Intenational Workshop

"Livestock, Climate Change and the Environment"

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Prediction of methane production in dairy cows based on fecal near infrared reflectance spectroscopy

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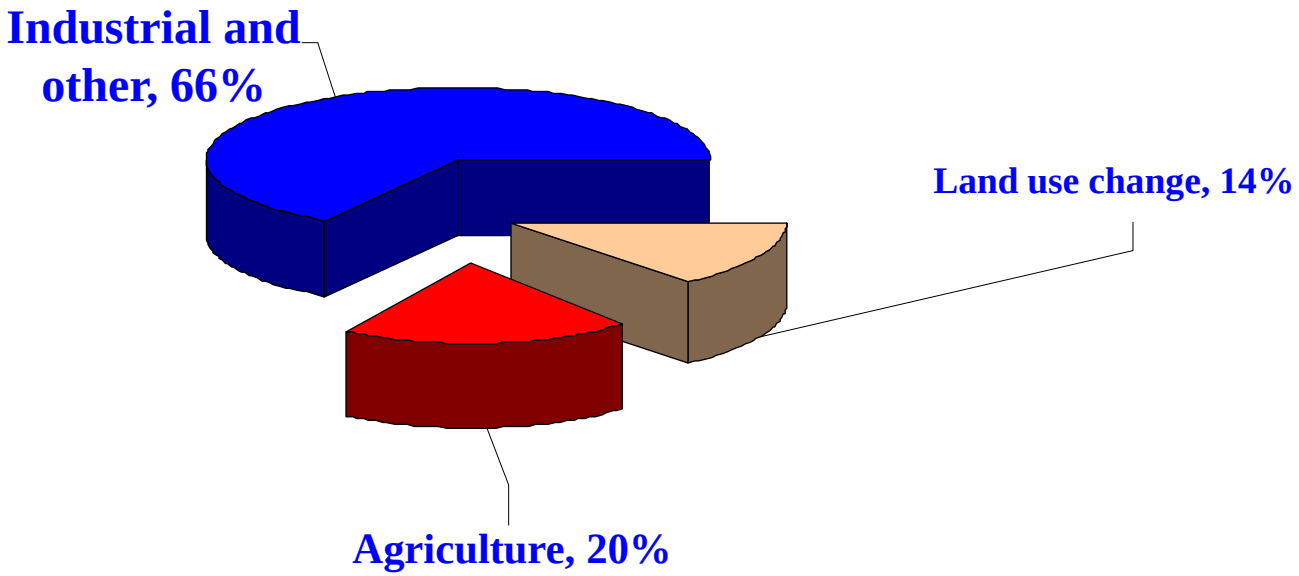
INTRODUCTION

Agriculture and global climate change

☞ **world climate change:**



☞ **agriculture: CO_2 , N_2O, CH_4 emission**

- ✓ CH_4 has the highest effect
- ✓ Effect of CH_4 is 300 times that of CO_2
- ✓ And is 20 times that of N_2O

