Food and Agriculture Organization of the United Nations

EKOS BRASIL

NICOLE LATIN AMERICA
Latin America Network for Soil and Water Management

HEAVY METALS IN AGRICULTURE:

CADMIUM IN COCOA BEANS
CASES IN ECUADOR AND TRINIDAD & TOBAGO

DSc Sasha Tom Hart
sashartom@gmail.com

June, 2023

Project Objectives

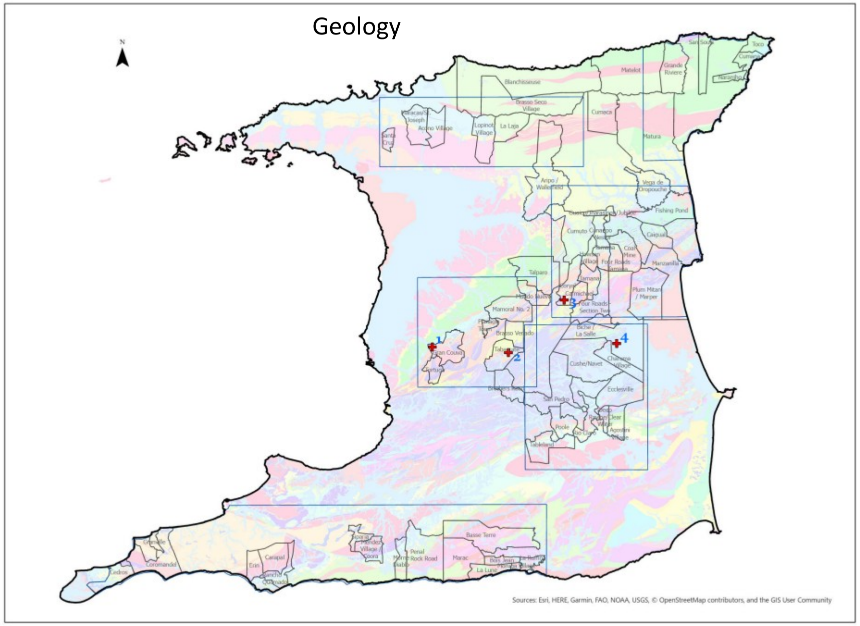
Main objective:

- **Contribute** to implement actions of agenda **GSOP18** ("**Be the solution to soil pollution.**"). Focus Cd/cacao triggered by **EU Reg. 488/2014**, max. levels **>2019** (<0.8mg/kg).

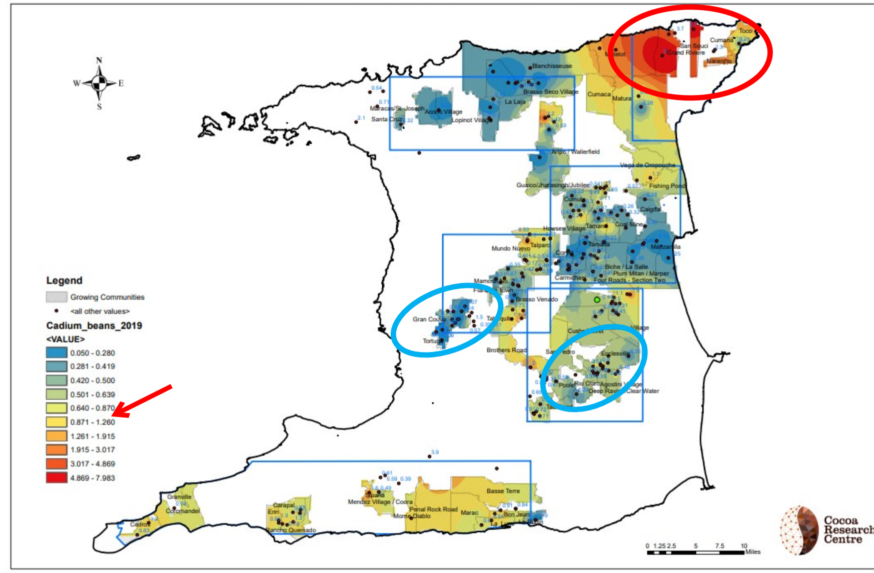
Specific objectives (initial steps):

1. **Identify** previous / ongoing **research** regarding Cd in cacao **(watershed to soil scale)**;
2. **Interviews at farms and learn from local context:** Eastern Lowland/Trinidad & Tobago, Manabí/Ecuador (suspended);
3. **Develop** initial **watershed scale conceptual models**, based on a **risk assessment approach**;
4. **Conclusions/ recommendations** for **solutions/ next steps**.

