

**Etude du déterminisme de l'envahissement du
réservoir de Boura (Burkina Faso) par le macrophyte
Ceratophyllum submersum :
théorie et empirisme participatif.**

1/ context of the project

2/ objectives “ “ “

3/ macrophytes' story

4/ discussion & lesson



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Philcecchi, collectif CPWF/VBDC-V3

The VBDC-V3 project: CONTEXT



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From CPWF1 to CPWF2

CPWF 1 [2002 - 2007]

68 projects

'More crop per drop'

5 research themes

Crop water **productivity** improvement

Water and people in **catchments**

Aquatic **ecosystems** & fisheries

Integrated basin **management** systems

Global & national water and food **services**

9 transboundary basins

Andes

Indus-Ganges

Karkheh

Limpopo

Mekong

Nile

Sao Francisco

Volta

Yellow river



Multi-disciplinary projects:
to reduce poverty & to enhance crop production

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From CPWF1 to CPWF2

Basin Focal Projects

6 work packages

WP1: status of poverty

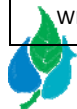
WP2: availability of water

WP3: water for agriculture

WP4: institutional contexts

WP5: water availability/productivity & poverty

WP6: knowledge management & sharing



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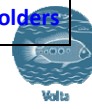
objectives

assessment: key aspects of
agricultural water use

opportunities & constraints to
improvement

opportunities & risks for
specified **interventions**

how to engage **stakeholders**



From CPWF1 to CPWF2

CPWF1 + BFP: emerging themes

Rainwater harvesting and rainwater management
Crop-livestock systems and livestock water productivity
Multiple-use systems at the community level
Integrated land and water management
Small reservoirs and other small water infrastructure in dryland areas
Wastewater management for peri-urban food systems
Water rights and water access at the catchment level
Broader water-related policy issues
Crop-aquaculture systems
Payment for environmental services
Water governance



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TOWARDS BDC

CPWF 2 [2009 - 2013]

Basins	Basin Development Challenges	areas
Andes	Increase productivity & reduce conflicts	selected basins
Indus-Ganges	Increase resilience	coastal areas
Limpopo	Increase productivity & reduce poverty	rainwater & Small Reservoirs
Mekong	reduce poverty	large reservoirs
Nile	strengthen rural livelihoods	rainwater
Volta	Increase productivity & reduce poverty	rainwater & Small Reservoirs



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VOLTA BDC

Management of Rainwater and Small Reservoirs for Multiple Uses

- Project V1 – Targeting and scaling out
- Project V2 – Integrated management of rainwater for crop-livestock agroecosystems
- Project V3 – **Integrated management of small reservoirs for multiple uses**
- Project V4 – Sub-basin management and governance of rainwater and small reservoirs
- Project V5 – Coordination and learning for adaptive management and change (coordination and change project)



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The VBDC-V3 project: OBJECTIVES



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Method

Uses **require** water (*quantity and quality*)
 Uses **impact** the resource (*quantity and quality*)
 There exist **trade-off** between impacts and requirements
 That **determine** the nature of available resources

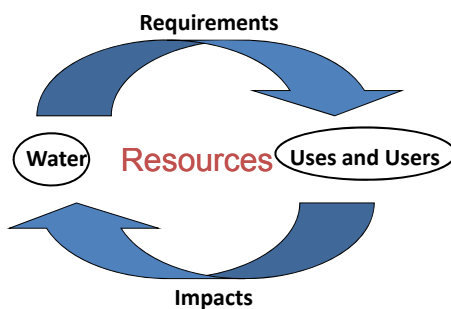
Key words

Integrated managements

Processes studies

Local scale

**Stakeholder's perceptions
and expectation**



Externalités hydrologiques, économiques, écologiques, sanitaires...
(consortium partenarial multi-disciplinaire)



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Site selection: process

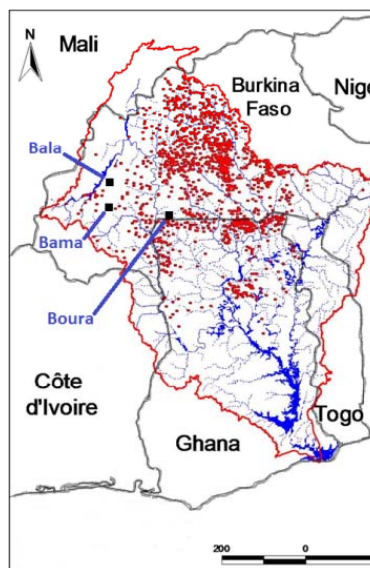
V3 PROJECT: core-site selection along the Mouhoun corridor in Burkina Faso a summary (April 2011)

The selection of our core-site in Burkina Faso has been performed in using a stepwise process.