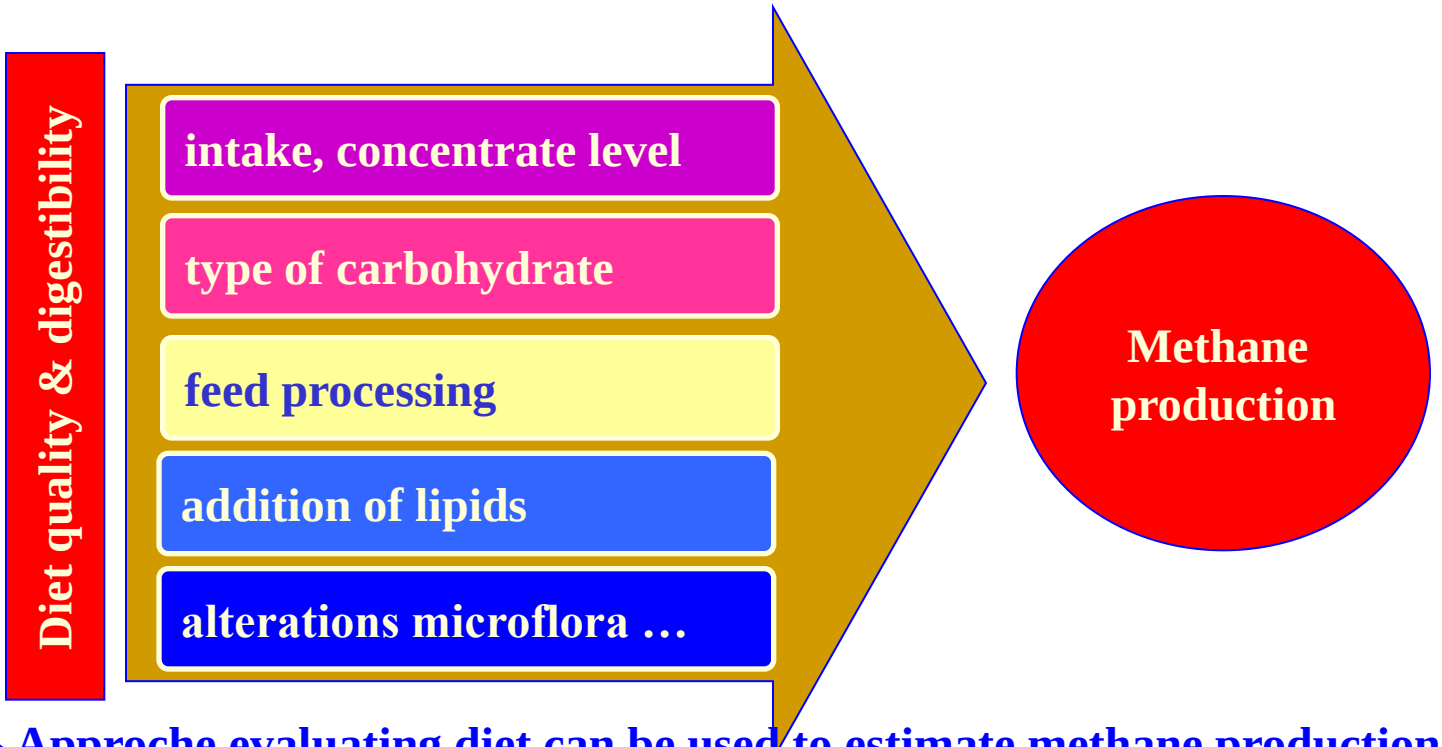
Aydinalp and Cresser, 2008

Livestock and global climate change

- **animal livestock:**
  - ✓ from livestock, manure management: 16% CH_4 in agricultuture
  - ✓ from ruminants: > 80% (100 million tonnes/yr)

  ⇒ It is important to estimate CH_4 emission from ruminant

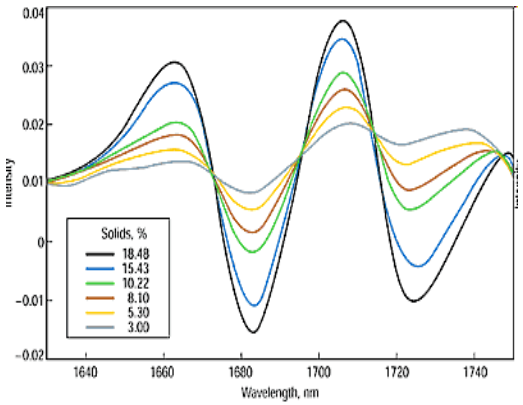
- **diet factors affecting CH_4 emission from ruminant:**



⇒ Approche evaluating diet can be used to estimate methane production

Novel approach

Near Infrared Reflectance Spectroscopy (NIRS)



☞**NIRS prediction of feed and diet quality:**

- ✓ feed chemical composition
- ✓ feed digestibility and available energy contents

☞**fecal NIRS prediction of diet quality and digestibility:**

- ✓ feed intake, diet quality (CP, NE, NDF, ADF…)
- ✓ digestibility (CP, NE, NDF, ADF…)

