



# Water quality in areas impacted by oil activities in the Ecuadorian Amazon: associated health risks and social perception of human exposure

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## In Ecuador



## In France



Monitoreo ambiental, salud, sociedad y petróleo en el Ecuador





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## Science of the Total Environment

journal homepage: [www.elsevier.com/locate/scitotenv](http://www.elsevier.com/locate/scitotenv)



### Drinking water quality in areas impacted by oil activities in Ecuador: Associated health risks and social perception of human exposure



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### Distribution, contents and health risk assessment of metal(loid)s in small-scale farms in the Ecuadorian Amazon: An insight into impacts of oil activities

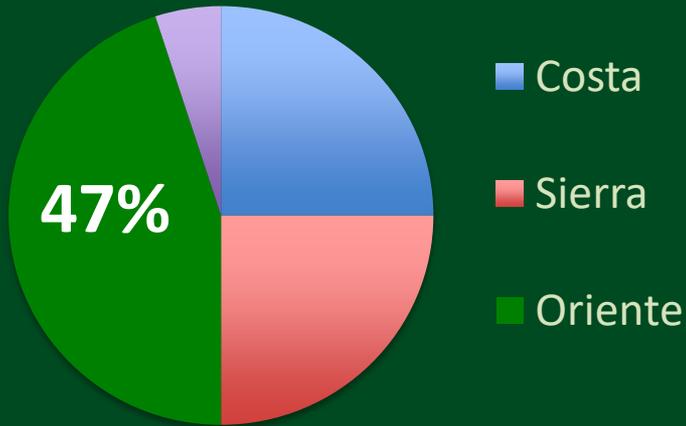


Barraza F.<sup>a,\*</sup>, Maurice L.<sup>a,b,1</sup>, Uzu G.<sup>c,d,1</sup>, Becerra S.<sup>a</sup>, López F.<sup>a</sup>, Ochoa-Herrera V.<sup>e</sup>, Ruales J.<sup>f</sup>, Schreck E.<sup>a</sup>

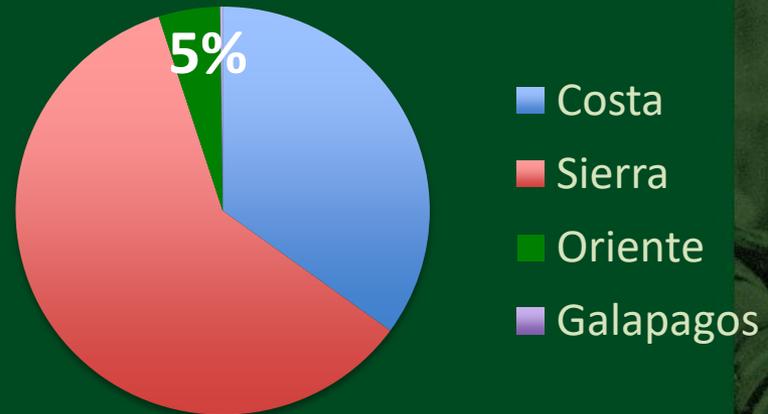


# Context

## • Area



## • Population



Living in poverty (<2,4 USD/d):

National mean (2014): 26%

Ecuadorian Amazon : 48% (2x Sierra and Costa)

Extreme poverty : 22% Amazon vs 6% national

### ***The Ecuadorian Amazon is :***

- ***One of the most biodiverse place of the world (60% of orchid species are Ecuadorian)***
- ***The highest rate of rivers per km<sup>2</sup> BUT***
- ***The highest richness of the country cohabits with the highest poverty...***

