Influence of phytosanitary practices used in cotton production on the aquatic agro-ecosystem and the health status of fish produced in water reservoirs in the north of Benin

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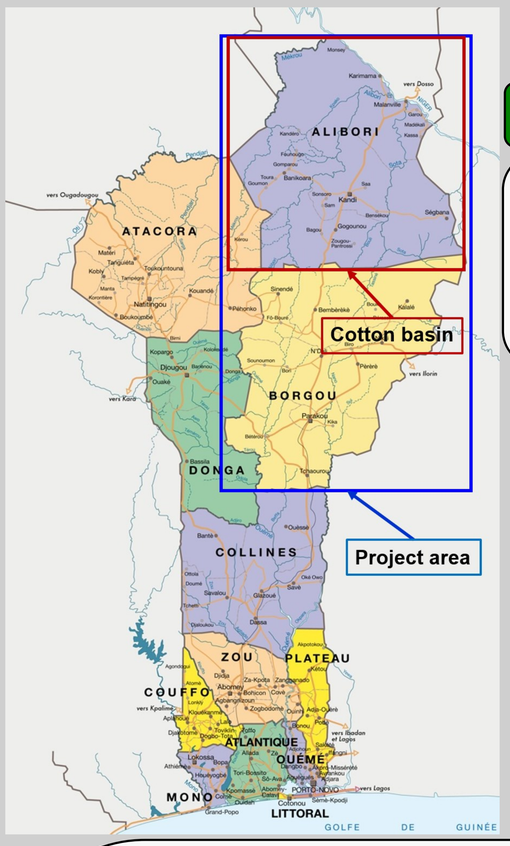
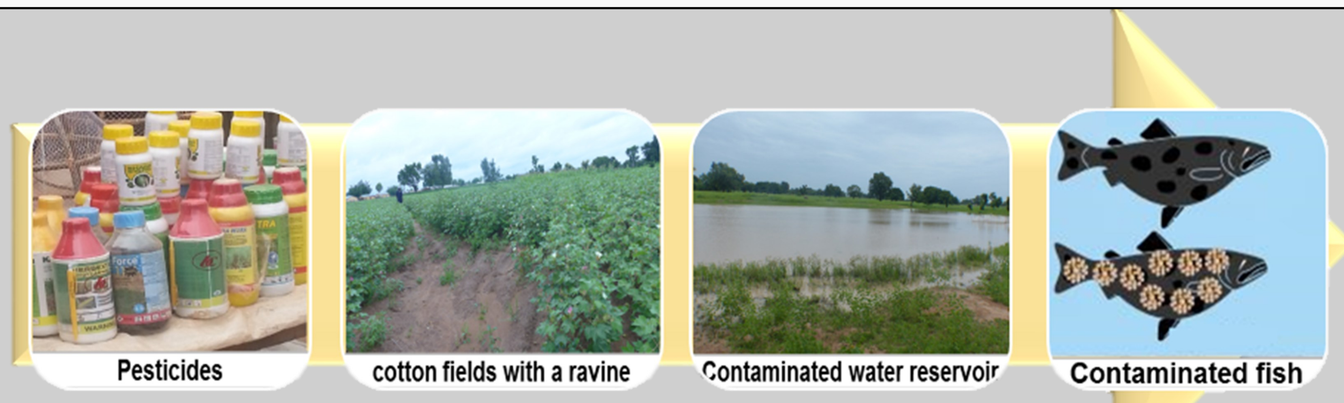


CONTEXT

The valorisation of water reservoirs through the development of plant, terrestrial animal and fish production has become a priority in local and governmental action programs in Benin (MAEP, 2017). Unfortunately, the northern part of the country, which has about 83% of these infrastructures (215 water reservoirs) faces complex ecotoxicological constraints caused by the ever increasing use of pesticides in cotton production, and that are not well understood (Agbohessi et al., 2014).