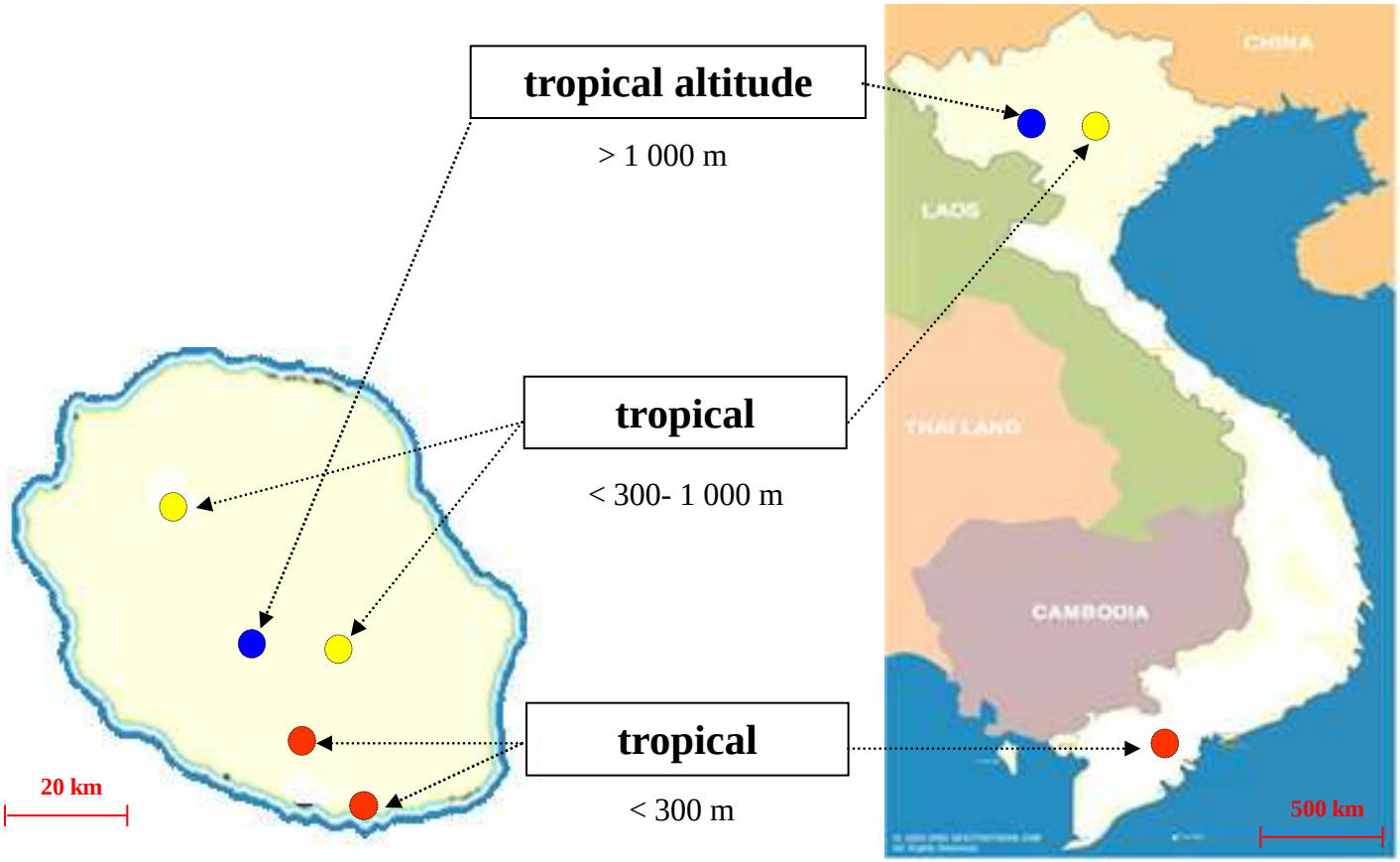
⇒ It is possible that we could estimate CH_4 emission based on fecal NIRS

Objective

- ✓ to predict methane production in dairy cows using fecal NIRS
- ✓ to compare different muti-regression methods (Global and Local calibration)

METHODOLOGIES

☆ experimental design:



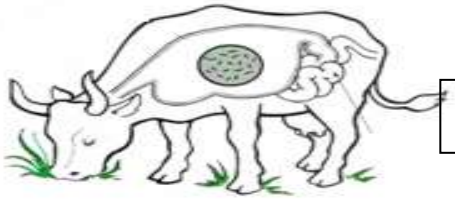
☆ data collection:

Data (intake + feces) : 1322 dairy cows

☆ reference method: Moe et Tyrell (1980)