- 0/ Identification of the Lower Mouhoun during the Ouagadougou Workshop (April 2010).
- 1/ Agreement with the V4 project to select a site in the Bougouriba sub-basin, already selected by the V4 project as a target zone (January 2011).
- 2/ Internal (within the V3 project) discussions that finally led to the rejection by V3 of the Bougouriba area, owing to logistical reasons.
- 3/ Compilation of available databases to identify a series of potential sites along the Mouhoun corridor that satisfy the criteria previously defined for our selection:
 - State of the infrastructures: we will not choose a site where the reservoir is damaged (dike, spillway...) potentially indicating a lack of care and maintenance. A fragile/weak place is also a risk for the whole project (elevated sensibility to extreme events and flood in particular...).
 - Size(1): we will select a site where water is permanent (in "normal" hydrological conditions).
 - Usages intensity: we will not choose an unexploited or a weakly exploited site. We will try to find a place where Multi-uses is effective.
 - Accessibility all along the year and proximity of stakeholders: for logistical purposes (particularly regarding participative approaches).
 - Size(2): we will not select a site exploited by too numerous villages (participative approaches again).
 - Mixed farming system: commercial cultures stimulate farming systems, both in inland valleys and on watersheds.
 - Existence of a management framework: we will not work in a place where no structure is already implemented, dedicated to the management / control / regulation of the access and of the usages of the reservoir.

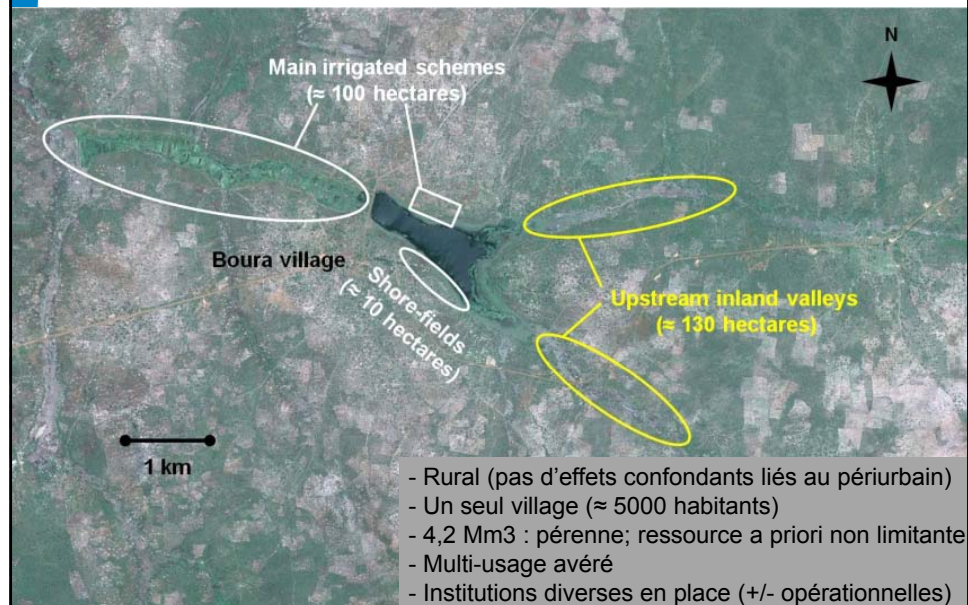
4/ Short list proposed in March to the V3 consortium.

5/ Field visits with Youssouf Dembelé (Inera Bobo Dioulasso) on Wednesday March 30th (Boura site) and Friday April 1st (Kayale site, near Koudougou) that finally led to the selection of the Boura site as core site for the V3 project in Burkina Faso (11° 2'49.63"N - 2°29'55.37"W).



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Site selection: result (Boura)



The VBDC-V3 project: MACROPHYTE'S STORY



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Agenda : Launching Boura - Juin 2011

Expliquer



Ecouter



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Agenda : Launching Boura - Juin 2011



Et entendre !



