Agroécologie et systèmes irrigués

Innovations et accompagnement des transitions en périmètres irrigués rizicoles en Asie du Sud-Est

cirad

GRET
Professionnels du développement solidaire

IRD

Eléments de contexte

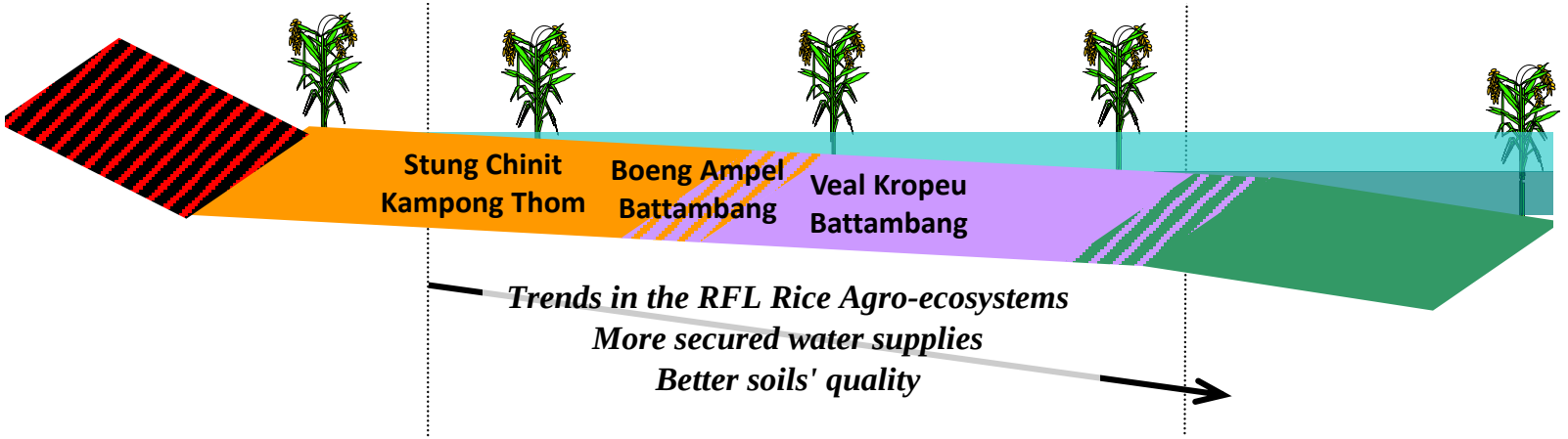
Lowland areas

- Rainfed and irrigated