CH4 l/d = 86.1+67.0*Cell+43.9* Hemi+12.9*Starch&Sugar
(brut matter ingested kg/d)

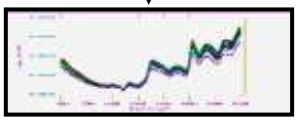
☆ prediction method:



Diet

Feces

Total CH_4, CH_4/kgDMI



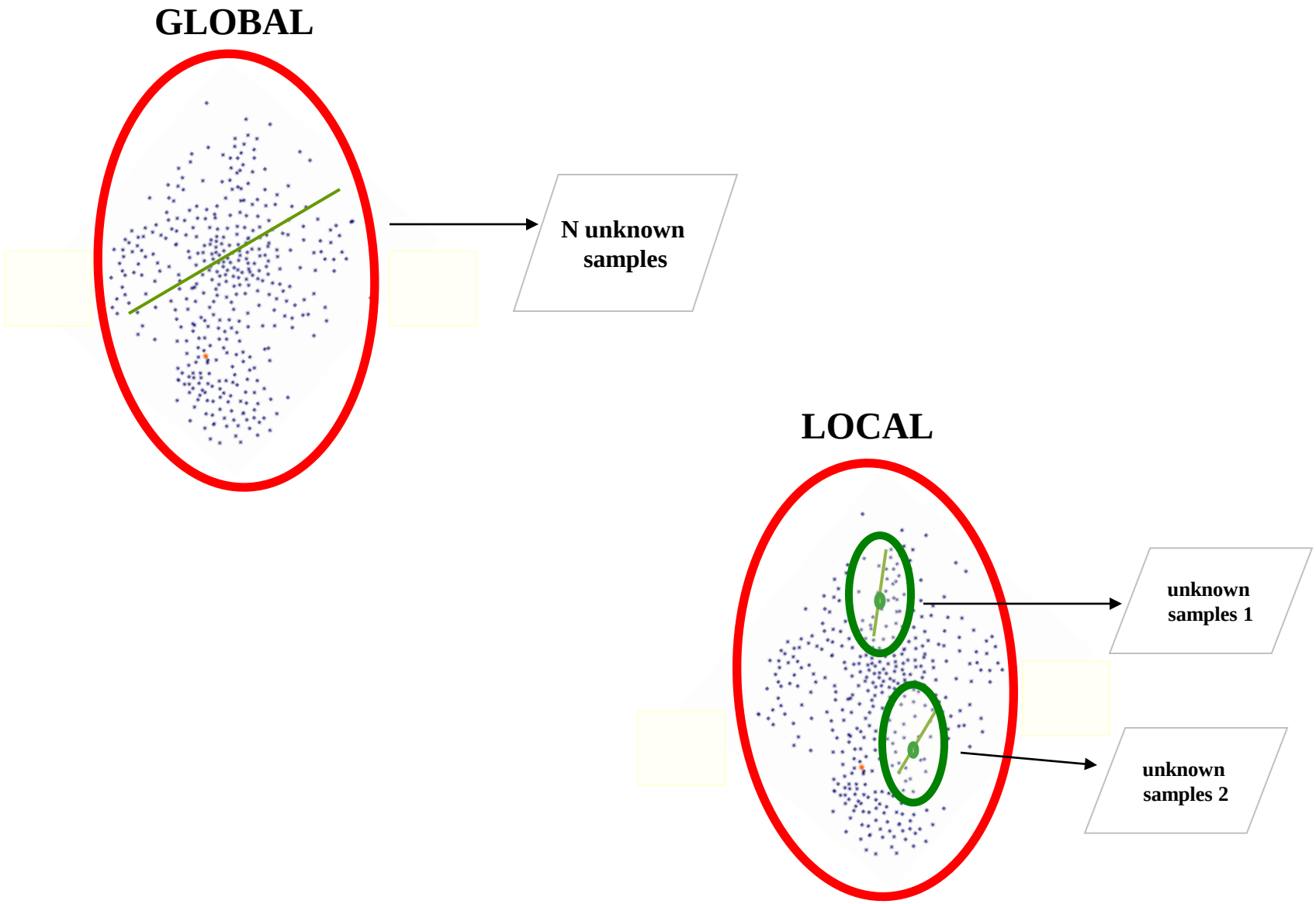
reference data

fecal spectra

WinISI III

$$Methane\ \ emission = \beta_0 + \beta_{1x} + \varepsilon$$

☆ prediction techiques:



RESULTS
&
DISCUSSION

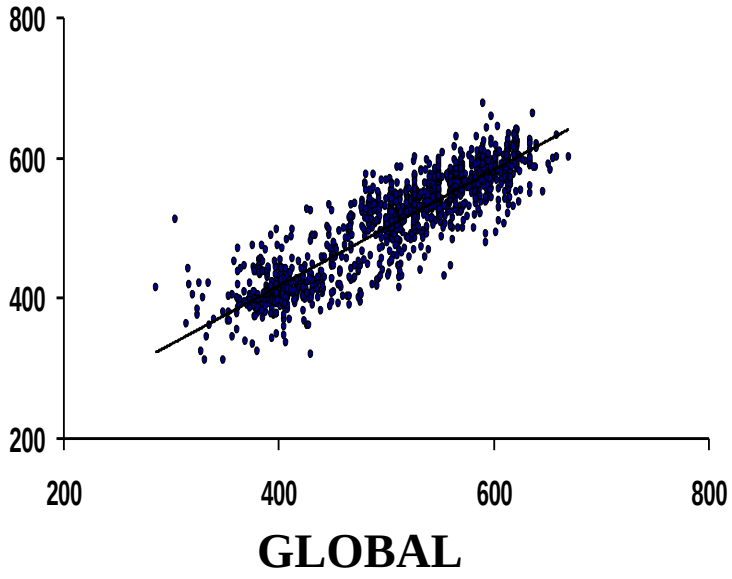
- **Calibration statistics (whole data)**
- **Validation statistics (validation data)**
- **Prediction statistics (averaged data)**

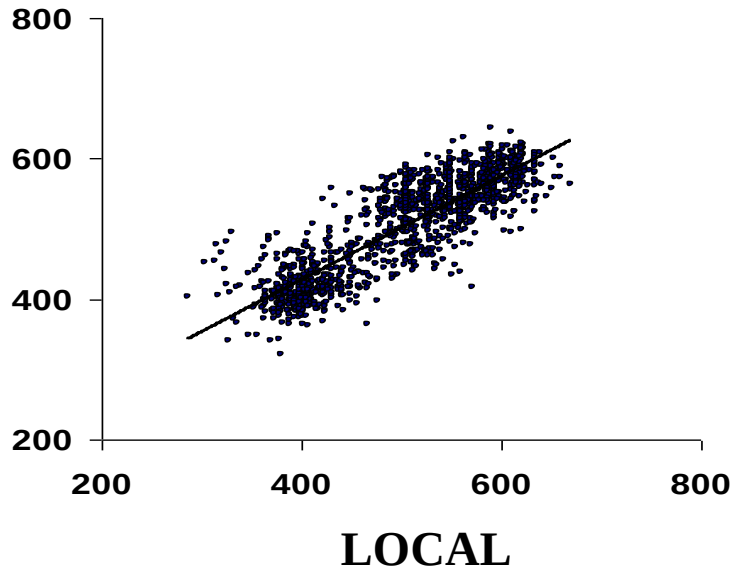
Calibration statistics of Global and Local equations

(whole individual data: N = 1322)

variables	GLOBAL		LOCAL		impropement,%	
	SE_c	R^2	SE_c	R^2	SE_c	R^2
Total CH_4, l/d	38	77	35	81	**8**	**4**
Efficience CH_4, l/kg DMI	1.5	84	1,4	86	**7**	**2**