WOMON



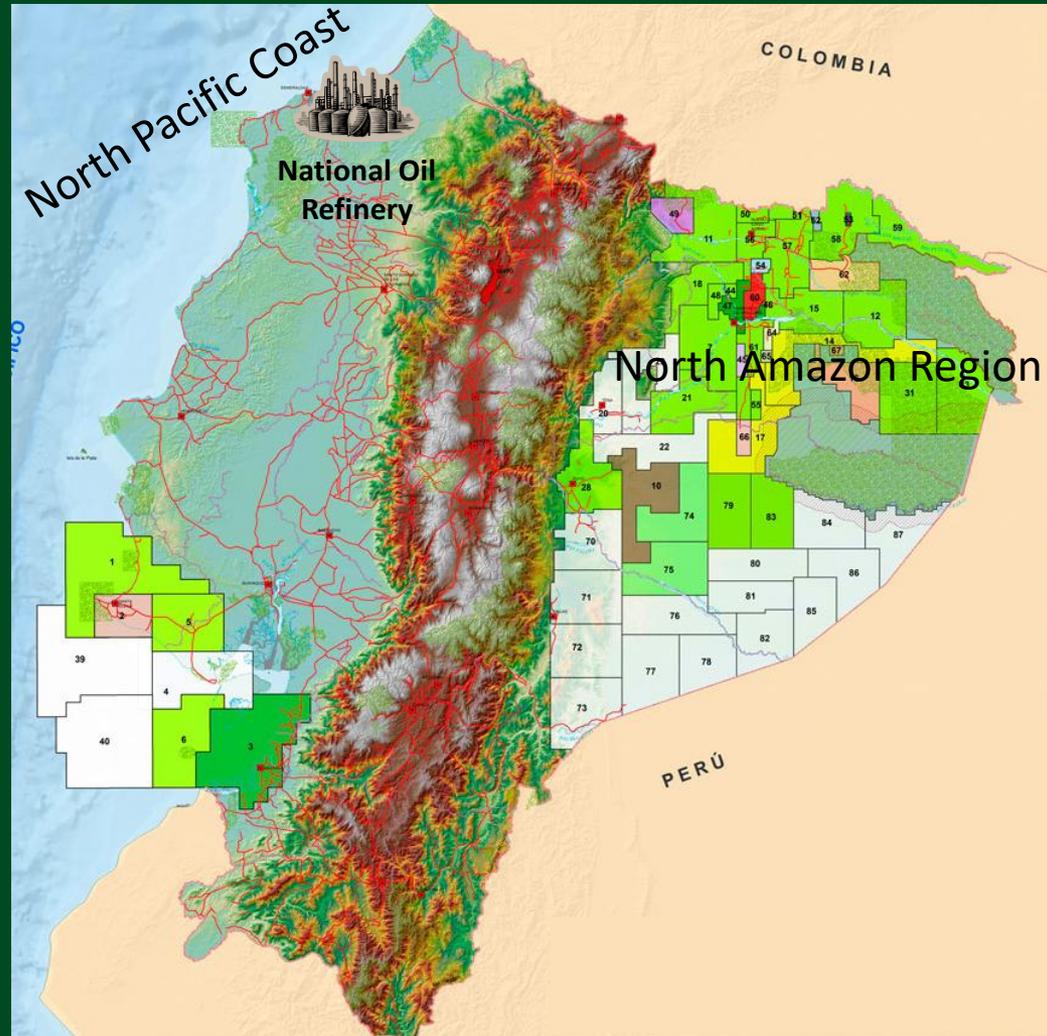
# Context

Ecuador is the 4<sup>th</sup> oil producer of Latin America

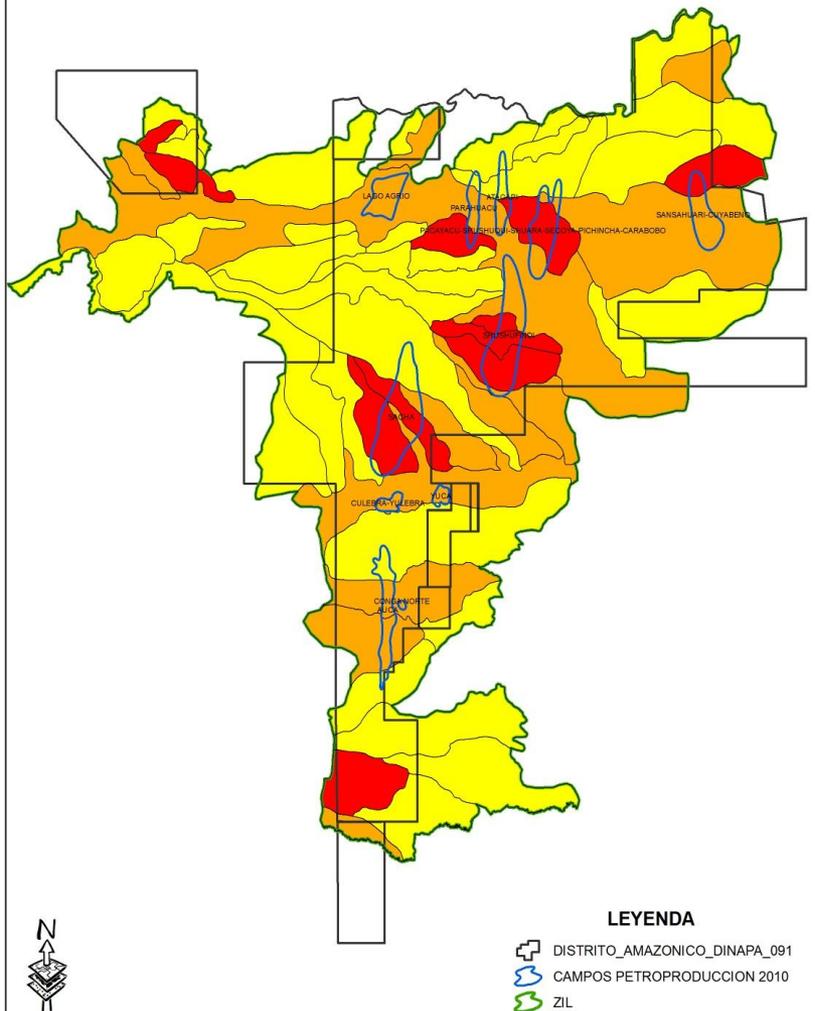
The Ecuadorian Amazon is :

