UNESCO-IWRA ONLINE CONFERENCE
17-19 JANUARY 2023
3RD IN THE IWRA ONLINE CONFERENCE SERIES

Emerging Pollutants: Protecting Water Quality for the Health of People and the Environment

How to prioritize agrochemical pollutant evaluation in drinking water? RISK21 tools provide a framework for chemical risk assessment

Eliana Munarriz PhD, MBA

17th January 2023 / 16:55 CET

unesco
Programme hydrologique intergouvernemental

IWRA International Water Resources Association

UNESCO-IWRA ONLINE CONFERENCE 17-19 JANUARY 2023 3RD IN THE IWRA ONLINE CONFERENCE SERIES

Health and Environmental Sciences Institute (HESI)

Developing science for a safer, more sustainable world.

MISSION: Collaboratively identify and help to resolve global health and environmental challenges through the engagement of scientists from academia, government, industry, NGOs, and other strategic partners. This mission is addressed within multi-stakeholder, global committees via:

- Development of decision frameworks
- Data sharing and collective analysis
- Novel experimental studies
- Peer-reviewed manuscripts
- Tool and assay development
- Scientific meetings and trainings

www.hesiglobal.org

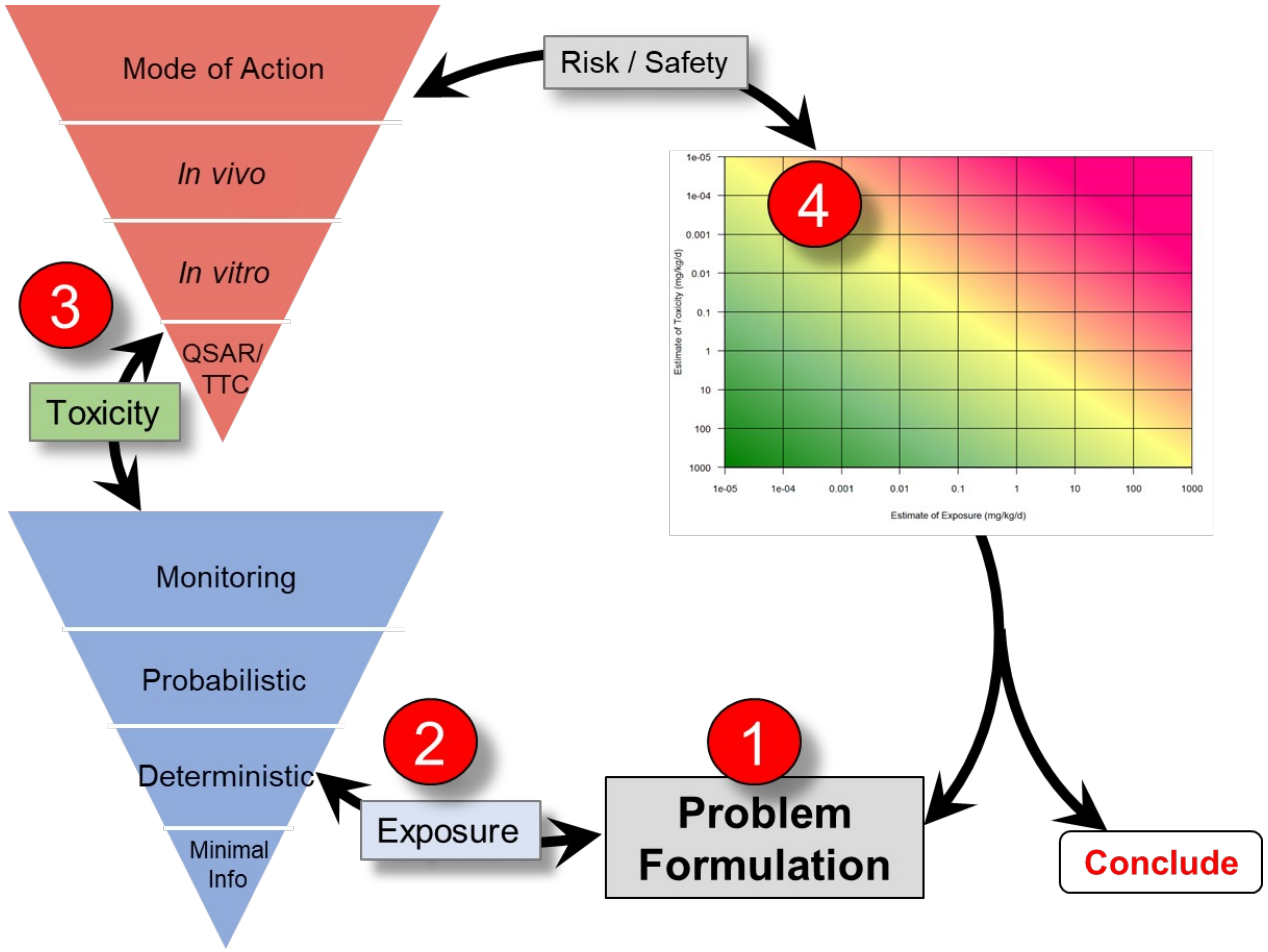
RISK21 and the Principles of Risk Assessment