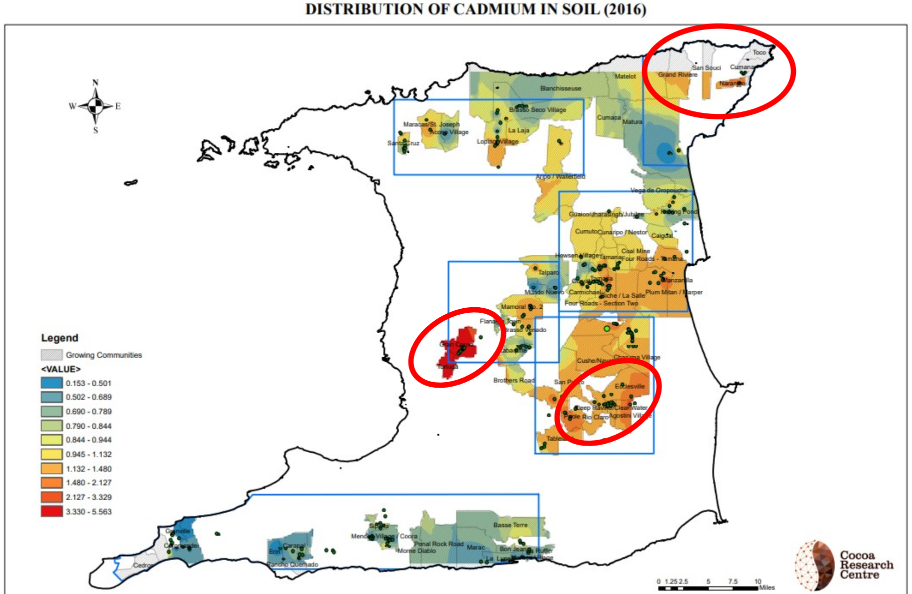
Identified Research: Examples (to be Continued)



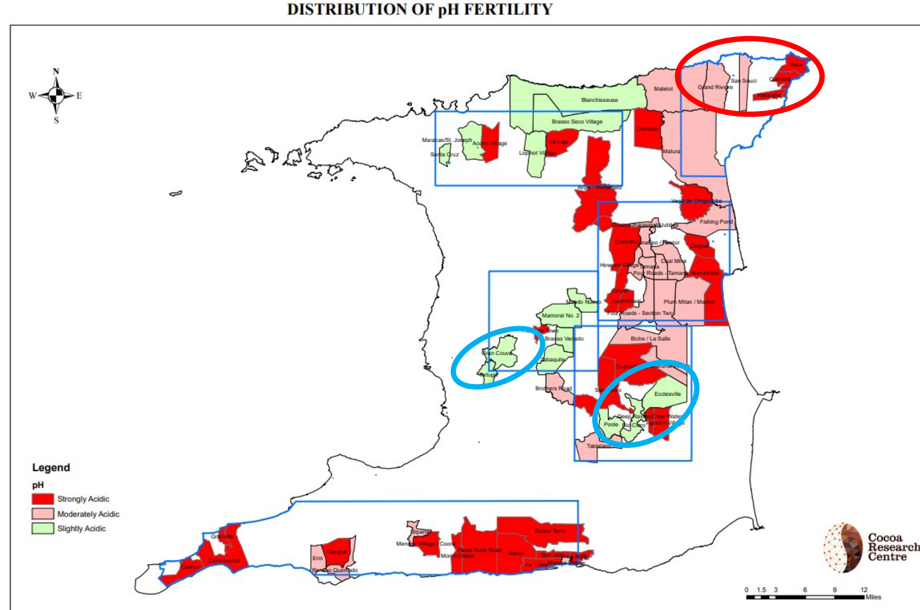
DISTRIBUTION OF CADMIUM IN BEANS



DISTRIBUTION OF CADMIUM IN SOIL (2016)



DISTRIBUTION OF pH FERTILITY



Ramtahal (2012): "The Triple Super **Phosphate** (TSP) (…) contained the highest Cd concentrations of **35µg/g**(…)" Limited **regulation on fertilizers (and manure)**