- 80% of the oil reservoirs
- Almost 50% of the State Budget
- 50% of the exportations

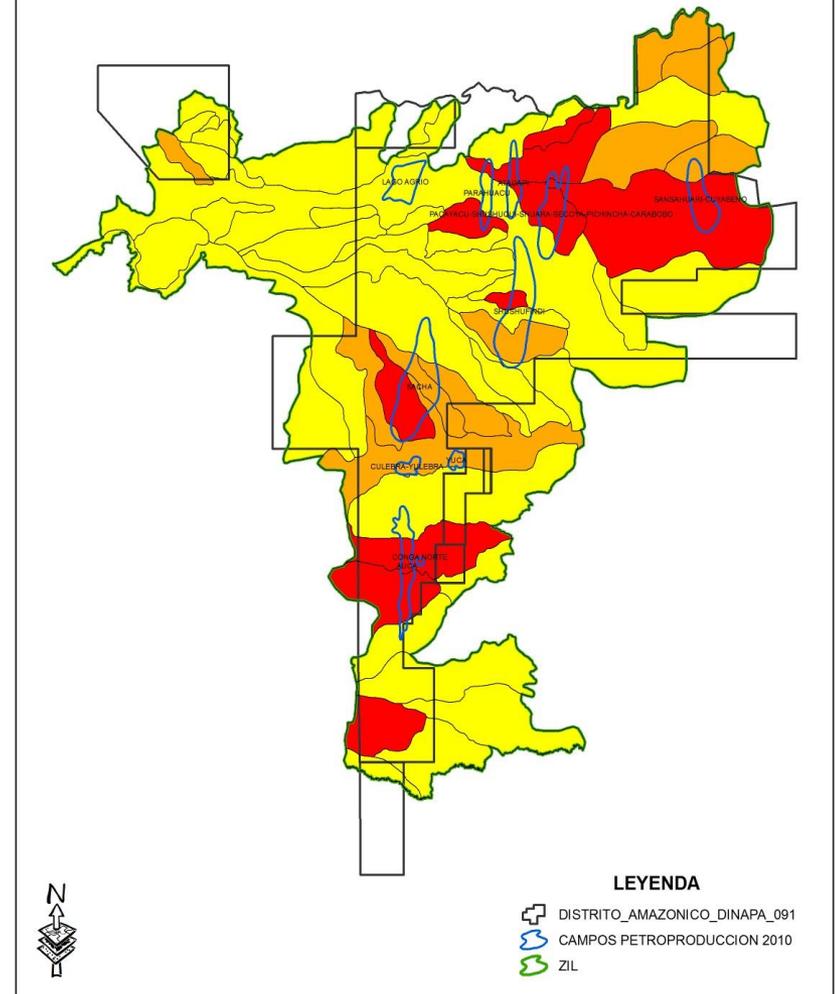
*But from 1964 to 1992, impacts oil exploitation by Texaco are equivalent to 30 fold the Exxon Valdez disaster...*



## Piscinas totales por ríos, quebradas y esteros



## Derrames por 1000 habitantes pobres



**PRAS**  
Programa de Reparación  
Ambiental y Social



**Ministerio  
del Ambiente**



# Objective

In this context, how local people do to get drinking waters?



