The impact of different rice production systems on the water quality in the Mekong Delta:

Nutrient and pesticide analysis

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Photo: La Thi Nga

Hypothesis, Objectives and Methodology

Hypothesis:

- **Different rice cropping-systems affect the amount and the spatial – temporal dynamics of nutrient and pesticide discharges into surface water bodies differently**

Objectives:

- 1. to **classify rice-based systems** in order to understand the runoff characteristics and relevant management practices
- 2. to **monitor the selected systems** with **concentrations of nutrients and pesticides** in surface water, soils and sediments
- 3. to **link management practice** of rice systems and **surface water quality,**
- 4. to **differentiate agricultural areas** with regard to their environmental footprint

Household surveys…(The objective 1 is carried out)

(2 soil types, different management practices, s-a 2011, 178 interviews)

Place	Soil type	System	Practice
1. Hau Giang (n=62)	Acid sulphate	Double rice	VietGap Non-VG
2. Can Tho (n=65)	Alluvial soil	Triple rice	IPM Non-IPM
		Double rice-upland crop	IPM Non-IPM
		Double rice	Global GAP Non-GAP
3. An Giang (n=51)	Alluvial soil	Double rice	Global GAP Non-GAP

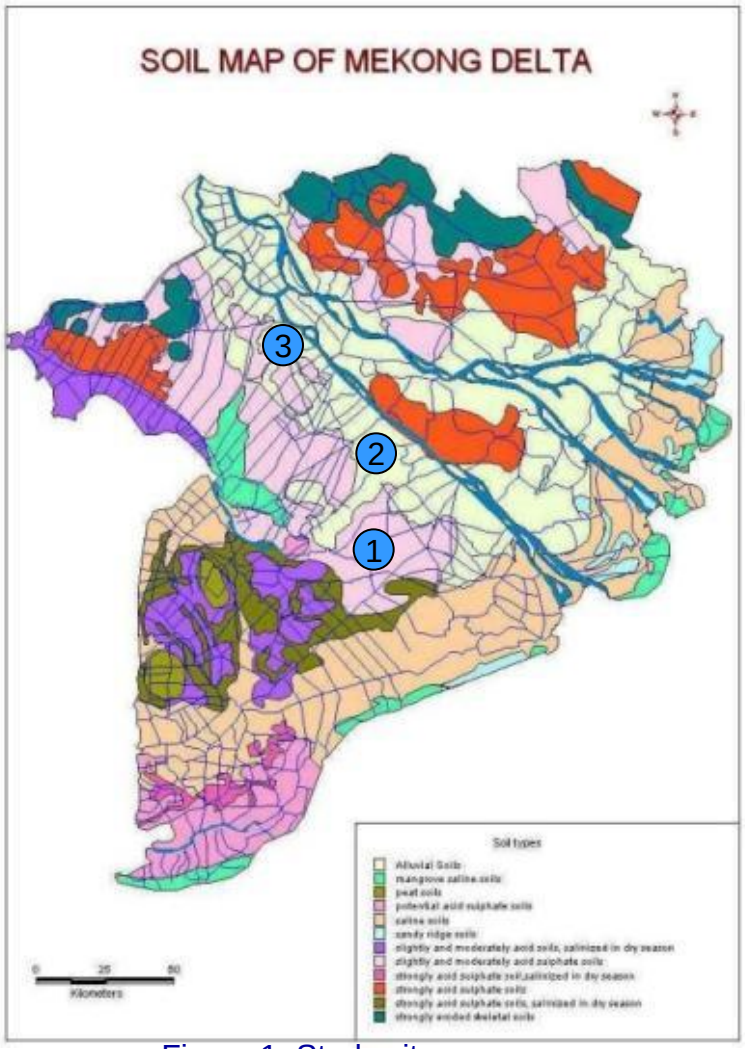


Figure 1: Study sites

Source of the map: Le Quang Minh 2001 (CTU)

Interview result: Fertilizer use (Summer-Autumn 2011)

Recommendation

(VietGAP, Global GAP, IPM for Summer autumn season)