Ceratophyllum submersum

Prolifération importante de végétaux flottants (*mais non identifiée*)

Dénoncée par l'ensemble des participants à l'atelier :

Phénomène :

- Récent : < 5 ans
- Nuisible : noyade, encombrement, pêche, moustiques, etc.
- Au déterminisme : inconnu et sans antécédent.

→ ***Demande explicite de prise en considération...***



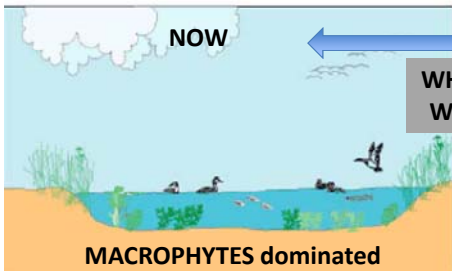
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Diagnostic co-construit (avril 2012)

Alternative Stable States theory for Shallow Lakes,
Scheffer et al. 1993.


- Both states are **RESILIENT**
- Shifts associated to **EXTERNAL DISTURBANCES**



NOW


MACROPHYTES dominated

**WHEN?
WHY?**




BEFORE

PHYTOPLANKTON dominated



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Affiche


- Présentation du modèle
- Support des interactions

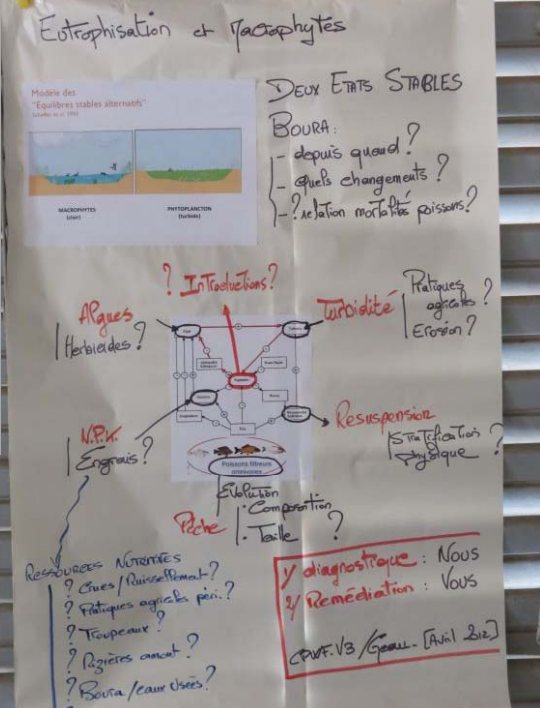
Session(s)

- Explication du modèle
- Notion de perturbation
- Identification d'hypothèses

- Déclinaison scientifique
- Schéma de mise en œuvre

Terrain (printemps-été 2013)
Restitutions (printemps 2014)





Eutrophisation et Macrophytes

Modèle des "Equilibres stables alternatifs" (Scheffer et al. 1993)

DEUX ETATS STABLES

BOURA:

- depuis quand?
- quels changements?
- relation mortelles poissons?