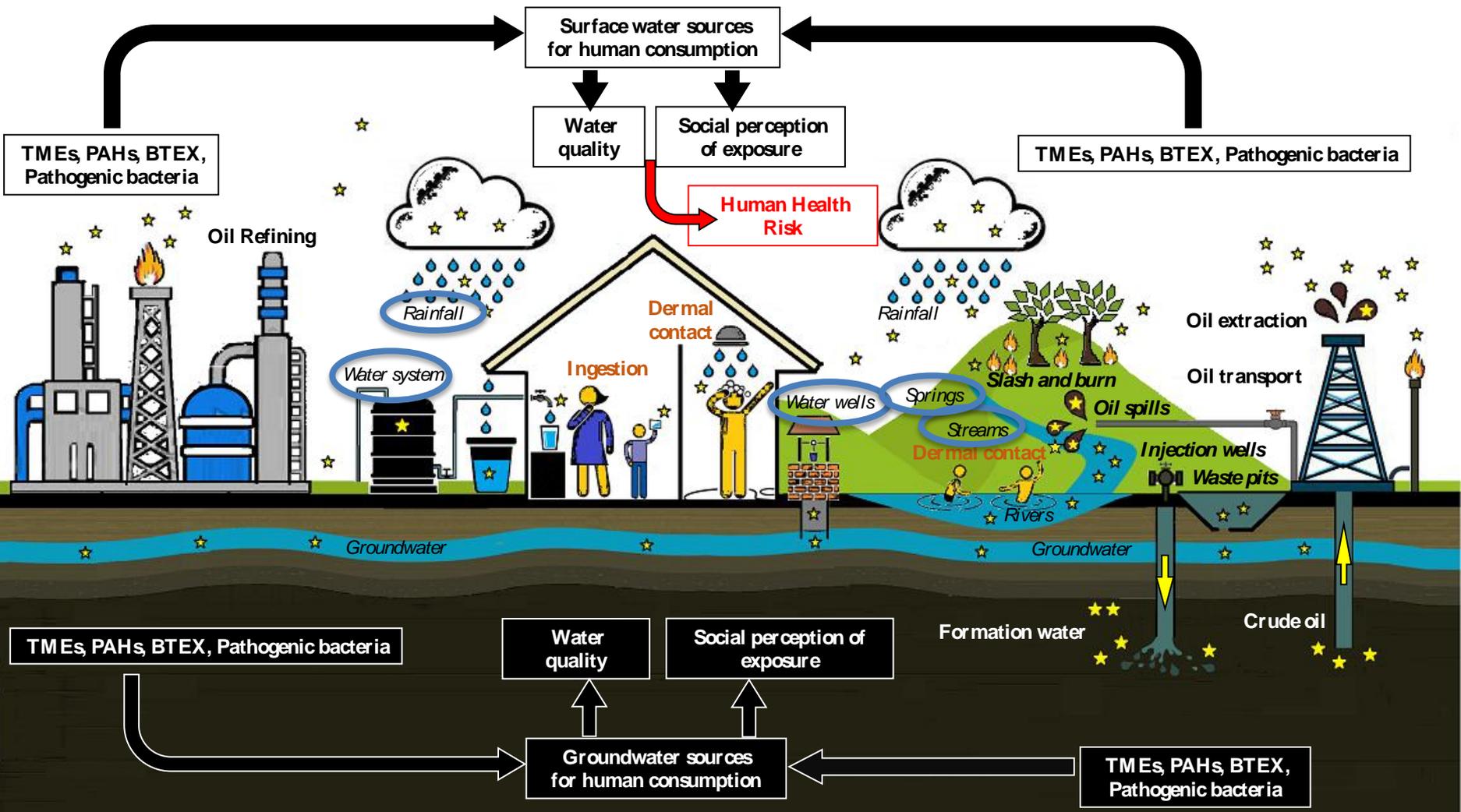
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MONOWI