Risk ≠ Hazard ≠ Exposure

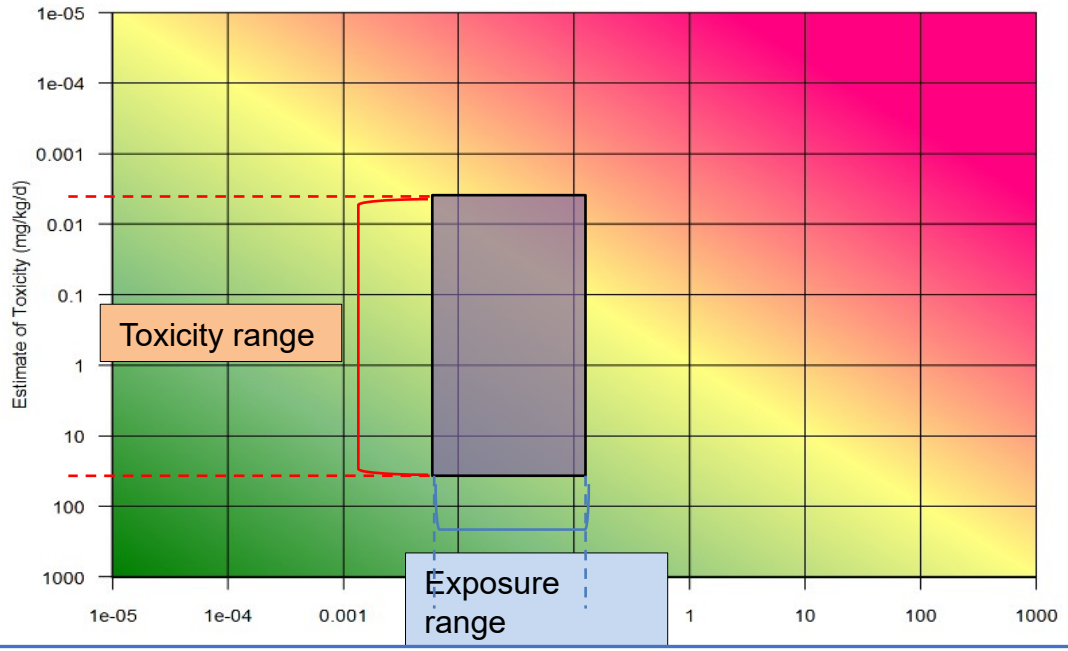
Risk = *ƒ* [Hazard x Exposure]

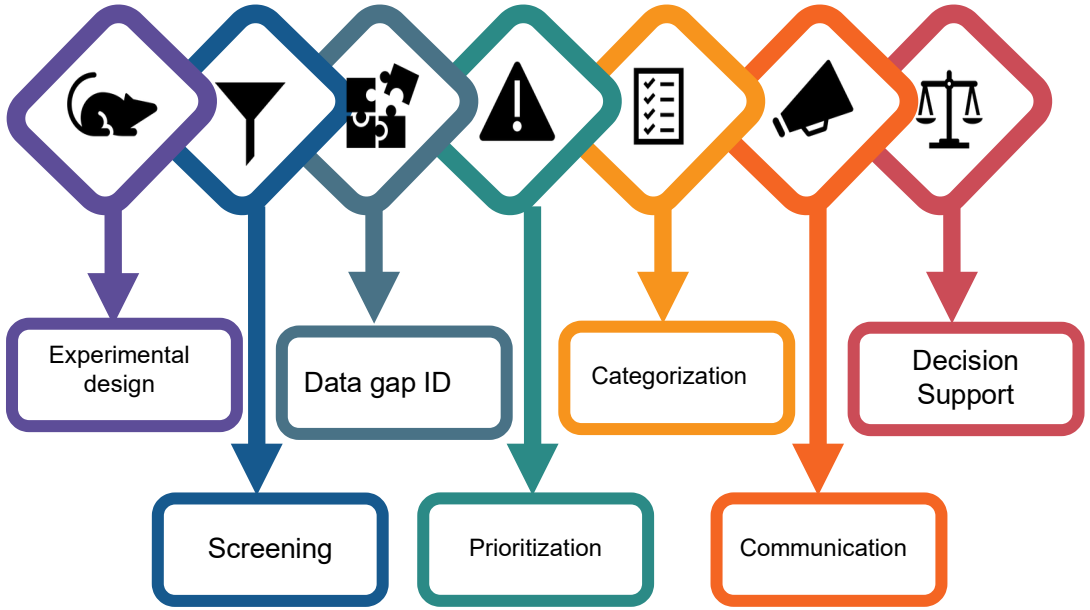
The probability of injury or illness resulting from the exposure to a potential hazard

RISK21 developed a conceptual framework for effective use of all relevant information for interactive and transparent evaluation of the sufficiency of exposure and hazard information to inform a risk-based decision.