- Rice-based farming systems

Major rice agro-ecosystems

Rainfed Upland | Rainfed Lowland | Deep water / Floating rice

Early | Medium | Late



Red & Black soils
Oxisol, Ultisol

Sandy Podzolic soils
Entisol, Ultisol, Alfisol

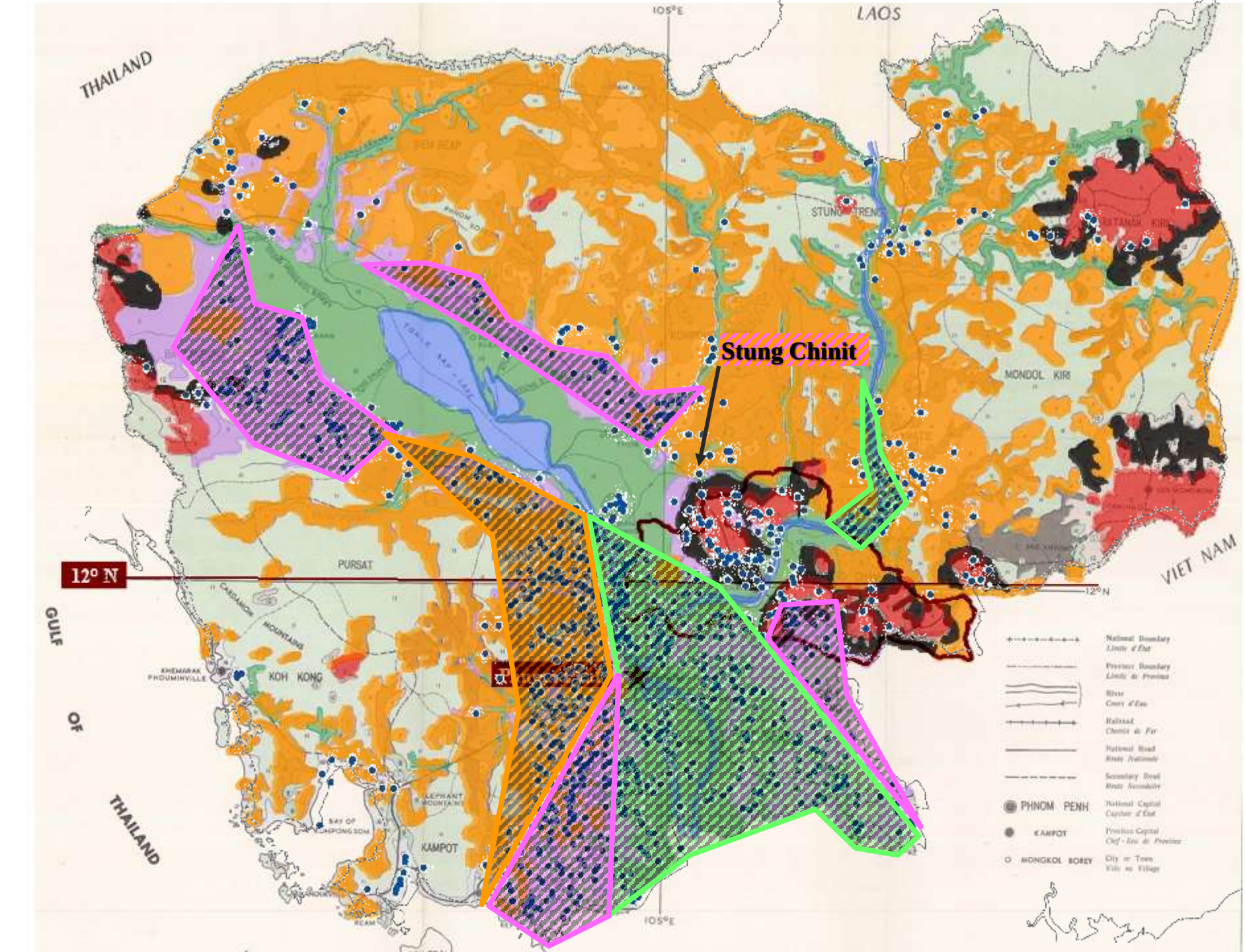
Hydromorphic plains
Ultisol, Alfisol, Vertisol