80 kg Nitrogen/ha

50 kg P2O5/ha

41 kg K2O/ha

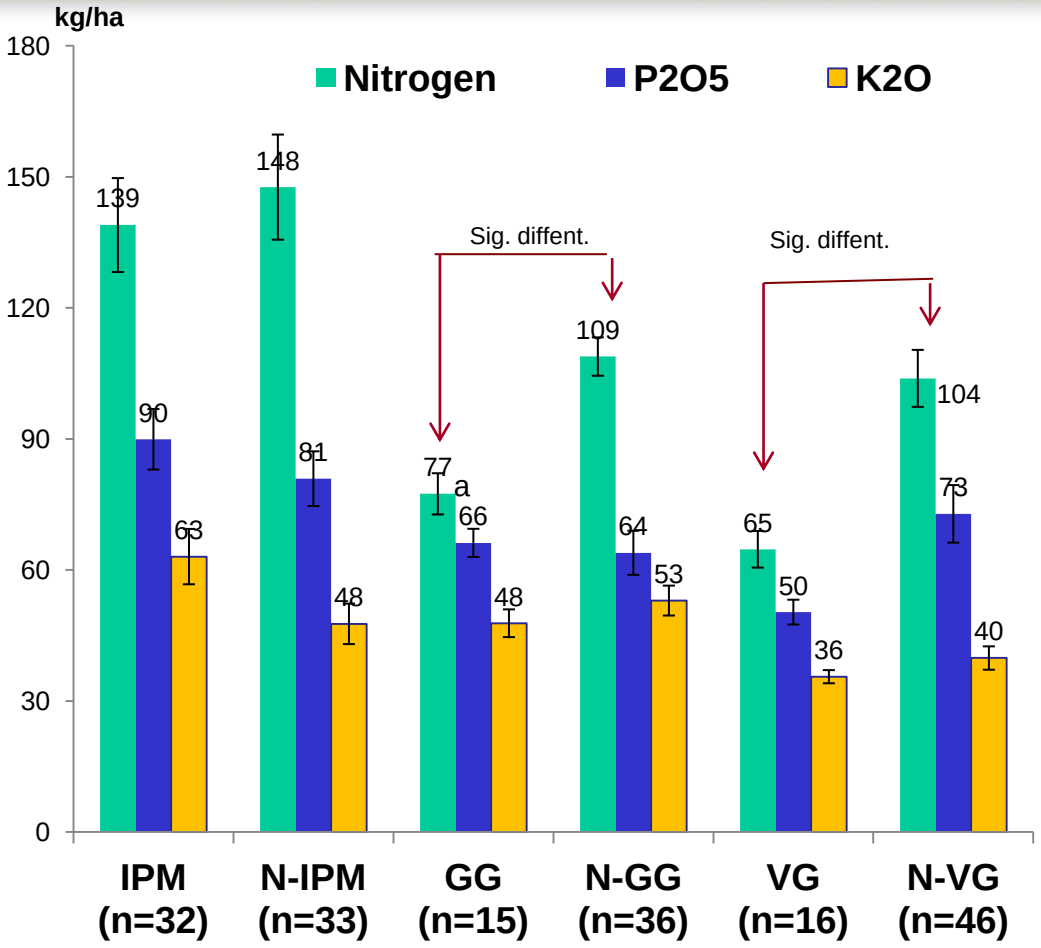


Fig. 2. Fertilizer use by different practices

- mean difference of fertilizer use between different practices based on household survey in Summer-Autumn 2012, P values, Mann-Whitney Rank Sum Test, the significant differences when P<0,05