Axis 1: Environmental Risk Analysis (ERA)

Diagnosis and classification of potential cultural and phytosanitary practices sources of pollution

- Sources: phytosanitary practices


Different origin / quality

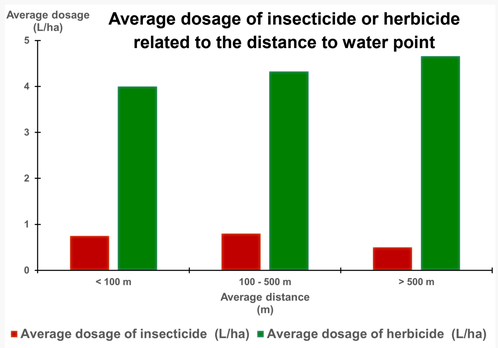

Protective measures


Non-compliance with doses

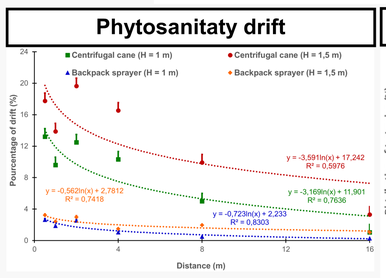

Mismanagement of stocks

- Environmental exposure:

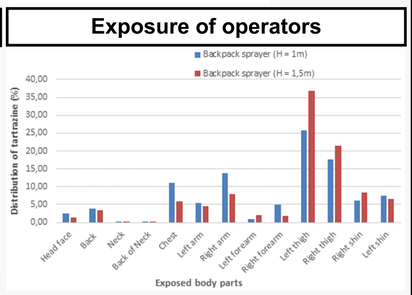
♦ ***Transfer mechanisms: Runoff, Drift, Infiltration***



Phytosanitaty drift



Exposure of operators



♦ ***Properties of the main active substances***

Active substances	Substance group	Classification CLP		
		Health	Environment	Group
Acétamipride	Néonicotinoïdes	H302	H412	H302 (4) ; H412 (3)
Cyperméthrine	Pyréthrinoïdes	H302 ; H332 ; H335	H400 ; H410	H302 (4) ; H332 (4). H335 (3) ; H400 (1) ; H410 (1)
Emamectine benzoate	Avermectines	H301 ; H311 ; H318 ; H331 ; H372	H400 ; H410	H301 (3) ; H311 (3) ; H318 (3) ; H331 (1) ; H372 (1) - H400 (1) ; H410 (1)
Lambdacyhalothrine	Pyréthrinoïdes	H301 ; H312 ; H330	H400 ; H401	H301 (2) ; H312 (4) ; H330 (2) - H400 (1) ; H401 (1)
Chlorpyrifos	Organophosphorés	H301	H400 ; H410	H301 (3) ; H400 (1) ; H410 (1)
Profenofos	Organophosphorés	-	-	-

► According to the CLP Regulation, almost all the active substances identified are very **toxic** to aquatic organisms

Axis 2: Development and validation of analytical methods

- Development and validation of methods for the analysis of locally used new phytosanitary molecules
- Adaptation of biomarker evaluation methods to local species (*Clarias gariepinus* and *Oreochromis niloticus*)

Axis 3: Assessment of contamination decontamination levels

Selection of biomarkers


Insecticides


Experimental Device


Clarias gariepinus


Oreochromis niloticus

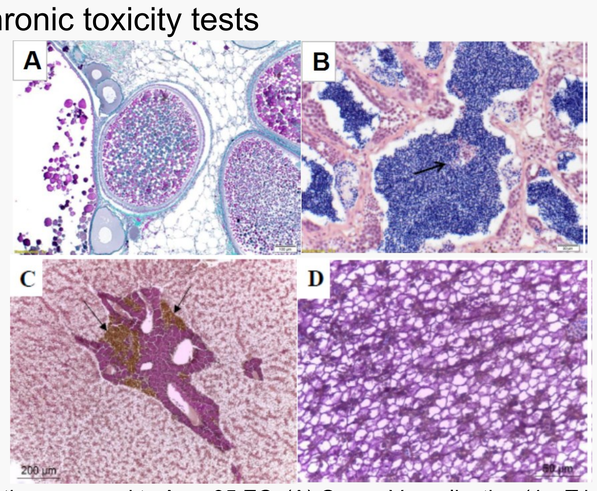
- Acute toxicity tests

Lethal concentrations of acetamiprid, lambda-cyhalothrin, Acer 35EC in *Clarias gariepinus* et *Orechromis niloticus*