Flooded area
Entisol, Inceptisol

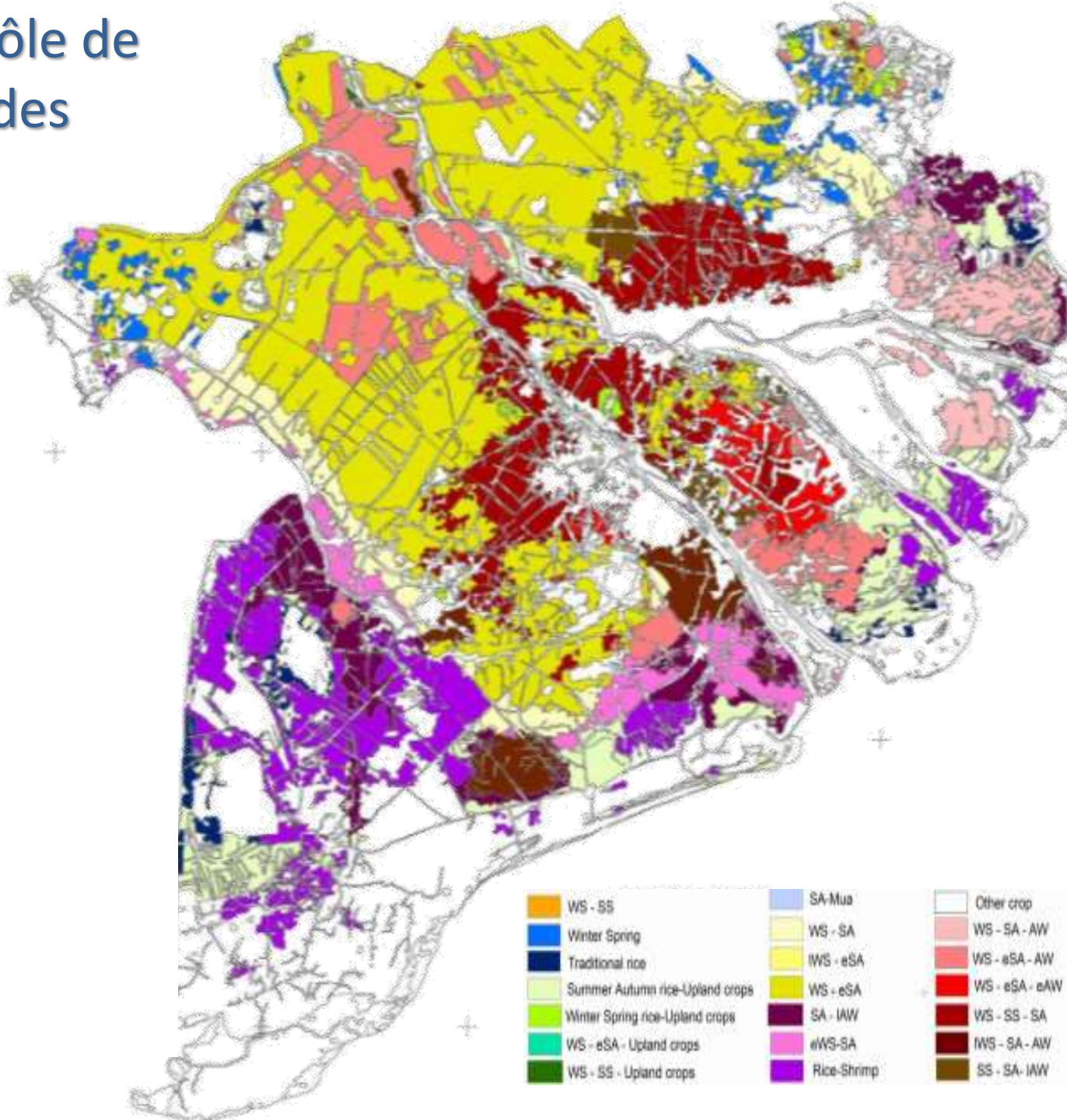
Position of most of the irrigation schemes allowing mainly complementing water supplies during the rainy season

Position of the strict dry season rice irrigated system (receding rice on “Prek-system”, “polder”, impoundment …)

- **Large diversité** de contextes biophysiques au niveau regional
  - Agroecosystèmes (sols, hydrologie)
  - Aménagement et contrôle de l'eau (irrigué**S** / inondé**S**)
- ➔ large gamme de modes de gestion (Σ de cult., Σ exploitation)


Stung Chinit
LAOS
THAILAND
VIET NAM
105°E
12° N
PURSAT
KOH KONG
KAMPOT
MONDOL KIRI
PHNOM PENH
KAMPOT
MONGKOL BOREY
GULF OF THAILAND

Hydrologie, contrôle de l'eau et diversité des systèmes



- Intensification des systemes rizicoles sous condition d'une amelioration du contrôle de l'eau
  - des gains de productivités couplés à un usage intensif de ressources (agrochimie, W du sol mécanisé) "sécurisés" par un contrôle du milieu

    → faible diversification des systems vs forte variabilité des milieux

    → Pression croissante de bioagresseurs (adventices, insects, maladies)
  - Les rizicultures inondés peu concernés par ces modes d'intensification et en "première ligne" face au CC

Innovations et intensification AE des systèmes rizicoles

From JC Castella, Oct. 2014

Agroecology principles

(Altieri, 2012)

- **Enhance the recycling of biomass** with a view to optimizing organic matter decomposition and nutrient cycling over time,
- **Minimize losses of energy, water, nutrients and genetic resources** by enhancing conservation and regeneration of soil and water resources and biodiversity,
- **Diversify species and genetic resources** in the agroecosystems over time and space at the field and landscape level,
- **Enhance beneficial biological interactions and synergies** among the components of agro biodiversity, thereby promoting key ecological processes and services.