L. Maurice

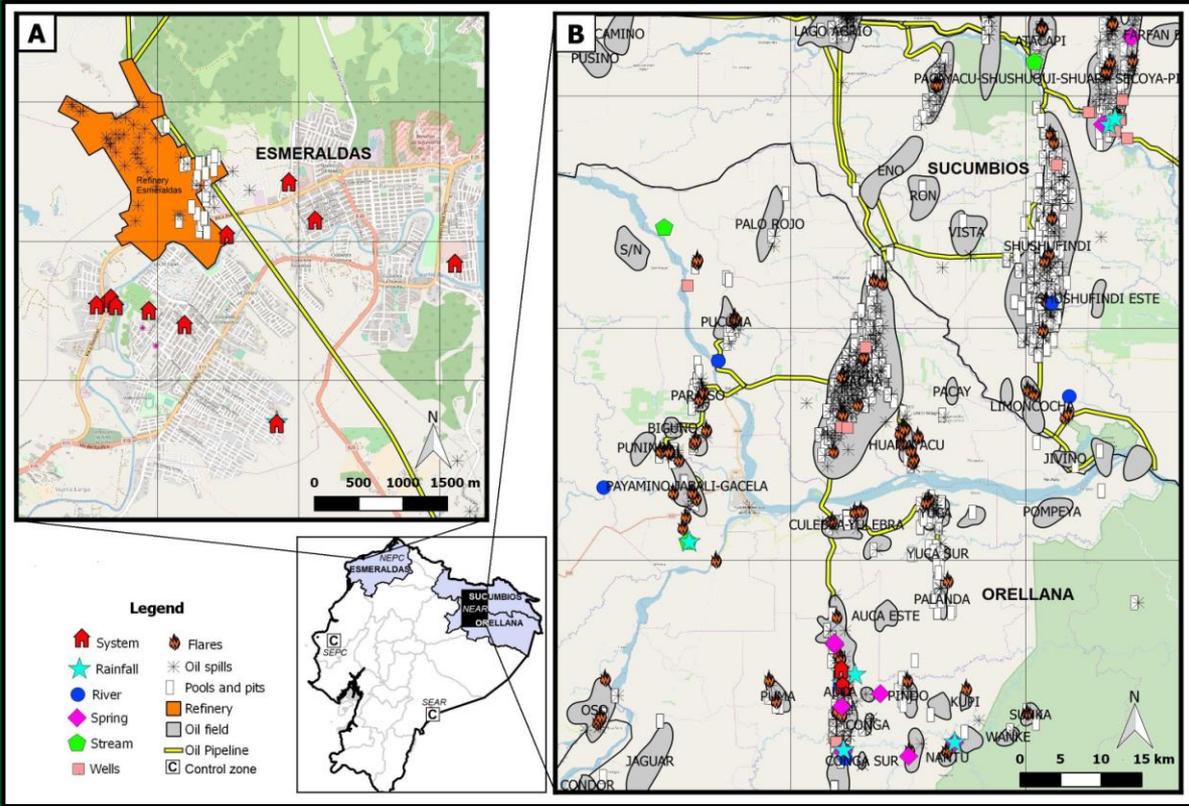
# Sources and exposure pathways





# Methods

- 5 water sources:  
system  
rainfall  
wells  
springs  
rivers and streams
- 2 areas:  
Amazon basin  
Esmeraldas
- Chemical analysis:  
TME  
Major cations  
PAHs  
Pathogenic bacteria



K, Mg, Na, Ca, Ni, V, Fe and Cu:  
naturally present in crude and formation waters

Ba, Co, As and Pb:  
added during the extraction, transportation or storage

Monitoreo ambiental, salud, sociedad y petróleo en el Ecuador

LIMONOW

L. Maurice

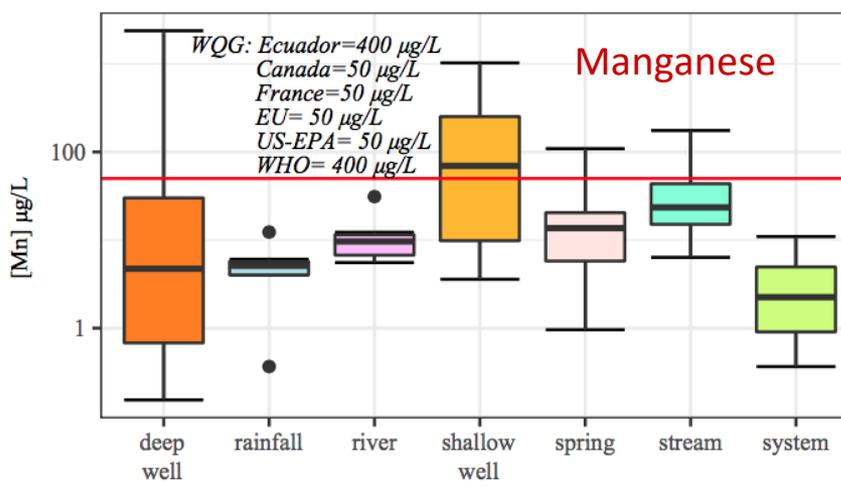
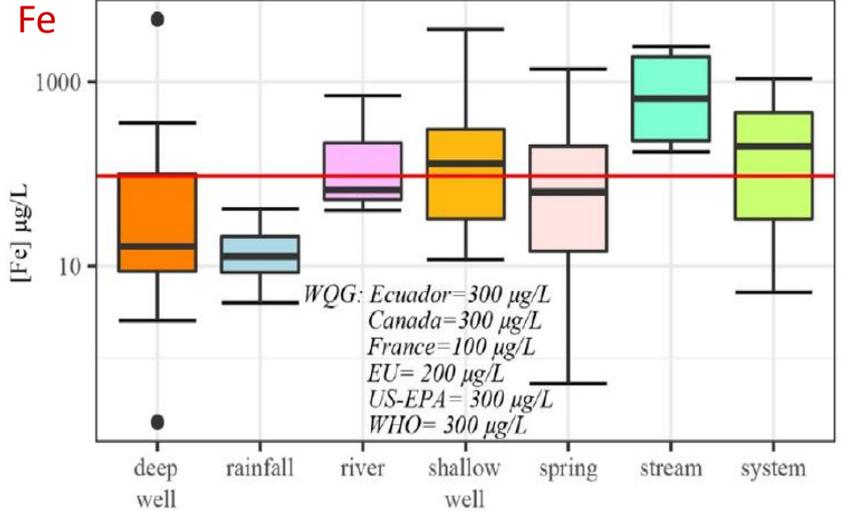
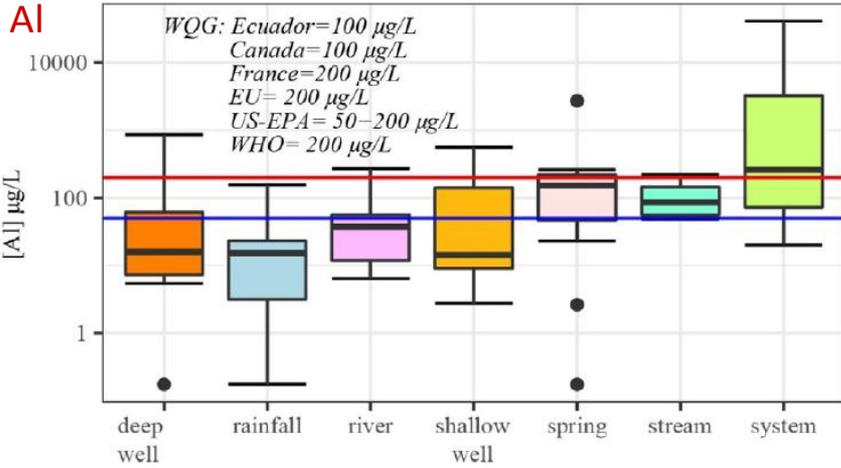