Number of spray Pesticide in Summer-Autumn 2011

(S-A 2011), double rice cropping system

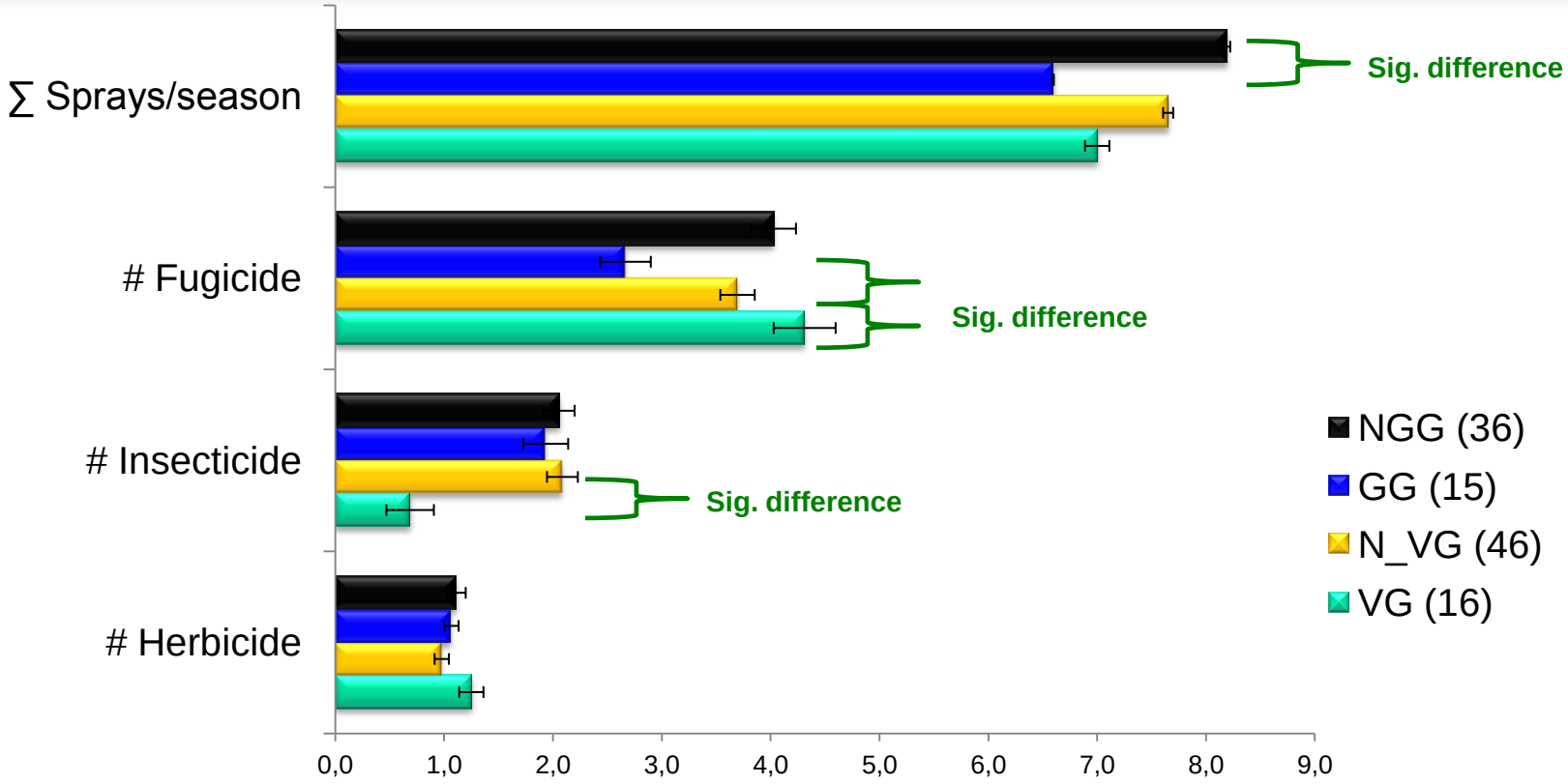


Fig. 3. Average number of pesticide sprays in Summer-Autumn 2011 by practices

• mean different of number of sprays in Summer-Autumn 2012, P values, Mann-Whitney Rank Sum Test, the significant differences when P<0,05

Interview results: Commonly used pesticides

- 78 commercial products with ***42 different active ingredients*** are currently using by 178 households

- Combined with other PhD's work:

16 selected compounds

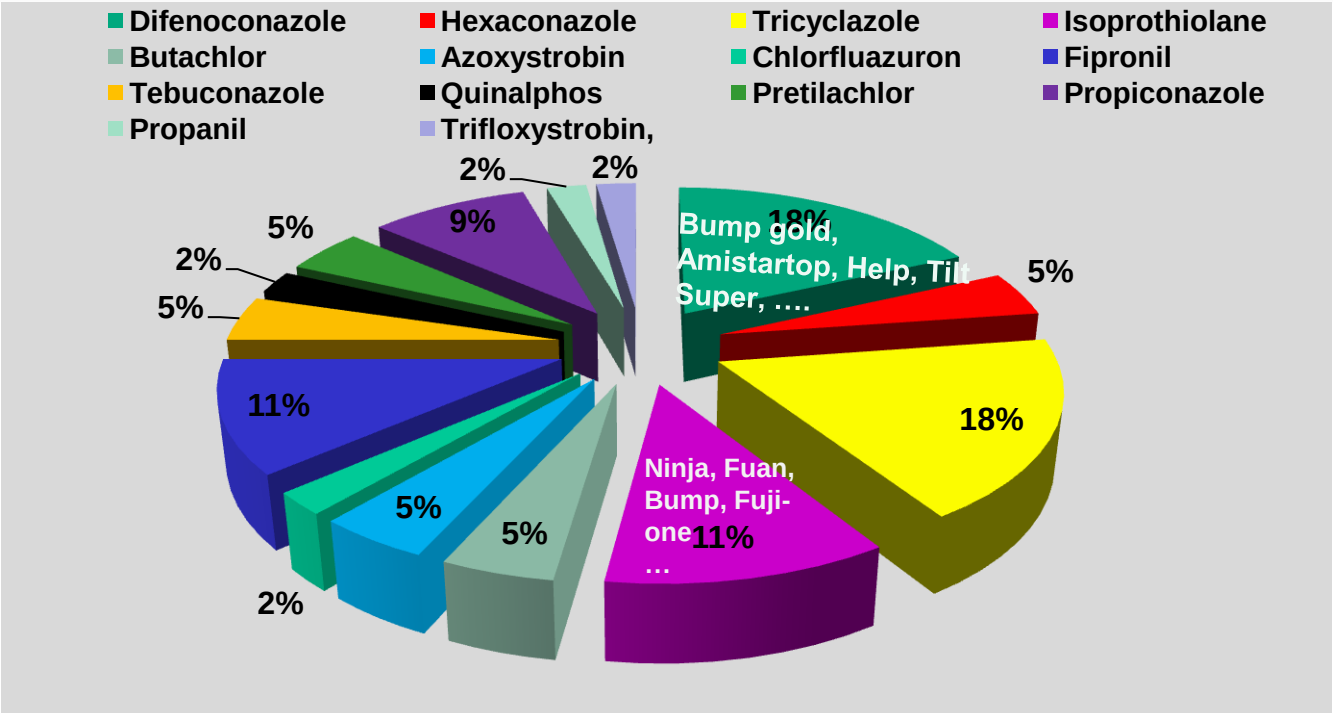


Fig 4. The most common use active ingredients in the study areas based on the household survey