Agroecology relies on five principles: **recycling**, **efficiency**, **diversity**, **regulation** and **synergies**.

Agreement on principles

Climate smart rice cropping systems

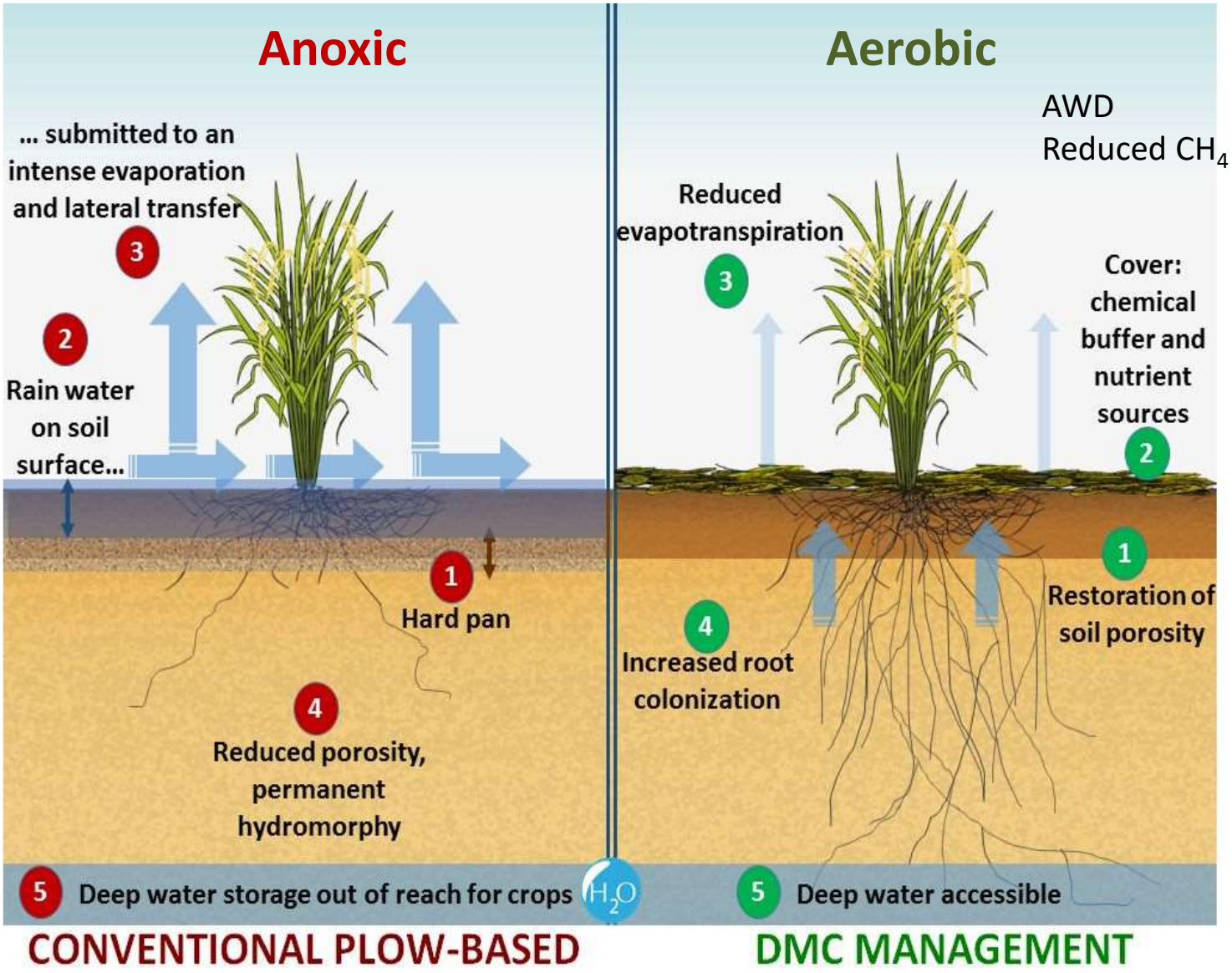
	Mitigation			Adaptation	State of art
	CO2	CH4	N2O		
***Thematic* - Level crops management**					
Variety development		var. with limited CH4 emission		selection / CC-induced alteration (resistance to drought, tolerance to salinization …)	on-going breeding program prospective for application
Potential impact		-?-		-?-	-?-
Nitrogen management	interdependence N and SOC dynamics		Balance Ammonium / Nitrate, fractionation, dose …		to validate impact / analyze pathways - high transferability
Potential impact	++		-?-		
AWD		reduction emission		reduced water consumption	operational - high transferability
Potential impact		+++		+	
Straw management	reduction emission (no burn, positive SOC balance)				operational - high transferability, livestock integration
Potential impact	+++				
***Systemic* - level cropping / farming systems management**					
SRI	to be evaluated	reduction emission via integration of AWD in the system	to be evaluated / likely to be significant with increased rely on O.M. based fertilization	reduced water consumption	operational -transferability function of the context-, based on simple message
Potential impact	-?-	+++	-?-	+	
CA	strong stimulation of positive SOC balance	water and soil management lead to aerobic condition	to be evaluated / likely to be significant with O.M. based fertilization	Context-based design, multi-functionality of cover-c.	methodology and technique references for systems design and up-scale (R&D approach)
Potential impact	+++	+++	-?-	+++	

