though a scan of a photograph of a hand-drawn map is perfectly acceptable.

**INTERVIEWING**

Interviews with local residents and community leaders are key to understanding the pathways present. Try to understand which areas are commonly used and which are rarely used. This will help you to divide the site into sectors.

**ESTIMATING POPULATION**

Estimate the approximate number of people coming in to contact with the pollutant in each sector. If you are taking soil samples, the number should reflect only those coming into contact with soil. Make a note of the groups at risk (children, workers, etc.).

**COMPOSITE SAMPLING**

Divide the site into two to six sectors based on use. The following categories are recommended: residential, public, agricultural, industrial, and commercial. Larger sites will require as many as 6 sectors, smaller sites may be covered in as few as 2.

Depending on sector size, collect from 3 to 10 samples of surface soil per sector, evenly distributed. Note that larger sectors will require more samples. Each sample should be about one half liter (500 ml) of soil, 5 grams. Combine all the samples in the same bag and blend the material to form a composite. Label according to Labeling Samples instructions on reverse. (See Figure 2).

\*Note: Bulk sampling in Figure 2 will require 6 composite samples, one for each sector.

Legend: ■ Agricultural ■ Residential ■ Public

★ Hot Spot Samples

## REA Sampling Strategy

- Balance time & cost vs. data extent
  - Get enough data to understand risk
- Composite samples at & around source
  - Sectors by land use
  - Typically 5 -10 samples
  - Focus on surface
- Hot Spot samples
- Water samples

## Site Map Required

### MAP THE SITE

Draw or copy a map of the site that shows the pollution source, the pathways to humans, the location of your samples and any pollution hotspots, neighborhoods that might be affected, and any other relevant landmarks or sites.

A digital map is preferable, though hand-drawn maps are acceptable.

### DIGITAL MAPS

Digital maps can be drawn using [bing](http://www.bing.com/maps/) (<http://www.bing.com/maps/>), Google Earth or a number of other free software applications.

#### Bing Maps (Figure 1)

1. Right Click on location > "Add a Pushpin" Name and Save the Pushpin
2. Mark area of contamination using area tool in "My Places Editor"
3. Actions > Export > KML

#### Google Earth

1. Use Path tool to draw area.
2. Save Path
3. Right Click Path in Places Menu > Save Place As > KML



Fig. 1. Created in Bing Maps and exported to KML. This simple map sufficiently demonstrates the pollution source and affected area.

## Data Management

- Flexibility regarding how to save data
  - Computer in field, upload in office or by internet
  - Paper in field, transcribe in office
- Data saved in consistent format
  - Integrated with Desk Screen data
  - Unique ID for each site, by coordinates
- Data base searchable by key fields
  - Coordinates, geography, pollutant, risk, investigator, level of pollutants found, etc.
- Map display for sites

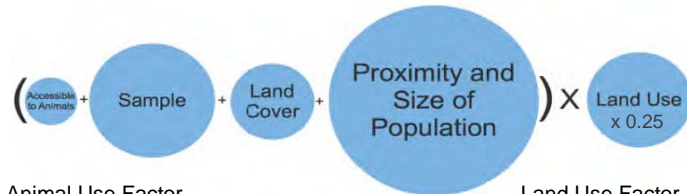


## REA Risk Evaluation Process

- Risk estimates for source, pathway, receptor
- Combine by addition to get composite risk
- Result: High, Medium or Low Risk
  - Process not sufficient for quantitative risk analysis
  - Qualitative scores for prioritization of further work
- Risk algorithms based on expert experience
  - Distance attenuation factors from USEPA
  - Half life in soil from data in literature
  - "Safe" levels from USEPA, others if not done by EPA



## Receptor Risk Algorithm



### Animal Use Factor

- 2 – milk, meat source
- 1 – other

### Sample Result Factor

For each composite sector sample, if:

- Sample <2xSL = 0
  - Sample >2xSL = 2
  - Sample >3xSL = 3
- Average all samples

### Land Cover Factor

1 – 4 Scale:

- 1 – pavement, to
- 4 – bare land

### Population Factor

Log (pop on-site) +  
0.5xlog(pop >50m ) +  
0.25xlog(pop>100m)

### Land Use Factor

0 – 5 Scale:

- 5 – houses, schools
- 0 – natural area, no human use

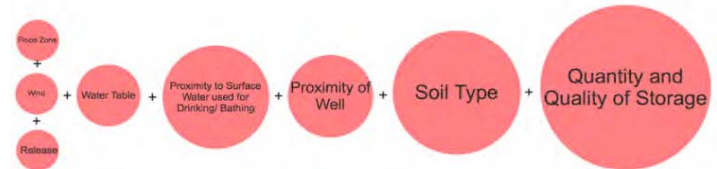
Low Risk = <5  
Medium = 5 – 9  
High Risk = >9

## Source & Pathway Risk Algorithms

Type and Quantity Risk = (Source Risk)



Release Risk = (Pathway Risk)



## Advantages and Limitations

- Low resource requirements
  - Short time, low cost
  - Can be done by non-experts
  - Commonly available, familiar software
- Incorporates international expertise
- Focuses REAs on sites mostly likely to be high risk through desk screen
- Searchable central database for all data
- Gain basic understanding of sites and risks
- REA not sufficient for intervention design
  - But can be adequate to determine no further work needed
- Method most applicable to smaller sites
  - Sites with a few specific pollutants rather than many

## Status and Next Steps

- Piloted by Vietnam Environmental Agency
  - Portions in use
  - Training and roll-out in planning
- Enhancements planned to allow more general use and integration in FAO POPs program
  - Other climates, geological situations
  - Other pollutants
  - Other types of sources



## Acknowledgements

Contributions to the development of this method are gratefully acknowledged:

- UN FAO: Kevin Helps
- Vietnam Environmental Agency: Vinh Thanh Hoang
- Vietnam Centre of Environment and Community Development (CeCoD): Duong Thi To
- Green Cross Switzerland: Dr. Stephan Robinson
- New York City University School of Public Health: Dr. Jack Caravanos
- Consultants: Nicholas Albergo (HSA Engineers), Andrew Maroko (GIS), Ding Dao (Vietnam advisor)



Thank you for your attention