Photos: La Thi Nga

Interview result: Irrigation management

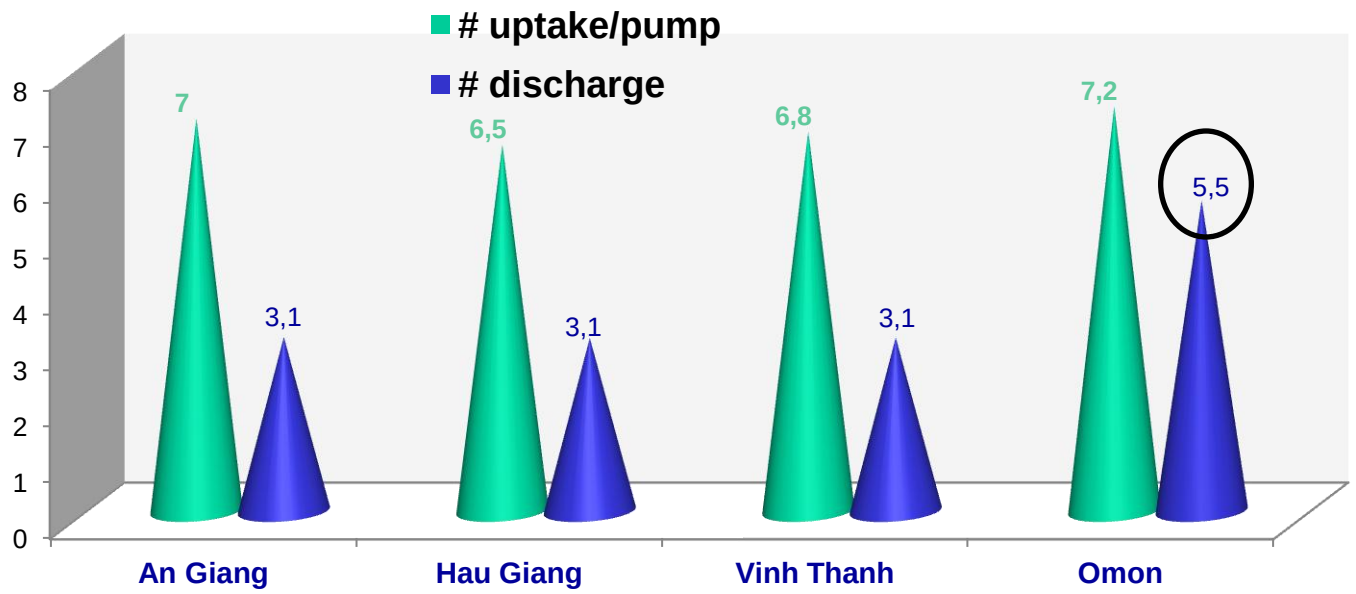


Fig. 5 Irrigation management at different places

Remarks :

• **90% farmers pumped** water from farm canals into their fields, **for all seasons**, fields are less affect by tide due to high proportion of **dyke coverage**

What to Sample and Monitoring?

Sampling	
Discharge water from selected fields	√
Farm canal water (irrigation source)	√
Soils: rice fields Sediments: canal	√

Monitoring Water	
Basic measurements: pH, EC, temperature, DO (in-situ measurement)	√
Nutrient levels: Ntot, NH4+, NO3-, NO2-, PO43-	√
16 selected pesticide compounds	√
Monitoring Soils + sediment	
Soil texture, pH, CEC, OM, % N, % P, 16 selected compounds	√