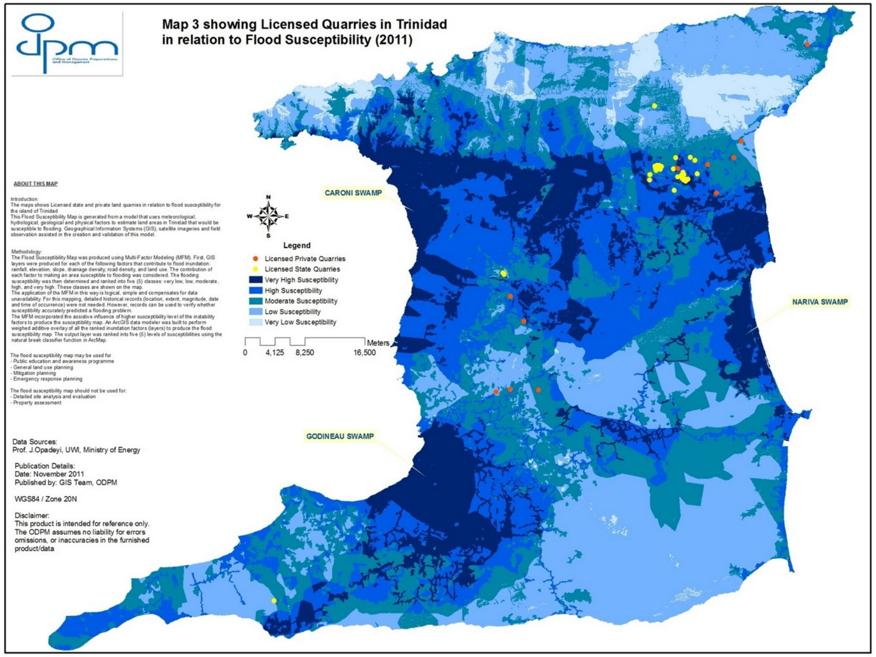
Table 43: Mean Cadmium Concentrations of Sediments and Soil Samples 5m and 10m Inland from Manacal River Bank at Locations 1-5

Cd (µg/g± SD)	Location				
	1	2	3	4	5
River Sediment	<LOQ	<LOQ	<LOQ	0.65±0.01	0.82±0.03
5m (0-5cm)	0.54±0.02	<LOQ	<LOQ	0.51±0.11	0.91±0.14
5m (5-45cm)	<LOQ	<LOQ	<LOQ	<LOQ	0.57±0.06
10m (0-5cm)	<LOQ	0.76±0.10	0.50±0.05	0.61±0.03	0.79±0.03
10m (5-45cm)	<LOQ	<LOQ	<LOQ	<LOQ	0.55±0.04

<LOQ: Below Detection Limit (< 0.5 µg/g)

>floods

"(…) suggests that **<u>similar studies be done</u>** in other flood-prone areas used for cacao cultivation."



HIMAWATEE BABOOLAL (2019):

"**Cd** (…) occurred at the **rural site** at levels **much <u>higher than expected</u>**."

"Like As, Cd also is reported to be **enriched in the fine PM** (…) indicating that **Cd may not be from natural erosion**."