# Drinking water quality

## ETM

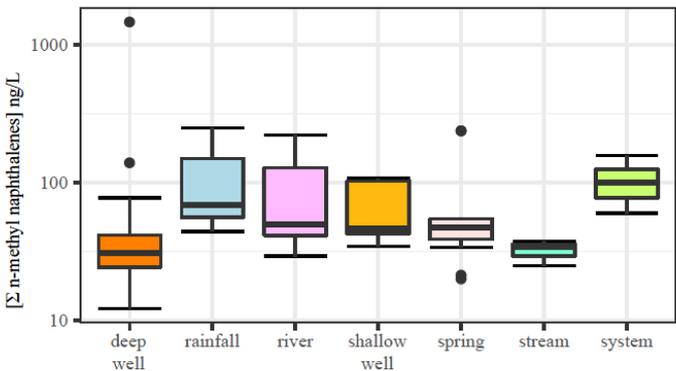
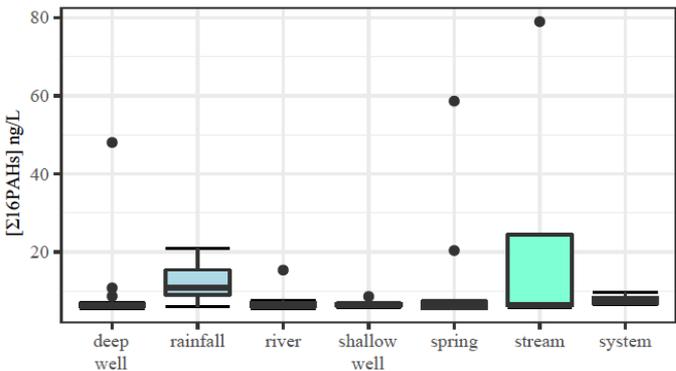
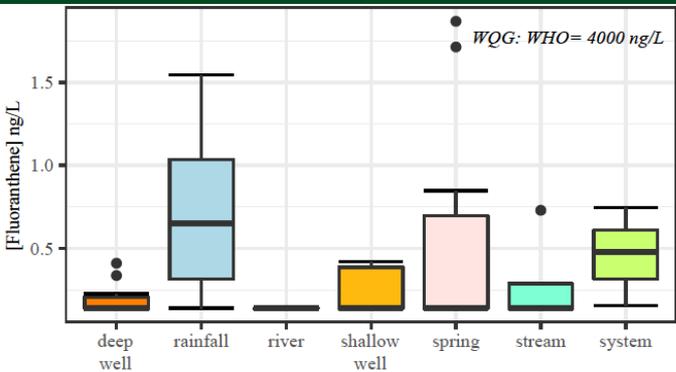


- Fe and Al: natural sources (tropical soil erosion)
- Al: high concentration in system =>  $Al_2(SO_4)_3$  in water treatment
- Mn (neurotoxin) : high concentrations in private wells => agriculture (pesticides)