Results: Nutrient and Pesticide analysis

Photos: La Thi Nga

Photo: Nguyen Dang Giang Chau

Monitoring results: Nutrient level in An Giang site S-A 2012

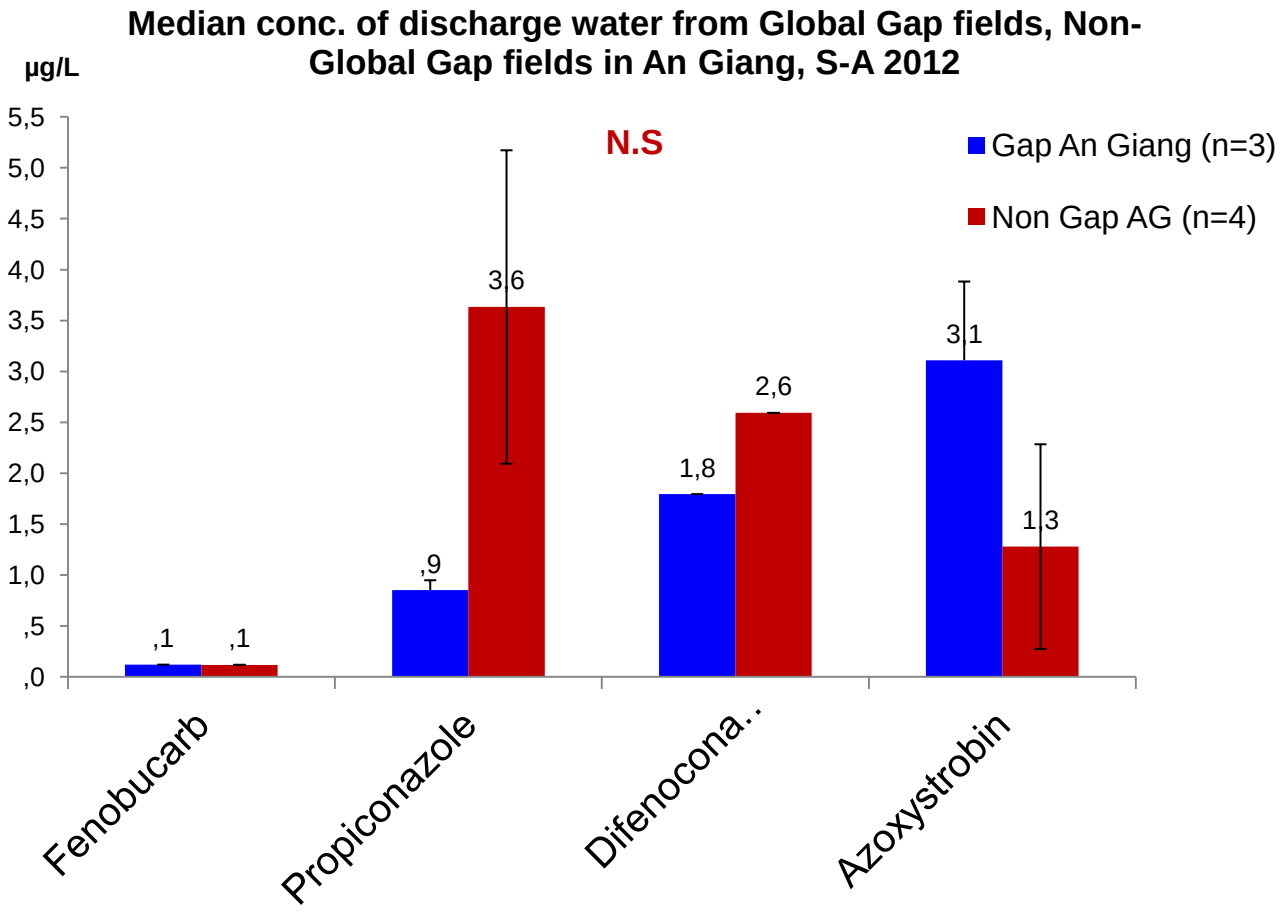
The standard values of the National Technical regulations for surface water 2008						
Water category QCVN 08: BTNMT	**pH***	**DO (mg/L)**	***NO_3^- (mg/L)**	**NH_4^+ (mg/L)**	***NO_2^- (mg/L)**	***PO_4^{3-} (mg/L)**
A1: use for water supply	**6-8.5**	**≥ 6**	**2**	**0.1**	**0.01**	**0.1**
A2: treat before supplying	**6-8.5**	**≥ 5**	**5**	**0.2**	**0.02**	**0.2**
B1: Irrigation water	**5.5-9,0**	**≥ 4**	**10**	**0.5**	**0.04**	**0.3**
B2: waterway or transportation	**5.5-9,0**	**≥ 2**	**15**	**1.0**	**0.05**	**0.5**

* New guideline QCVN 39: 2011/BTNMT National Technical Regulation on water quality for irrigated agriculture:

pH: 5,5-9,0; DO≥ 2.0, not mentioned on nutrient levels, but add SO42- (600 mg/L), Bo (B): 3 mg/L; As: 0,05 mg/L; Cd 0,01 mg/L; Cr 0,1 mg/L; Hg 0,001 mg/L, Cu 0,5 mg/L; Pb 0,05 mg/L; Zn 2 mg/L; E.Coli 200/ 100ml water

Water Sample (QCVN:08)	**DO**			**NH_4^+**		
	B1	B2	***XB2***	A2	***B1***	B2
Discharge water from G.GAP fields (n=6)	***0***	83%	***17%***	0	***50%***	100%
Discharge water from Non-Gap fields (n=6)	***33%***	83%	***17%***	17%	***50 %***	100%
Farm canal water samples (n=14)	***7%***	100%	0	29%	***100%***	100%