Algues / **Herbicides?** / **Herbicides?** / **Herbicides?**

Introductions? / **Turbidité** / **Pratiques agricoles?** / **Erosion?**

Resuspension / **Stratification thermique?**

Engrais? / **N.P.K.** / **Pêche** / **Composition** / **Taille**

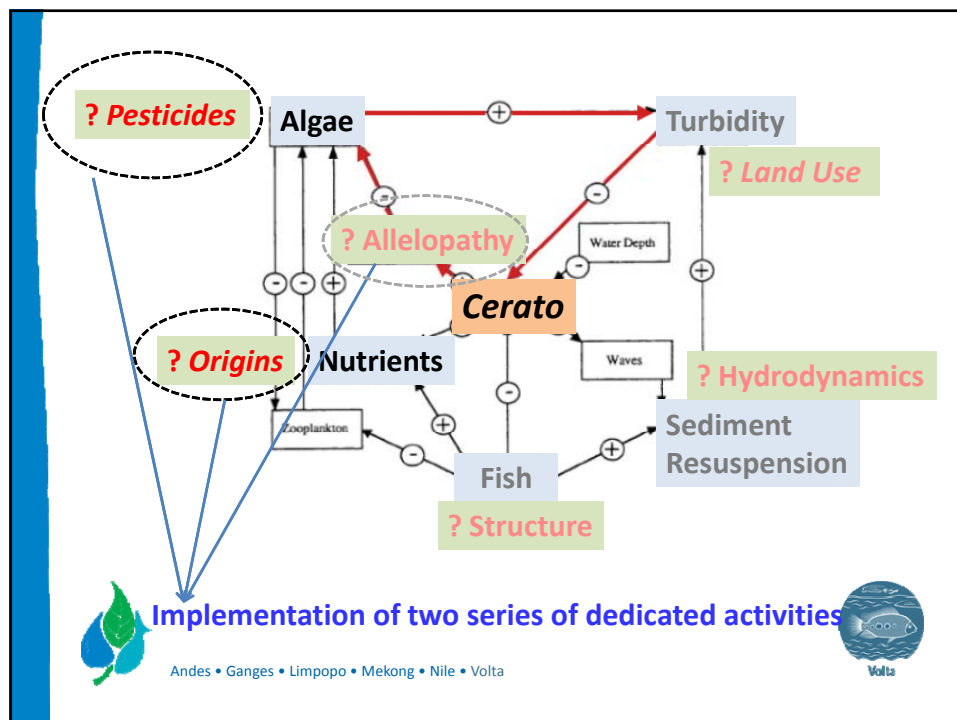
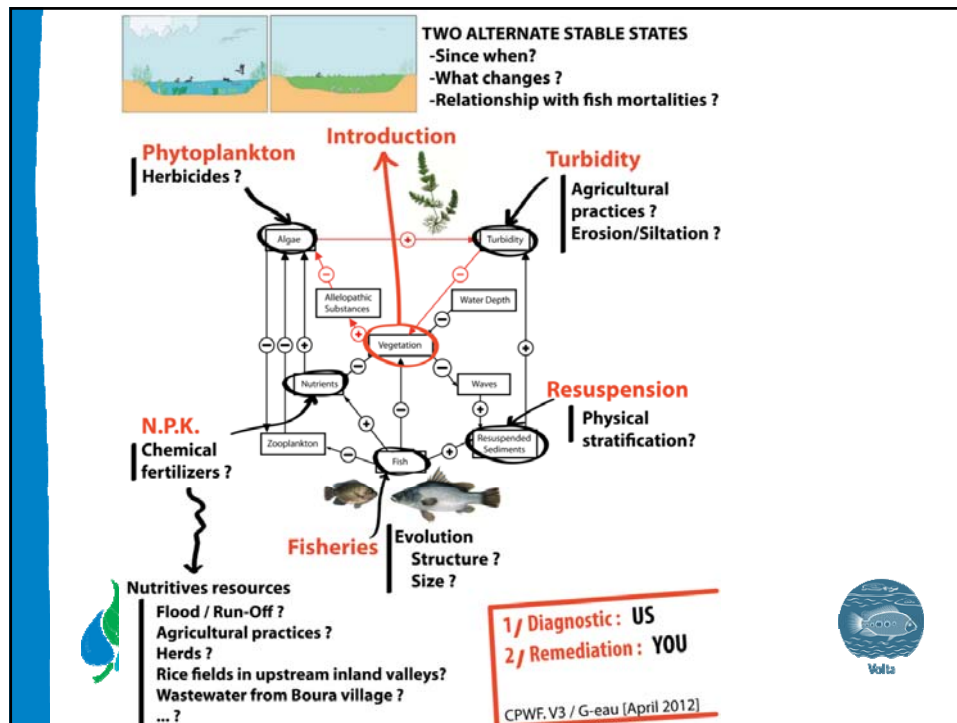
Substitution / **Composition** / **Taille**

RESSOURCES NATURELLES

- ? Cues / Ruissellement?
- ? Pratiques agricoles péri?
- ? Troupeaux?
- ? Régimes amont?
- ? Boue / eaux usées?

Y diagnostique: Nous
Remédiation: Vous

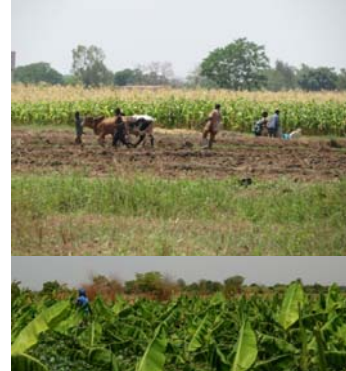
CPWF V3 / Geras - Avril 2012



METHODOLOGY (pesticides)



BALA: 'pristine'



BAMA: 'impacted'



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BOURA: Contamination status ?