Enhancing ecological processes through Conservation Agriculture systems
Minimum soil disturbance
Soil cover
Diversity of crops/species

From anoxic to aerobic conditions … opens ways to

→ adaptation and mitigation to CC

→ Diversification of cropping systems



Example based on topographic position – Flood plains

Development of fodder legumes on residual soil moisture in the dry season. Banan district, Battambang

Establishment of cover/relay crops after wet season rice (Battambang, Banan, 32 ha, 18hh)

Phka Rumdoul

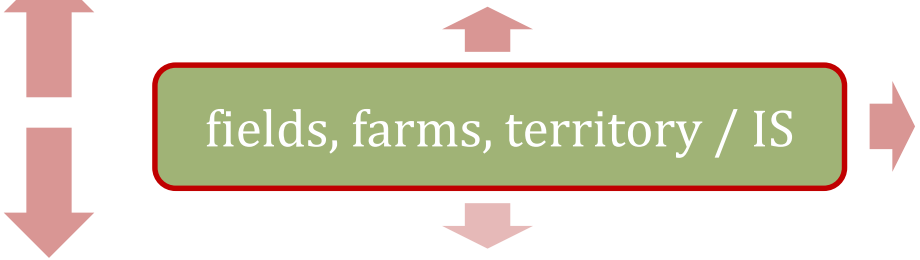
- 2015: 3.5 t/ha
- 2016: 4.0 t/ha
- 2017: 4.6 t/ha

Sowing rice on living cover crop, increasing efficiency

- Higher flexibility
- Reduction of production cost
- Higher input/production of biomass
- Continuous process of decomposition/mineralization during rice cycle
- Towards 0 herbicide
- Quality of the products

Vers un couplage R&D et vulgarization agricole basé sur les OP / associations d'usagers

- Different scales/dimensions:
  - Agricultural engineering platform (technical training, diagnosis, typology, constraints, conception CS/practices, collective learning)



  - Social engineering platform (technical training to support FWUC/FO, production means purchase, integrated mngt of resources, landscape)

Co-conception des systèmes au travers de boucle d'apprentissage

Differents objects, différents points de vue, différentes échelles …

Distinguer
les processus d'innovations techniques et organisationnelles

des methodologies d'accompagnement des transitions AE

Accompagnement et qualification des transitions AE en SI

. Remodeler l'accompagnement agronomique des OPs et Associations d'usagers autour des innovations AE

Agricultural extension, innovations, learning process

- Different scales: trials (inventions, 'field of possibilities', prospective and research on biophysical processes), on-farm (performances/efficiency, resources management: fodder/soil fertility…) and extension (from simple tools to integrated system, impacts) as a support for R&D, extension and collective learning.