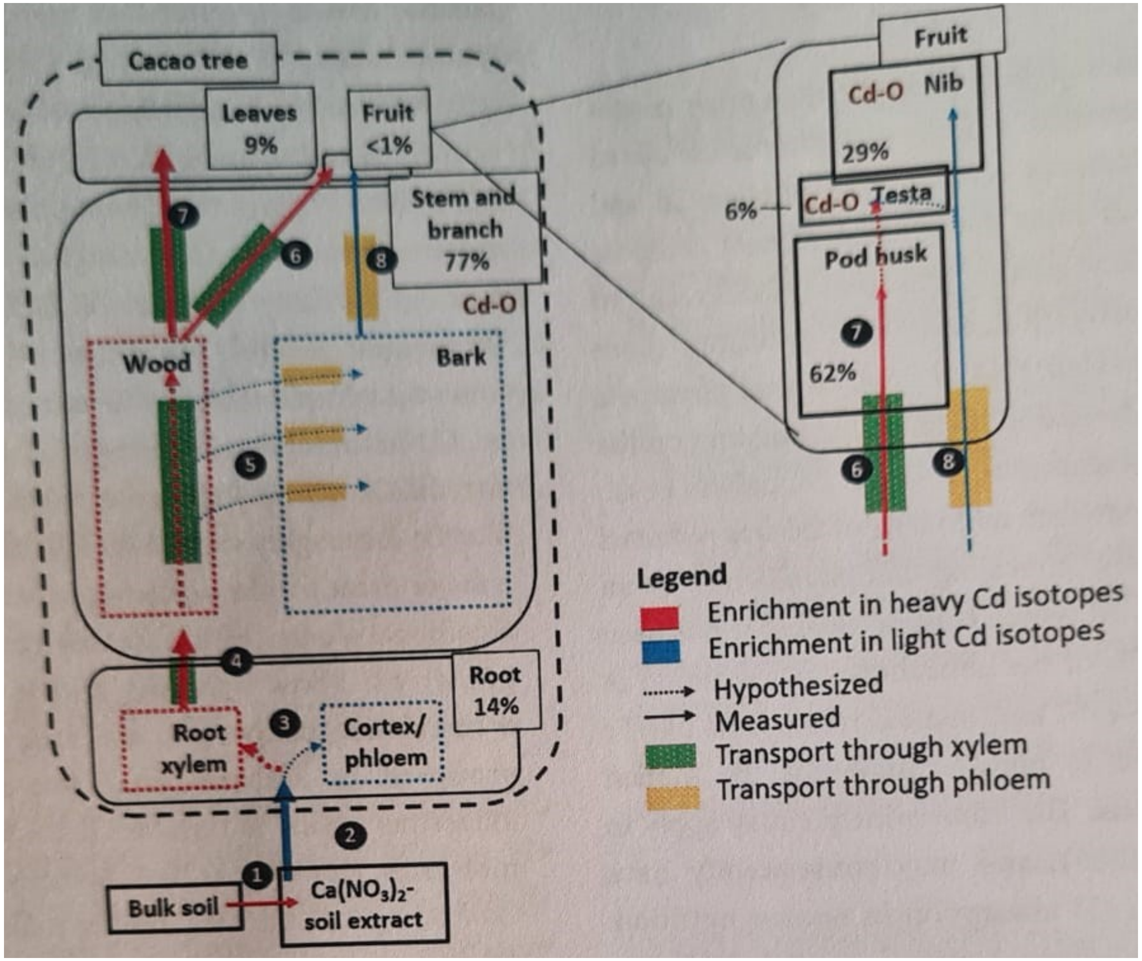
"(…)periods that **<u>overlap with peak Sahara dust influx</u>** over the Caribbean."

GARRISON et al., (2010):

"The African dust system is the largest in the world**, annually exporting <u>billions of tons of eroded mineral soils to the Caribbean</u>** and Americas (…)."

"Dust from Africa is a **known source of nutrients and co-factors** to downwind organisms and ecosystems (…)."

"The **<u>enrichment of Cd</u>** and Zn in dry deposition samples from (…) **Mali** was similar to (…) dust aerosol samples collected in **Barbados** (Trapp et al. 2008)"



"(...)**isotope fractionation** patterns alluded to a **more direct transfer from branches to nibs** that from leaves to nibs. The largest fraction **(57%) of total plant Cd** was present in the **branches** (...)." Blommaert et al. (2022)

Important researches on **complex settings; basis for actions**

Need for further data (confirm, spatial distribution, over time)