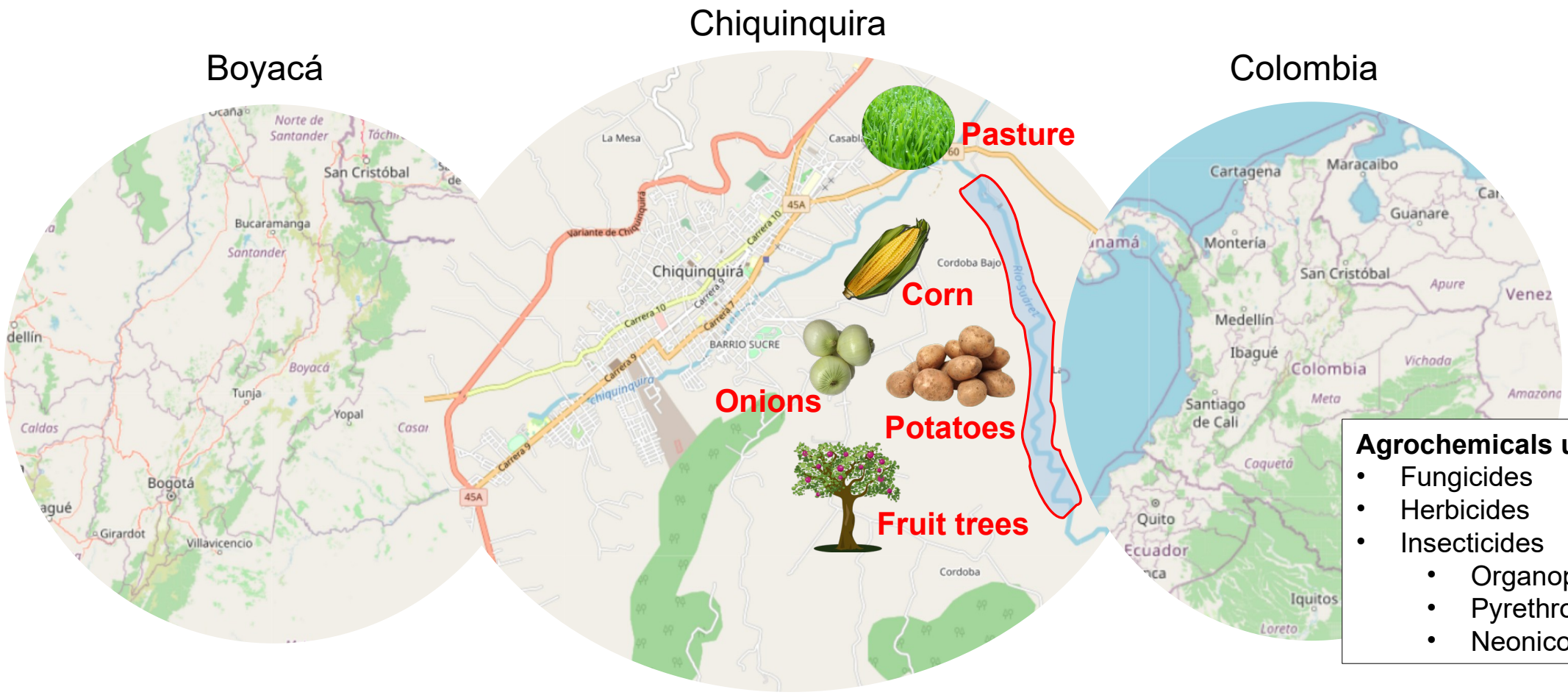
RISK21 Matrix and Applications





RISK21 approach takes advantage of existing information and aids in identifying when additional data are needed to make a decision.

Pesticide Monitoring in Colombia: RISK21 Application Example



Agrochemicals used:

- Fungicides
- Herbicides
- Insecticides
  - Organophosphates
  - Pyrethroids
  - Neonicotinoids

Objective and Scope of the Analysis

Evaluate which of the 4 insecticides most commonly used on potato crops in the Chiquinquirá region should be prioritized for monitoring or further evaluation based on a potential risk to human health through exposure via drinking water consumption.