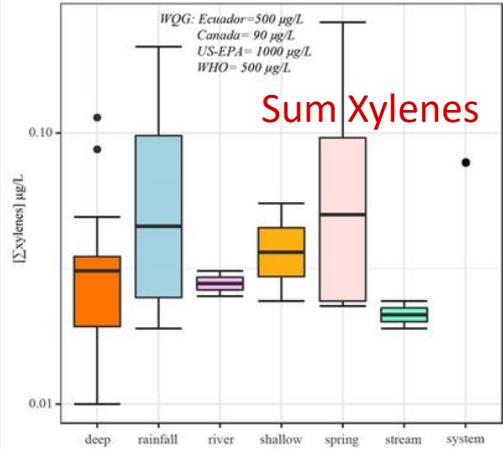
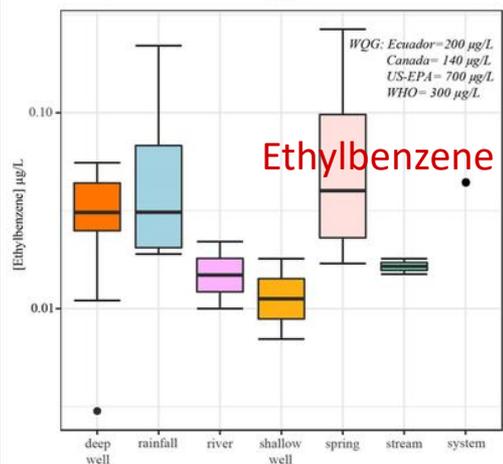
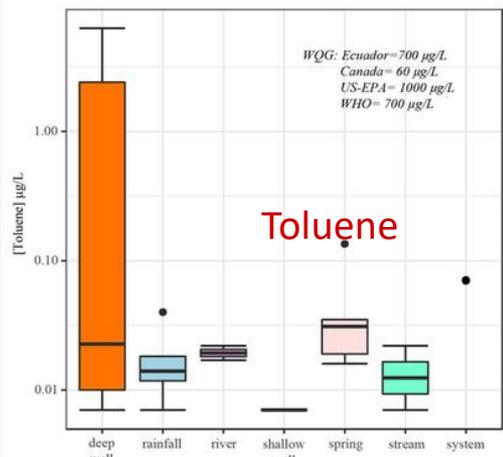
# Drinking water quality

## PAHs & BTEX



- No PAHs (16 priority by US-EPA)
- Toluene (in deep private wells)

Monitoreo ambiental, salud, soc



EPOC





# Human health exposure

## Drinking waters

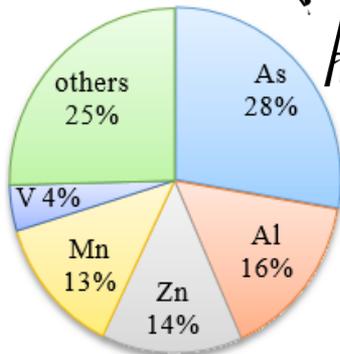
**Hazard Index (% > Reference value US-EPA)**

### NORTHERN AMAZON REGION

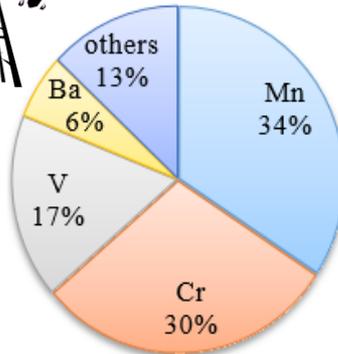
Ingestion



Dermal



Adults: 4%  
Children: 11%



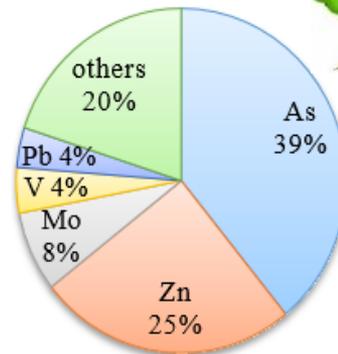
Adults: 0%  
Children: 0%

### SOUTHERN AMAZON REGION

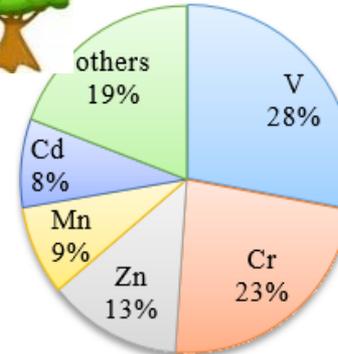
Ingestion



Dermal



Adults: 0%  
Children: 8%



Adults: 0%  
Children: 0%

**Hazard Quotient**

$$HQ = \frac{ADD}{Rfd}$$



**Hazard Index**

$$HI = \sum HQ$$

ADD= Average daily potential dose ( $mg\ kg^{-1}\ day^{-1}$ )

Rfd = reference dose ( $mg\ kg^{-1}\ day^{-1}$ )



# First conclusions

- A punctual enrichment in volatile hydrocarbons is observed in several private wells.
- Low mineralization of drinking waters is a special health issue in the Amazon region.
- The bacterial contamination of waters needs more attention by public policy.
- Local stakeholders are unable to provide effective water supply and water treatment systems.