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METHODOLOGY (pesticides)

Collaboration EMA/ Alès



3 Floating devices



2 Pocis

2 Chemcatchers



13 days

04-06/2013



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METHODOLOGY (pesticides)

Molécule	Type	Famille	Formule
Acetochlor	Herbicide	Chloracetanilides	$C_{14}H_{22}ClNO_2$
Alachlor	Herbicide	Urées	$C_9H_{10}Cl_2N_2O_2$
Atrazine	Herbicide	Triazines	$C_6H_9ClN_3$
Azoxystrobin	Fongicide	Strobilurins	$C_{22}H_{31}N_3O_5$
Chlortoluron	Herbicide	Urées	$C_{10}H_{11}ClN_2O$
DCPU (N-(3,4 dichlorophényl)-urée)	Métabolite	Urées métabolites	$C_7H_6Cl_2N_2O$
DEA (déséthyl atrazine)	Herbicide	Triazines métabolites	$C_6H_{10}ClN_3$
DET (Déséthyl terbutylazine)	Métabolite	Triazines métabolites	$C_7H_{12}ClN_3$
DIA (Désopropyl atrazine)	Métabolite	Triazines	$C_7H_9ClN_3$
Diuron	Herbicide	Urées	$C_9H_{10}Cl_2N_2O$
DPCMU (N-(3,4 dichlorophényl)-N-(méthyl)-urée)	Métabolite	Urées métabolites	$C_8H_9Cl_2N_2O$
Flazasulfuron	Herbicide	Sulfonyl urées	$C_{13}H_{12}F_2N_2O_5S$
Imidaclopride	Insecticide	Néonicotinoïdes	$C_9H_{10}ClN_2O_2$
Isoproturon	Herbicide	Urées	$C_{12}H_{18}N_2O$
Linuron	Herbicide	Urées	$C_9H_{10}Cl_2N_2O_2$
Metolaxyl	Fongicide	Amides	$C_{15}H_{21}NO_4$
Metolachlor	Herbicide	Chloracetanilides	$C_{15}H_{22}ClNO_2$
Oxadixyl	Fongicide	Phénylamides	$C_{14}H_{11}N_3O_4$
Pencconazole	Fongicide	Azoles	$C_{13}H_{15}ClN_3$
Propyzamide	Herbicide	Amides	$C_{12}H_{11}ClNO$
Simazine	Herbicide	Triazines	$C_7H_{12}ClN_3$
Terbutylazine	Herbicide	Triazines	$C_8H_{10}ClN_3$



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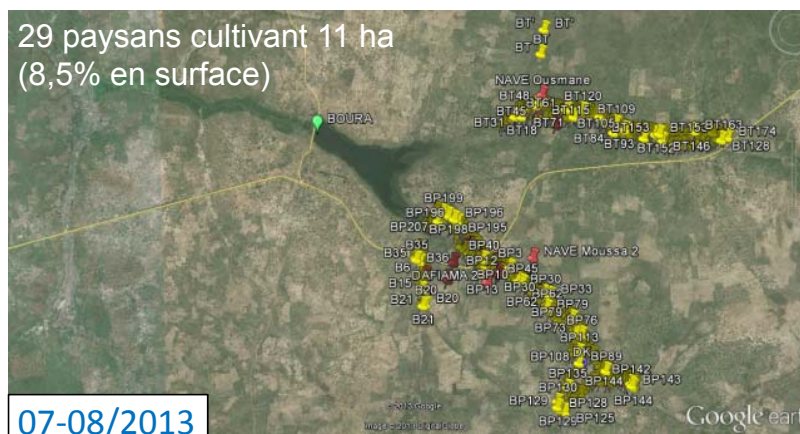
22 Chemicals



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METHODOLOGY (surveys)

29 paysans cultivant 11 ha
(8,5% en surface)



07-08/2013



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Two upstream Inland Valleys

- agricultural practices
- intensification pathways



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RESULTS (pesticides)

Among the 22 chemicals targeted:

- 12 exhibited concentrations up to the detection limits;
- All were all present in Boura (i.e. N > Bala & Bama).