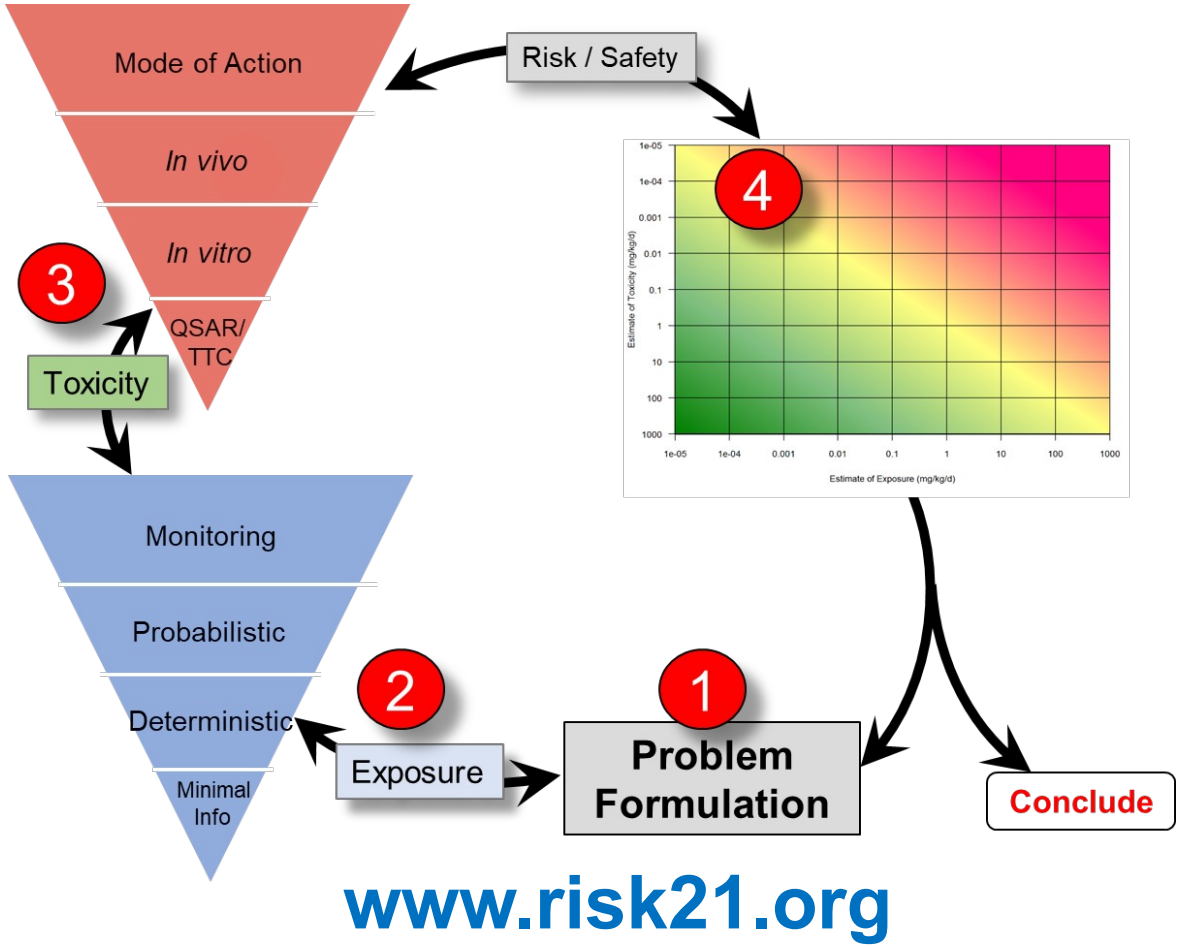
Main Insecticides Used on Potato Crops in Chiquinquirá

Pesticide	Chemical class	Mode of Action
Chlorpyrifos (CH)	Organophosphate	AChE inhibition
Lambda cyhalothrin (LC)	Pyrethroid	Disruption of voltage-gated sodium channels
Cypermethrin (CY)	Pyrethroid	Disruption of voltage-gated sodium channels
Thiamethoxam (TM)	Neonicotinoid	Interference with nicotinic AChE receptor

All of these pesticides have been used for over 5 years in the region

Available data and reliable studies are available

- Physical chemical properties
- Environmental fate studies (OECD Test Guidelines)
- Toxicity studies (Rodent studies with reference values)