Pesticide monitoring: An Giang in S-A 2012



Residue limits discharge water of paddy rice

(Australia 1996, JEA, 1997; IUPAC, 2003):

Fenobucarb: 200 ug/l (II, WHO)

Propiconazole: 100 µg/L (Health Value, Australia 1996)

Difenoconazole (II, WHO, No value set)

Azoxystrobin: 5000 ug/l (III, WHO)

Fig.7. Median concentration of selected compounds in discharge water from Global.GAP fields and Non-Global GAP fields in An Giang during Summer-Autumn 2012, Mann-Whitney Rank Sum Test, the statistically significant difference when $p<0,05$

Conclusions: An Giang site

Household surveys:

- **Fertilizer use**
  - Viet Gap, Global gap farmers, tend to reduce Nitrogen use, close to recommendation rate
  - Non-gap farmers used higher amount of Nitrogen in S-A
- **Pesticide use**
  - Global GAP farmers: *reduced number of total sprays* and significantly difference with Non Global GAP's farmers
  - VietGap farmers: *reduced number spray of fungicide, insecticid*e than in Non-VietGAP
  - VietGap farmers: used the *Metarhizium anisopliae fungus* as the biological control to control BPH)….***Good news !***

Monitoring results:

- **Nutrients:** QCVN 08 & QCVN 39
  - QCVN:08: discharge water from both Gap fields and Non-Gap fields have fulfilled requirement for B1 (Irrigation water) *except DO value,* NH_4^+
  - The new QCVN 39: the discharge from *both Global GAP and Non-Global Gap fields fulfill requirement in term of nutrient level for* the irrigation water.
- **Pesticides:** JEA, 1997
  - No difference in conc. of monitored compounds in discharge water of 2 groups and
  - No detected *compounds have higher conc. than residue limits* for irrigation of paddy rice followed JEA 1997. *The guideline of VN on selected compounds in surface water are not in place*
  - but remained *5,5% of interviewed households in An Giang* used surface water for drinking, cooking and household activities, that *may pose any potential health problems* in the long term.
  - Controversial data if compare practices

Factor shape the future of the Global GAP An Giang

Date is compiled household interview data 2011-2012, expert interviews 2012

Chau Phu, An Giang		Global Gap (n=10)	Non-Global Gap (n=26)
Inputs use	Cultivar	Jasmine 85 (110 days)	Jasmine 85 (110 days)
	N-P_2O_5-K_2O (kg/ha)	79-73-55	113-61-54
	Number sprays	**6,30**	**8,00**
	# herbicide	1,00	1,00
	# insecticide	2,00	2,27
	# fungicide	2,30	3,77
	Irrigation management	inside dyke , # pumping 7 times	inside dyke, # pumping 7 times
	# discharge water	3-4 times/season	3-4 times/season
Yield (ton/ha)		**5,63**	**5,96**
Record history cultivation		**Yes**	**No**
Attend trainings		**Yes**	**No**
G.A.P certificate		**Yes**	**No**
****Rice price 2011**		**6,800 VND/ kg**	**6,800 VND/ kg**

Workplan

Research activities	Feb 2011-2012	Feb 2012-2013	Feb 2013-Feb 2014
• Course work			
• Labwork: 100 samples to analyze			
• Data analysis			
• Publications			
• Writing thesis			




Thank you for your attention
Photo: La Thi Nga

Global GAP certificates

GLOBALG.A.P.

CERTIFICATE

Herewith the Certification Body
of TÜV SÜD Management Service GmbH

accredited after EN 45011 for GLOBALGAP,
certifies that the company

TÜV SÜD
Management Service

Final site selection, site replicates

Location	System	Specific Good practice	Typical practice
4. Thoai Son, An Giang	Double	Standard-farming model	Non-Standard-farming model
5. Chau Phu, An Giang	Triple	Standard-farming model	Non-Standard-farming model

Replicates: 3 field/ each practice (6 fields/system), monitoring 3 seasons

Standard-farming model monitoring 1 season

What to monitor and analyze ?