	Insecticides	*LC50 (ppm)*
Clarias gariepinus		
Eggs ($LC50_{48h}$)	*Lambda-cyhalothrin*	*0.1497*
	Acer 35EC	*73.540*
	Mixture	*13.260*
Fingerlings ($LC50_{96h}$)	*Acetamiprid*	*264.50*
	Lambda-cyhalothrin	*0.0008*
	Acer 35EC	*0.2100*
	Mixture	*0.0430*
Female broodstock ($LC50_{96h}$)	*Acer 35EC*	*0.1752*
Orechromis niloticus		
Fingerlings ($LC50_{96h}$)	*Acetamiprid*	*182.90*
	Lambda-cyhalothrin	*0.0029*
	Acer 35EC	*0.1268*
	Mixture	*0.5685*

Mixture = Lambda-cyhalothrin + acetamiprid in the proportions of acer dissolved in acetone

- Chronic toxicity tests



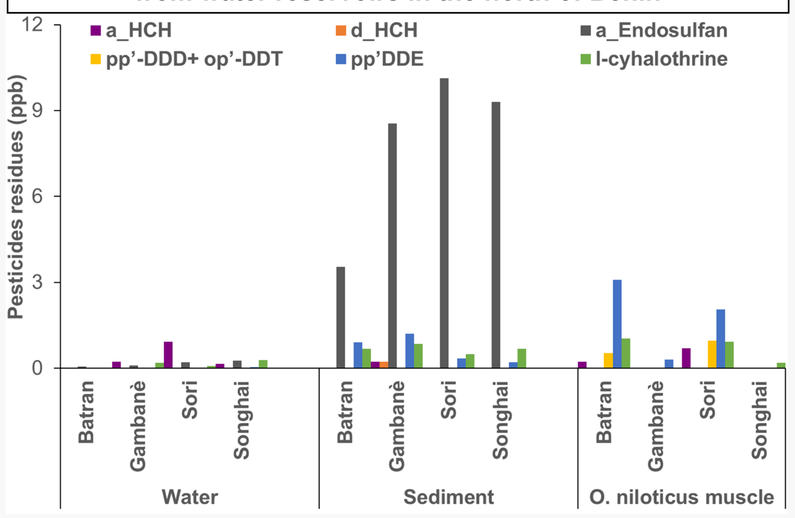
O. niloticus exposed to Acer 35 EC: (A) Ovary: Vacuolization (4x, Tri-green); (B) Testis: Necrosis (20x, HES); (C) Melano-macrophage centers at ni (100X, HES) and (D) Liver: steatosis (400X, HE + PAS)

Axis 4: Influence of production practices on the level of contamination and the health risk


Farming infrastructure

- Evaluation *in situ* of bioaccumulation levels of phytosanitary molecules in fish according to the farming techniques

Pesticide residues levels in water, sediment and fish collected from water reservoirs in the north of Benin



- Identification of the biological impacts of molecules in fish depending on farming techniques:

♦ Biomarkers of **oxidative stress** (CAT, SOD, GR, GPx, etc)

♦ Biomarkers of the **immune system** (lysozyme, complement, Ig, macrophage activity etc.)

♦ Biomarkers of the **neuroendocrine system** (AChE, serotonin, dopamine, GABA, etc.)

♦ Biomarkers of the **reproductive system** (sex steroids, VTG, histology, etc)

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References:

MAEP (Ministère de l'agriculture de l'élevage et de la pêche), 2017. Plan National d'Investissements Agricoles et de Sécurité Alimentaire et Nutritionnelle (PNIASAN) 2017 – 2021, 139p

Agbohessi PT, Imorou Toko I, Kestemont P, 2012. Etat des lieux de la contamination des écosystèmes aquatiques par les pesticides organochlorés dans le bassin cotonnier béninois. Cahier d'Agriculture, 21, 46-56