	Chemicals (N)	Discrete samples (N)	Chemcatcher (N)	POCIS (N)
Bala	8	4	6	4
Bama	9	4	6	10
Boura	12	6	6	12



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RESULTS (pesticides)

The 6 principal have been quantitatively assessed:

- No pesticide residues in Bala (Pristine = OK);
- Comparable concentrations in Boura and Bama;
- Cocktail in Boura: 5 **herbicides** & 1 **insecticide**

Banalisation de l'usage des pesticides

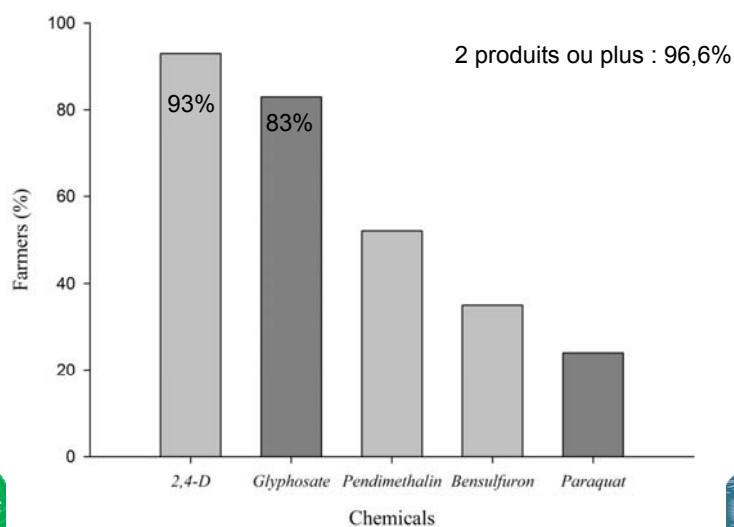
	Atrazine	DIA	DEA	Diuron	Linuron	Imidaclopride
Bala	-	-	-	< 0.5	-	-
Bama	> 10	> 10	> 10	< 3	< 3	-
Boura	> 9	> 7	> 13	< 1	< 12	< 15



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RESULTS (surveys)



Percentage of use of the five main herbicides applied by the Boura farmers
(dark grey: total herbicides; light grey: selective herbicides)

RESULTS (surveys)

100% of farmers used pesticides and fertilizers

- quantities of fertilizers are proportional to the surfaces of Inland valleys' fields

Pratique récente sinon nouvelle; en pleine **expansion**

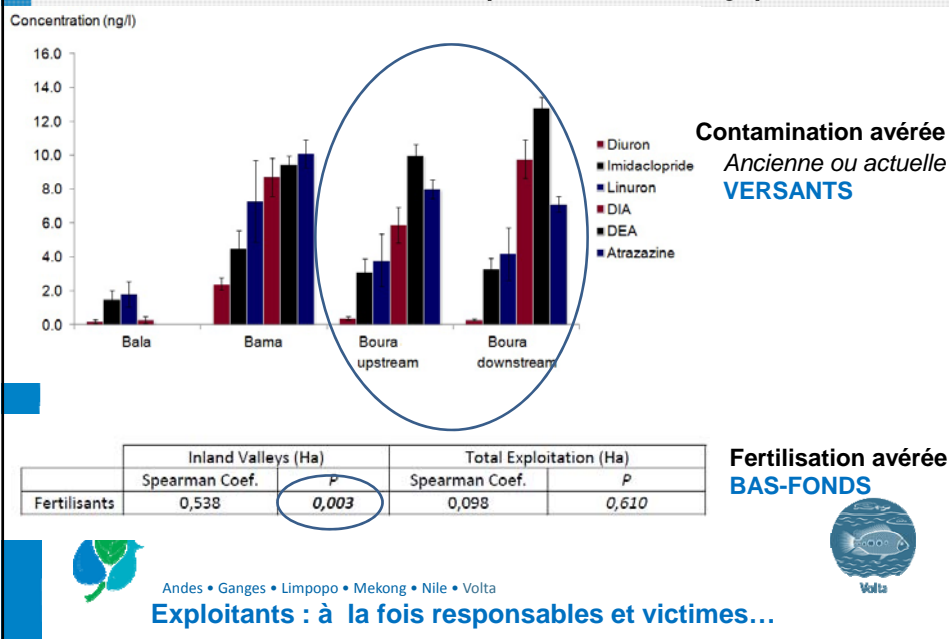
	Inland Valleys (Ha)		Total Exploitation (Ha)	
	Spearman Coef.	P	Spearman Coef.	P
Fertilisants	0,538	0,003	0,098	0,610

Les producteurs utilisent d'autant plus d'engrais que leurs parcelles de bas-fonds sont grandes (*Spearman*, $P=0,003$).