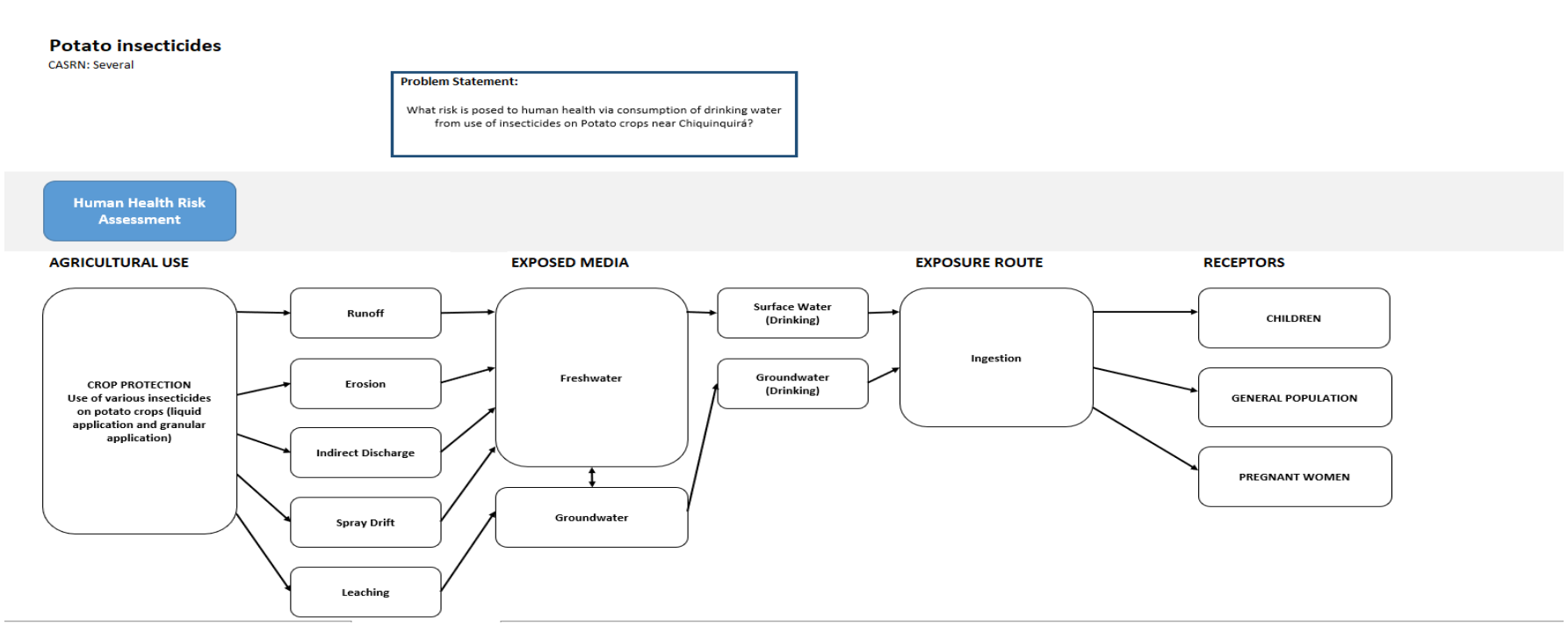
www.risk21.org

1

UNESCO-IWRA ONLINE CONFERENCE 17-19 JANUARY 2023 3RD IN THE IWRA ONLINE CONFERENCE SERIES

Problem Formulation

HESI-RAFT: Risk Assessment problem Formulation Tool



Identify which of the insecticides used on potato crops near Chiquinquirá should be prioritized for additional evaluation (or potentially monitoring) based on potential human health concerns from exposure via drinking water.

2

UNESCO-IWRA ONLINE CONFERENCE 17-19 JANUARY 2023 3RD IN THE IWRA ONLINE CONFERENCE SERIES

Factors that Impact Pesticide Exposure

- **Pesticide properties:**
  - **Half-life (soil, water, etc.)**
  - **Soil mobility**
  - **Water solubility**
  - **Microbial degradation**
- **Application rate & methods**
- **Drainage of agricultural fields**
- **Irrigation**
- **Soil type and topography**
- **Climate and rainfall**

OECD / ISO Guidelines In databases

http://sitem.herts.ac.uk/aeru/ppdb/en/index.htm

Pesticide labels

Hydrology information; built into some models

Specific to regions – integrated into some higher-tier models

Each region / country is unique!

**MUST consider relevant test conditions for the particular environment (e.g., pH, soil type, etc.)*

2

UNESCO-IWRA ONLINE CONFERENCE 17-19 JANUARY 2023 3RD IN THE IWRA ONLINE CONFERENCE SERIES

Information to Estimate Exposure

Pesticide	Soil half-life (days)	Water-sediment dissipation rate (DT50) (days)	Aqueous hydrolysis (DT50) (days)	Aqueous photolysis (DT50) (days)	Water solubility (mg/L)	Sorption coefficient (soil Koc; L/kg)
CH	150	36.5	53.5	29.6	1.05	5509
LC	175	15.1	Stable	40	0.005	283,707
CY	22.1	17	Stable	Stable	0.009	307,558
TM	50	40	Stable	2.7	4100	56.2