**But how local communities perceive the contamination risk?  
And how do they face (or not) the risk?**

MONITORING



# First conclusions

- A punctual enrichment in volatile hydrocarbons is observed in several private wells.
- Nowadays, drinking water risk is rather due to the low mineralization of the water sources in the Amazon region.
- The bacterial contamination of waters needs more attention by public policy.
- Local stakeholders are unable to provide effective water supply and water treatment systems.

**But how local communities perceive the contamination risk?  
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MONITOR



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MONITOR



# Social perception of the risk

- Perceived environment and perceived exposure to health risks

*The social experience of the environmental pollution is that “everything is polluted and oil companies are lying”. Contamination is mainly perceived empirically, directly from the farms or indirectly from a decrease in aquatic biodiversity*

- Facing the risk but to which risk high priority is given?

*The knowledge does not guarantee the action*

- Chronic and historical distrust of oil companies

*People are not changing their daily practices waiting for a recognition and retribution due to the damage caused by the oil companies during the last decades*

**Social and economic constraints lead people to choose the risks they have to face**



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# Conclusions

- Limits of (inter)national regulations  
*Legal, technical (no min. recommended values) and political*
- Health risks due to drinking water exposure is more impacted by the precarious living conditions than by the oil activities in the Ecuadorian Amazon region  
*Contrarily to the common prejudices*
- Local people focus the health risk on oil companies  
*without any satisfactory processing of the historical impacts of the oil activities in the country, people ignore other possible sources, such as agriculture practices or the lack of water treatment*

**Water quality preservation is the most shared argument that can become a symbol of the oil companies' environmental debt and of the government to solve this issue**



# Most cited words



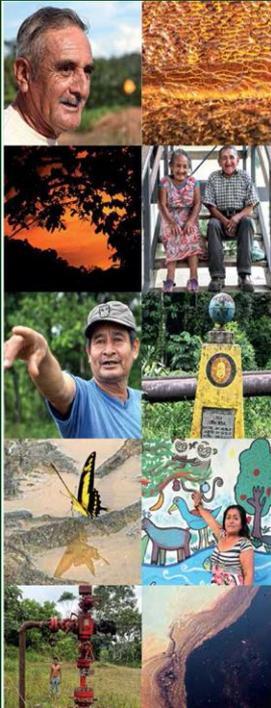
Nvivo© simulations

S. Becerra





# THANKS FOR YOUR ATENTION !



La explotación petrolera, base de la matriz energética mundial, es hoy ampliamente debatida en un contexto marcado por los cambios globales. Por el contrario, las condiciones de vida en los territorios donde se extrae el petróleo suelen ser poco mediatizadas. Este libro ofrece una perspectiva científica interdisciplinaria sobre el caso ejemplar de la región amazónica de Ecuador, testigo del papel ambiguo que desempeñan las actividades petroleras. Los paisajes de pozos, oloductos, mecheros se mezclan con los paisajes agrícolas; la contaminación ambiental genera conflictos pero también empleos y compensación social; los discursos y los comportamientos oscilan entre denuncias y dependencia.

*L'exploitation pétrolière, au fondement de la matrice énergétique mondiale, est aujourd'hui mise à l'index dans un contexte marqué par les changements globaux. A l'inverse, les conditions de vie générées sur les territoires d'extraction, sont largement moins débattues. Cet ouvrage offre un éclairage scientifique interdisciplinaire sur le cas de la région amazonienne d'Équateur, témoin du rôle ambigu que jouent les activités pétrolières. Les paysages de puits de forage, d'oléoducs, de torchères y côtoient des paysages agricoles ; les contaminations environnementales y génèrent des conflits mais aussi des emplois et des compensations sociales ; les discours et les comportements oscillent entre dénonciation et dépendance.*



Sylvia Becerra, Laurence Maurice, Sabine Desprats-Bologna (coordinadoras)

## NUESTRO VIVIR EN LA AMAZONIA ECUATORIA: ENTRE LA FINCA Y EL PETROLERO

*Vivre en Amazonie équatorienne:  
entre pétrole et terres agricoles*

*Sylvia Becerra, Laurence Maurice, Sabine Desprats-Bologna*

MONOIL