Il n'y a en revanche pas de lien entre la quantité d'engrais utilisée et la taille totale des exploitations (*Spearman*, $P=0,610$).

Confirmant les déclarations des paysans qui indiquent que seules les parcelles de Bas-fonds sont fertilisées à l'aide d'engrais chimiques.

RESULTS (summary)



DISCUSSION (pesticides)

After a 13-day accumulation period :

- \leq concentrations reported in other West African countries;
- $<$ EC50 values for phytoplankton, for atrazine and for diuron.
- $<$ EU environmental quality benchmark
- The same is true also for *Ceratophyllum* shoots
- \ll recommended water quality benchmark in drinking water

The contamination level we have quantified for herbicides should not affect the different primary producers of the Boura Lake.



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DISCUSSION (surveys)

Origin of agrochemicals:

- discrepancy “assessment” (POCIS) & field realities (2,4D, Glyphosate, Paraquat)
- uses and abuses of fake or illegal agrochemical products
- effectiveness of ‘imported’ urea (without N...)
- abuses of chemical fertilizers !

The excessive use of chemicals within inland valleys is acknowledged and should contribute to the eutrophication tendency of the Boura Lake.



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DISCUSSION

Atelier de restitution et d'information (Printemps 2014)

1- Présentation et discussion des résultats, suivies de

2- Déclaration d'intention des riverains :

- *Régulation des pratiques agricoles (paysans)*
- *Plan Communal de Développement (mairie)*

REALISME (réalité) ET POST EVALUATION ???

3- Identification de deux impasses :

- *Poids du cheptel transhumant ?*

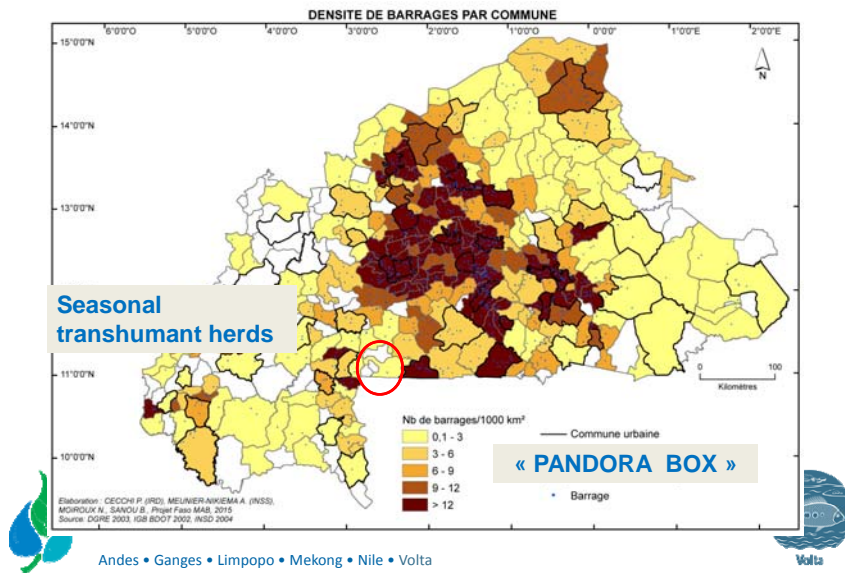


- Impact des dérégulations hydrologiques ?