Application rate and method information

- Available on the pesticide label
- Country, region, and crop-specific
- Information available via user-surveys (e.g., farmers)

Concentration of AI: 480 g/L
Application rate (high): 1.0 L/ha
CH Application = **480 g/ha**

CULTIVOS	OBJETIVO BIOLÓGICO	DOSIS	P.C.	P.R.
Café	Minador *(Leucoptera coffeella)* Broca del café *(Hypothenemus hampei)*	1.0 L/ha	30 días	24 horas
Papa	Tostón *(Liriomyza sp.)*	0.5 - 1.0 L/ha	21 días	
Tomate	Cogollero *(Scrobipalpula absoluta)*			
Pastos	Chinche de los pastos *(Collaria columbiensis)*	0.25 - 0.5 L/ha	13 días	
Aguacate*	Picudo *(Heilipus lauri)*	0.6 L/ha	7** días	

Example for CH; labels accessed for the other 3 pesticides as well

2

UNESCO-IWRA ONLINE CONFERENCE 17-19 JANUARY 2023 3RD IN THE IWRA ONLINE CONFERENCE SERIES

Andean-specific Exposure Tool Development

- **Based on USEPA's GENEEC2 screening model**
- **VERY basic inputs (see table below)**
- **Provides conservative, screening-level surface water estimated environmental concentrations (EEC) in ug/L**
- **Allows calculation of risk quotients with input of aquatic toxicity data**

Pesticide	Soil half-life (days)	Water-sediment dissipation rate (DT50) (days)	Aqueous hydrolysis (DT50) (days)	Aqueous photolysis (DT50) (days)	Water solubility (mg/L)	Sorption coefficient (soil Koc; L/kg)	Application (g ai / ha)	Application method / type	EEC (ug/L)	Human Exposure via DW (ug/kg/day)
CH	150	36.5	53.5	29.6	1.05	5509	480 (1 application)	Tractor / High Boom; Fine / Medium spray	2.8	0.08
LC	175	15.1	Stable (110)	40	0.005	283,707	50 (1 application)	Tractor / High Boom; Fine / Medium spray	0.006	1.7×10^{-4}
CY	22.1	17	Stable (110)	Stable (110)	0.009	307,558	50 (1 application)	Tractor / High Boom; Fine / Medium spray	0.005	1.4×10^{-4}
TM	50	40	Stable (110)	2.7	4100	56.2	21.25 (1 application)	Granular	1.0	0.03