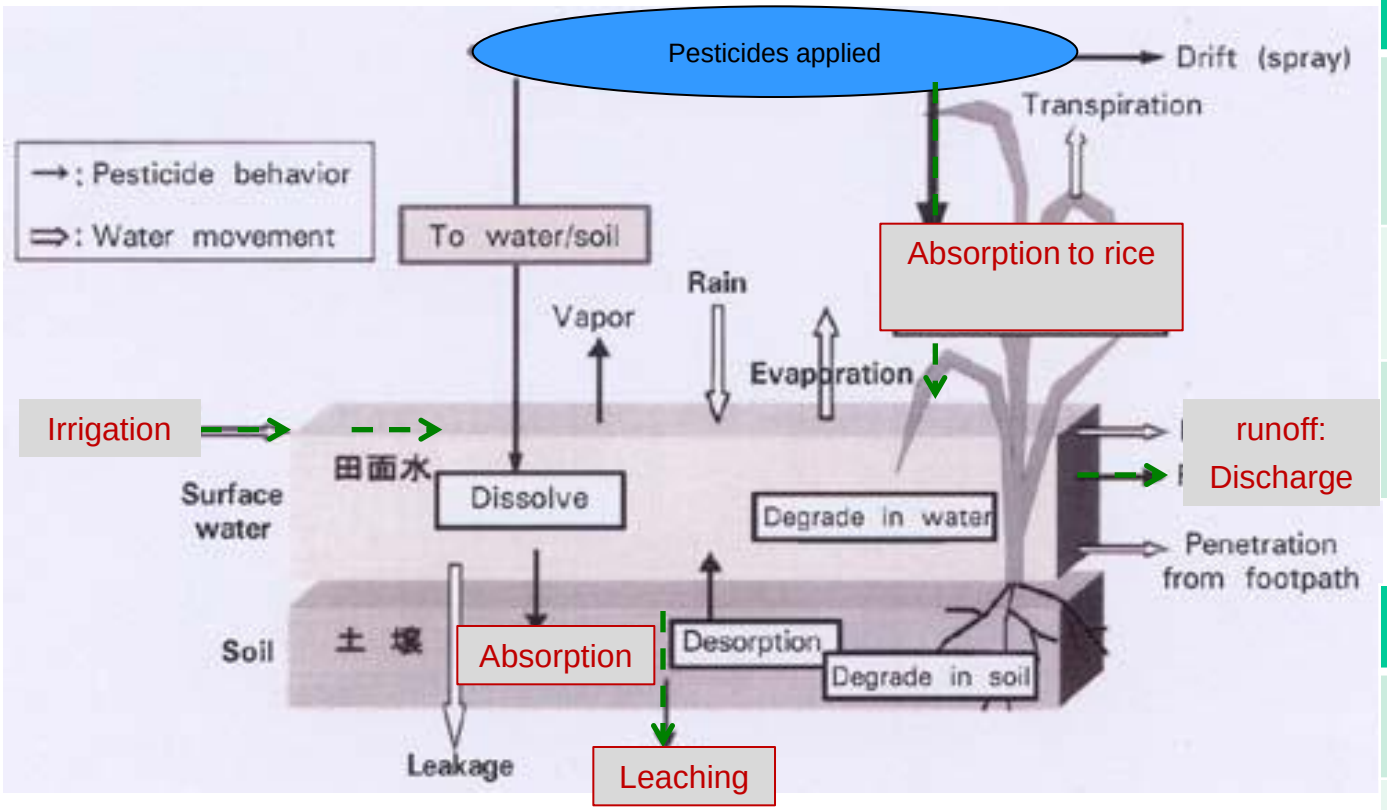


Figure 6. Scheme of pesticides behavior in paddy rice.

Adapted from Yasuhiro Yogo (2009): Approaches to the problems on pesticide residues in crops and soil in Japan. National Institute for Agro-Environmental Sciences, Ibaraki, Japan

Monitoring Water

Basic measurements: pH, EC, temperature, DO (in-situ measurement)	√
Nutrient levels: Ntot, NH4+, NO3-, NO2-, PO43-	√
16 selected pesticide compounds	√

Sampling

Discharge water from selected fields	√
Farm canal water (irrigation source)	√
Soils: rice fields Sediments: canal	√