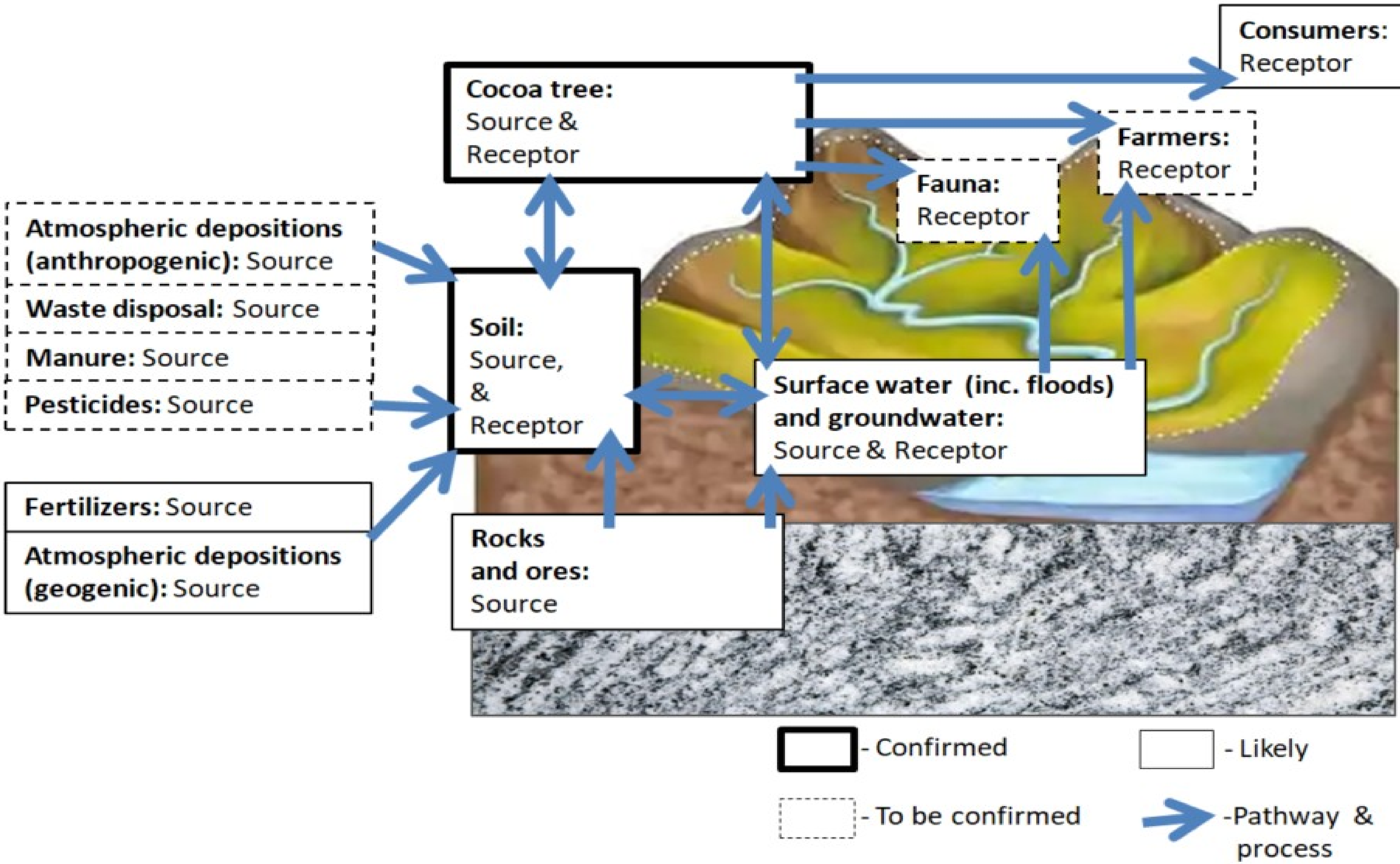
Interviews and Local Context

Institutions

Farms

Sources and Processes

<u>Conceptual Model</u> Cd/cocoa, Eastern Lowlands/T&T (watershed level, risk elements)



Conclusions

The 2 study regions can be classified as **Complex Areas** (ITRC, 2017) with **technical and non tec. challenges = long term solutions and adaptive management** (intermediate objectives, periodic monitoring, conceptual model updates).

The applied **watershed scale initial steps were considered useful** by several stakeholders to support a **more clear and holistic understanding of the pollution**, in addition to develop **recommendations** and propose **next steps**.

Recommendations

Possible intervention solutions, from **watershed to soil scale:**

1. Evaluate and manage **surface and groundwater quality**.
2. Geogenic and anthropogenic **air emissions of Cd.**
3. Evaluate impact of **flooding and manage occupation**.
4. Import and application of **fertilisers**.
5. Import and application of **manure**.
6. Decrease **bioavailability of Cd** in the soil by applying **amendments**.
7. Application of **nature-based solutions.**
8. Management of cacao **leaves and wood**.
9. Alternative crops to **replace cacao at specific locations**.
10. **Combine** best management practices for Cd **with related programs**.

Next steps

In order to further **assess/prevent/minimize soil pollution,** the **continuation of the project** shall include the following steps:

1. **Test** the proposed **solutions - new standardized field data combined with programs** Climate Change, Carbon Seq., Biodiversity, Lab. Meth.
2. **Update the watershed conceptual models based on risk approach**.
3. **Apply** the project to **other pilot test areas in Latin America** and, possibly, **other geographies. Care with differences. Evaluate expanding to other crops and metals (data + adaptation).**
4. **Stimulate knowledge exchange** opportunities between relevant institutions. Results/outcome shall **reach decision makers.**
5. **Develop Action Plans, Road Maps, and guidelines** – foster action about **Cd-Cocoa situation (current and future).**