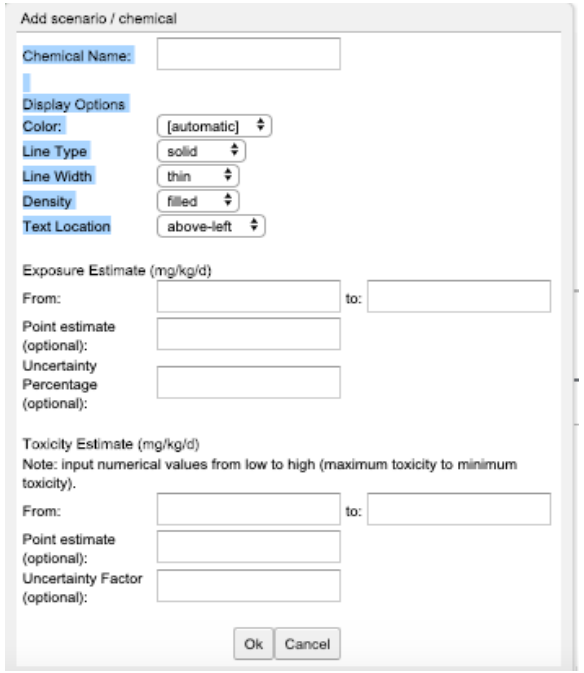
Toxicity Data

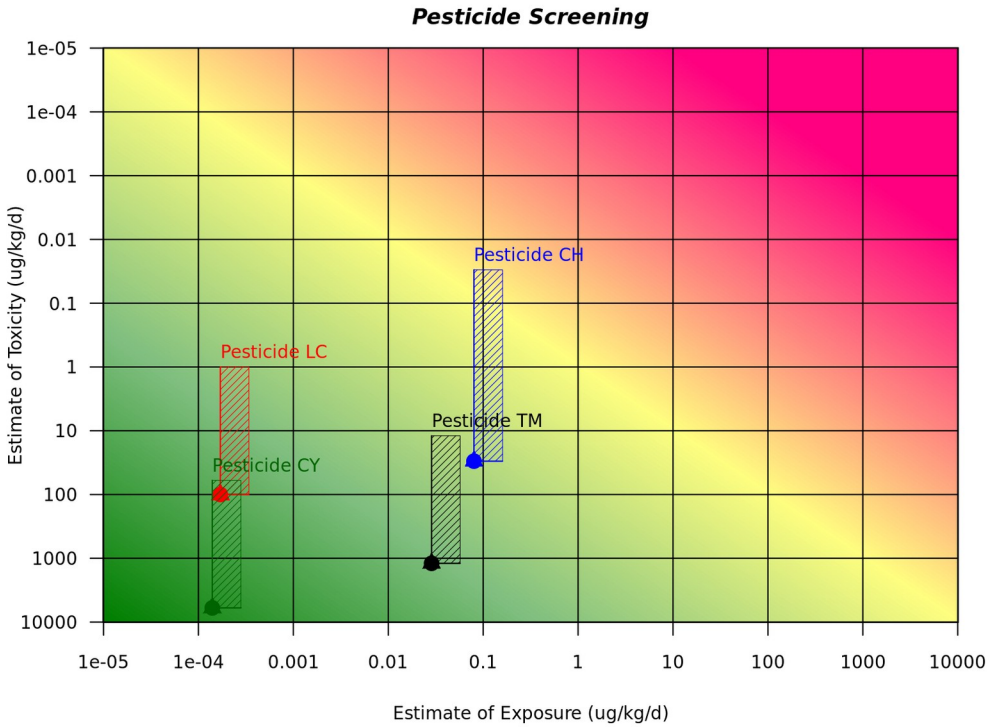
Pesticide	Chronic POD (NOAEL)	Study	Endpoint(s)	UF	cRfD
CH	0.03 mg/kg/day	Multiple	AChE inhibition (plasma & RBC)	1000x UF	3e-5 mg/kg/d
LC	0.1 mg/kg/day	Dog	Neurotox	100x UF	0.001 mg/kg/d
CY	6 mg/kg/day	Dog	Neurotox	100x UF	0.06 mg/kg/d
TM	1.2 mg/kg/day	Rat 2-gen	Testicular tubular atrophy; sperm abnormalities	100x UF	0.012 mg/kg/d

RISK21 Pesticide Monitoring Prioritization

- **Exposure: using the EEC and considering that a person drink 2L/day (from the same source!) and body weight of 70 kg. The calculated ug/kg/d value w/ 100% uncertainty applied**

- **Toxicity: Plotted rodent NOAEL values + UFs applied to calculate cRfDs**



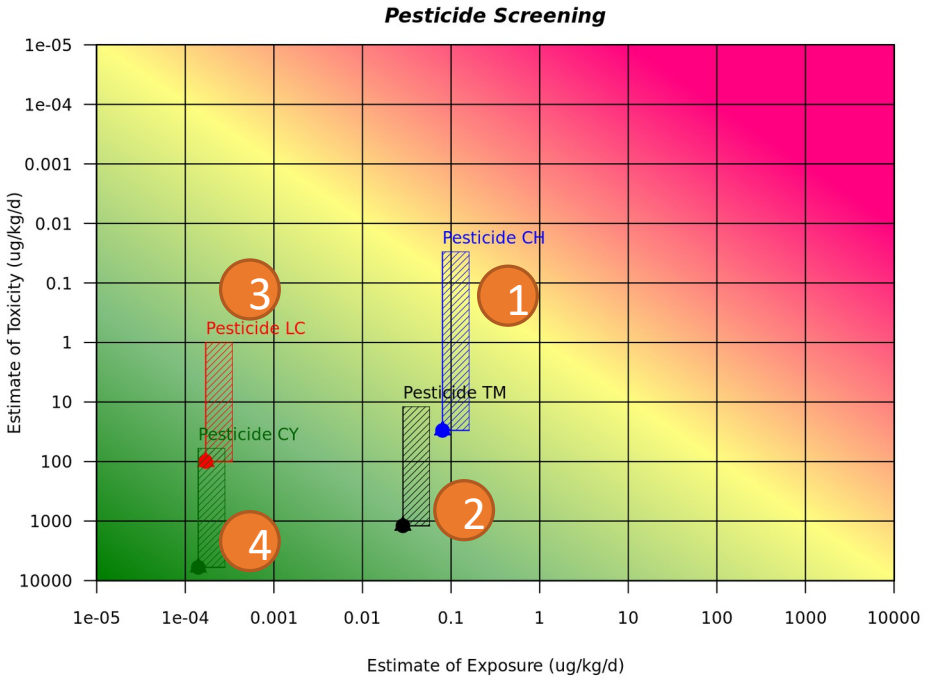


Conclusion: Differences between in Pesticide Prioritization based on Hazard and Risk