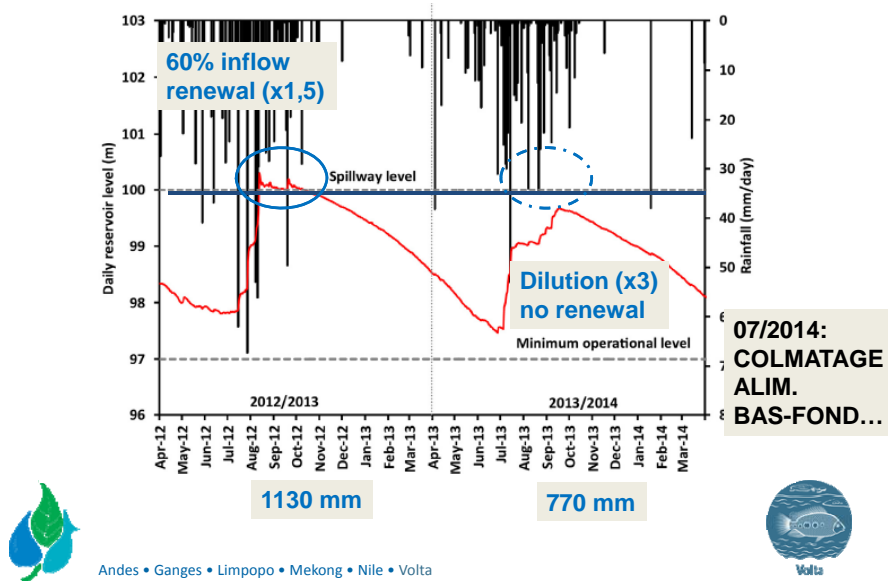
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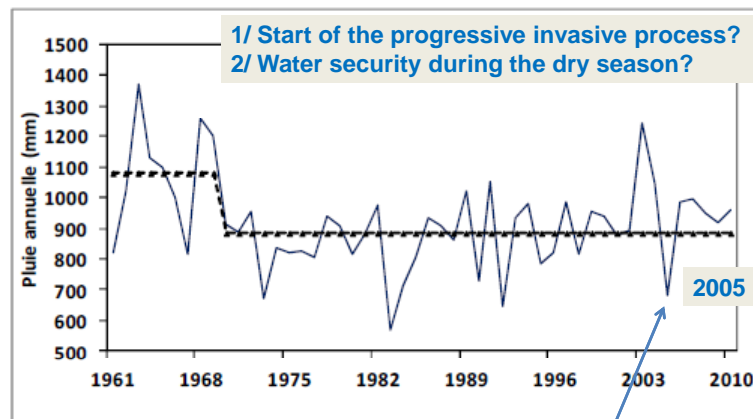
DISCUSSION (herds)



DISCUSSION (hydrology)



DISCUSSION (hydrology)



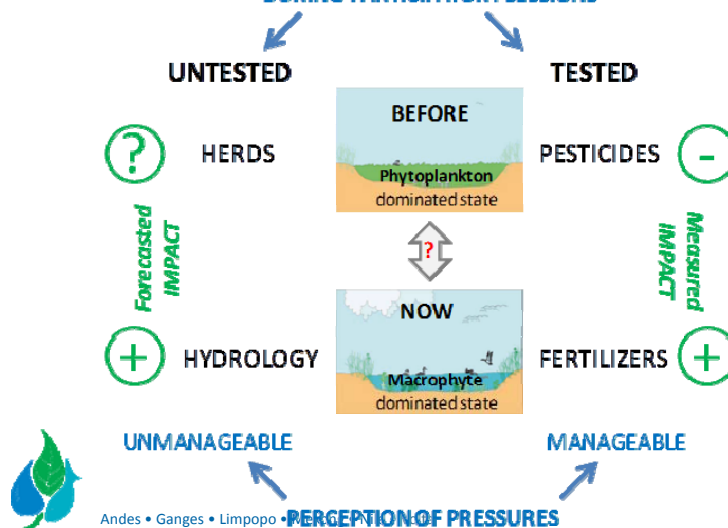
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DISCUSSION

HYPOTHESES COLLECTIVELY DISCUSSED
DURING PARTICIPATORY SESSIONS



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Leçons



Approche participative de la question
liées à la prolifération des macrophytes ?

- Un fil rouge support d'interactions constructives entre chercheurs et acteurs locaux
- Un vecteur de prise de conscience du fonctionnement du réservoir (vivant)
- Les acteurs, victimes et responsables, disposent d'une marge de manœuvre
- Il peut potentiellement exister des tensions autour de la ressource en eau
- *In fine*, quelle vocation pour le lac de Boura : multi-usages ou agriculture exclusive ?



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Merci de votre attention !