Soil as a reservoir: water, nutrients, diversity

Water, soil fertility mngt

Diversification, dry season

Gestion et partage espaces et des ressources

- Diversification et
  - Gestion de l'eau
  - Valorisation des produits
  - Développement de ressources fourragères et gestion du bétail

- Vers une gestion de la diversification à l'echelle des paysages au sein des PI

- Pilotage des systèmes et modélisation de l'offre hydrique

Mise à disposition d'un germoplasm diversifié

Laos, Cambodia, Echo Asia – A unique germplasm

- Preserve a large diversity of staple crops and cover/relay crops – **55 species, 335 cultivars**
- Share genetic resources
- Train field practioners (preservation and storage): Echo Asia, Nov. 2017
- Produce seeds of keys cover/relay crops for public institutions, development operators and private sector
- Organize national event (Aug. 2018)
- Publish a catalogue (Oct. 2018)
- Develop a business plan

Annual production: >1 ton of stylo, >1 ton of Centrosema, 2 tons of sorghum and pearl millet, 3 tons of sunnhemp, 1 ton of *C. ochroloeuca*…

A large diversity of pulse crops: soybean, mungbean, rice-bean and cowpea

Forages and cover crops

On-farm seed production of sunnhemp

… d'une mécanisation adaptée

NT planter

seed broadcasting

Mécanisation adaptée

Broadcaster

Rollers

Roller and broadcaster

Versatile no-till planter – Sowing green

Machinery should fit with the principles of ecological intensification, improving resource-use efficiency while preserving the soil capital.

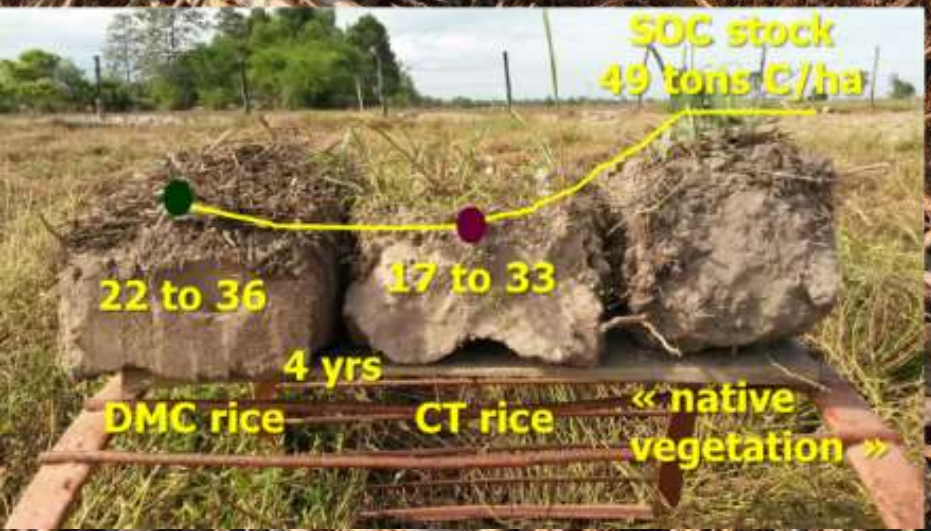
Accompagnement et qualification des transitions AE en SI

- évaluation des *performances* des systèmes AE
- qualification des *impacts* des innovations AE sur les sols, l'eau et les produits
- caractérisation des *émissions de GES* des systèmes AE et conventionnels

Increase in soil organic matter driving nutrient cycling, soil biological activity, water retention and adaptation to climate change

Stung Chinit, Cambodia

80% sand



ΔSOC: 0.65 to 1.2 ton C ha^{-1} yr^{-1}

Leng et al., forthcoming

Conclusion

- Large gamme d'innovations AE adaptée à la diversité des agroécosystèmes rizicoles, irrigués et inondés
- Articuler les ressources (projet de dev., facilité transversales, Recherche) pour

→ Avancer sur l'ingénierie de projet pour engager les agroécosystèmes rizicoles dans des processus de transitions AE (méthodologie, coûts)

→Renseigner ces innovations (performances, services écosystémiques, indicateurs) → calcul de TRI *complet*

→Renforcer les plaidoyers, institutionnaliser les approches, évolutions des politiques autour du couple eau agricole / AE