Prioritization based on hazard

Pesticide	Chronic POD (NOAEL)	Study	Endpoint(s)	UF	cRfD
CH	0.03 mg/kg/day (1)	Multiple	AChE inhibition (plasma & RBC)	1000x UF	3e-5 mg/kg/d
LC	0.1 mg/kg/day (2)	Dog	Neurotox	100x UF	0.001 mg/kg/d
CY	6 mg/kg/day (4)	Dog	Neurotox	100x UF	0.06 mg/kg/d
TM	1.2 mg/kg/day (3)	Rat 2-gen	Testicular tubular atrophy; sperm abnormalities	100x UF	0.012 mg/kg/d

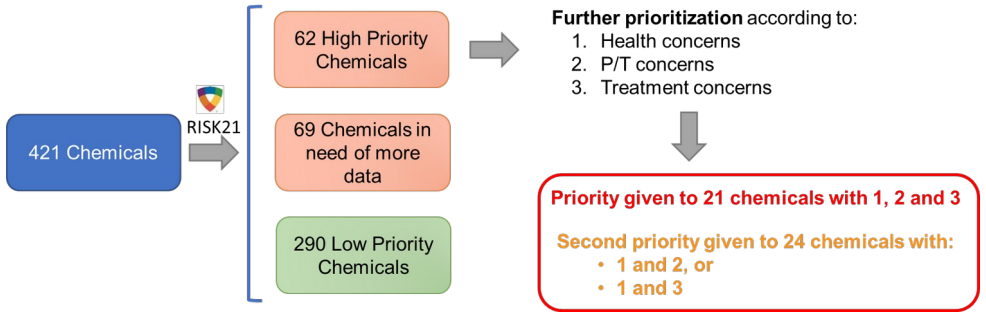
Prioritization based on risk

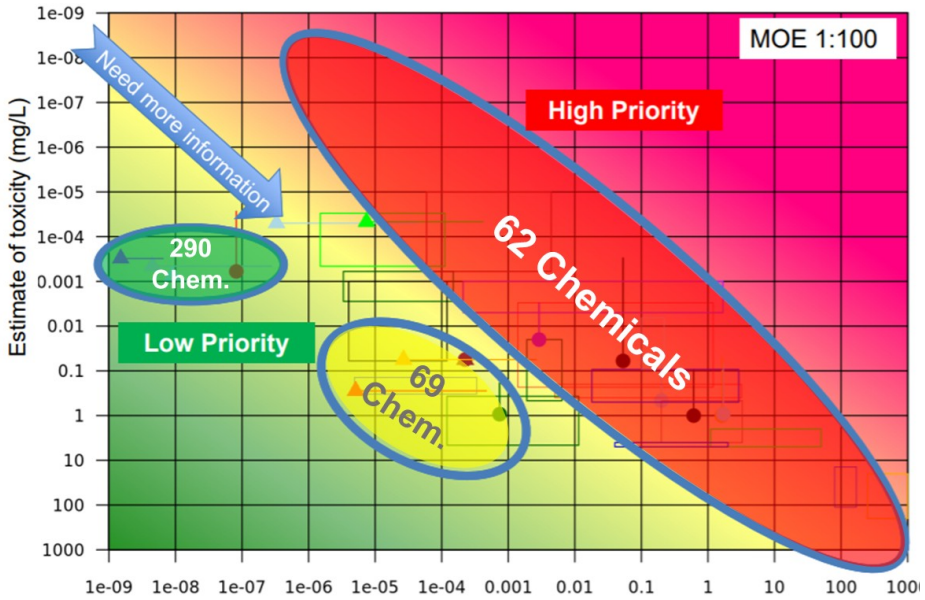


RISK 21 is an accessible, free and user friendly tool for Chemical Risk Management

Conclusion: RISK21 is an accessible and easy to use approach for Risk Assessment

- **Broader application:** Exposure and Hazard Driven Prioritization for the Evaluation of Chemicals in Drinking water in Canada – 421 chemicals*





- **RISK21 brings authorities a coherent, science-based decision-making tool, easy-to-handle and communicate chemical pollutant risk.**
- **Contribute with Governance processes for priority-setting and analysis of potential future scenarios of chemical exposure and environmental and human health analysis.**

*Presented at the HESI RISK21 Summit (Feb. 2020) by T. Barton-Maclaren, Health Canada. Presentation available at: https://risk21.org/wp-content/uploads/2020/03/BartonMaclaren-RISK21-Summit-2020-3.pdf

Acknowledgements

MINSALUD

Liliana Rojas
Lady J. Dominguez

Michelle Embry
Sandrine Deglin
Syril Pettit

Ariana Rossen

Applied Nematology Lab
Agriculture and Bioscience Institute - CONICET
School of Agriculture
University of Buenos Aires
Argentina

RISK21 Training and Information
emunarriz@agro.uba.ar
membry@hessiglobal.org