SE_c = standard error of calibration ; R^2 = coefficient of determination



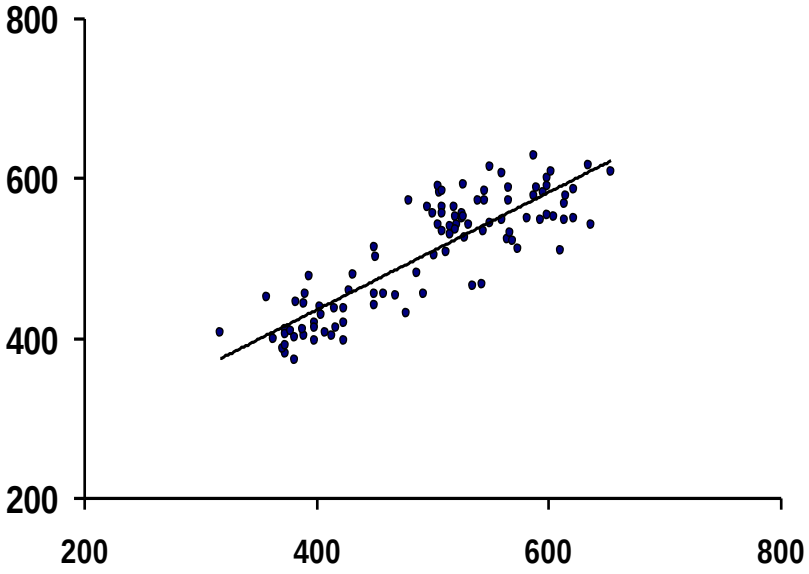


Validation statistics of Global and Local equations

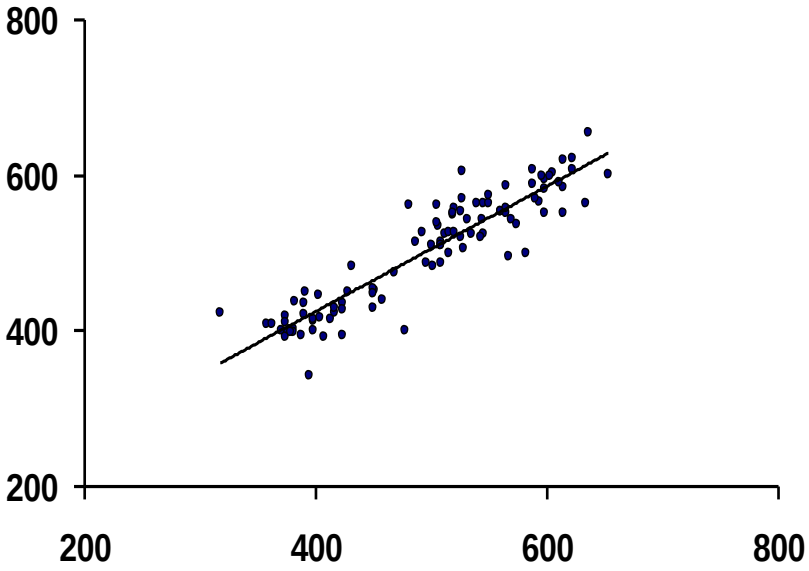
(individual independant data: N = 100)

variables	GLOBAL		LOCAL		impropement,%	
	SE_c	R^2	SE_c	R^2	SE_c	R^2
Total CH_4, l/d	44	74	33	84	**25**	**10**
Efficience CH_4, l/kg DMI	1.7	77	1,5	80	**12**	**13**

SE_c = standard error of calibration ; R^2 = coefficient of determination



GLOBAL



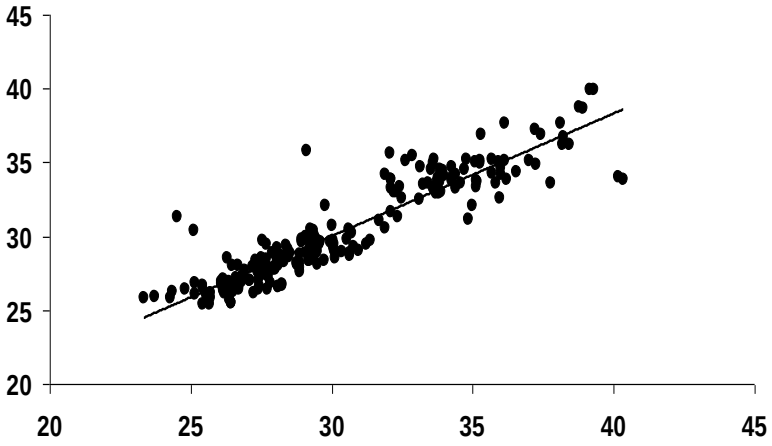
LOCAL

Prediction statistics of Global and Local equations

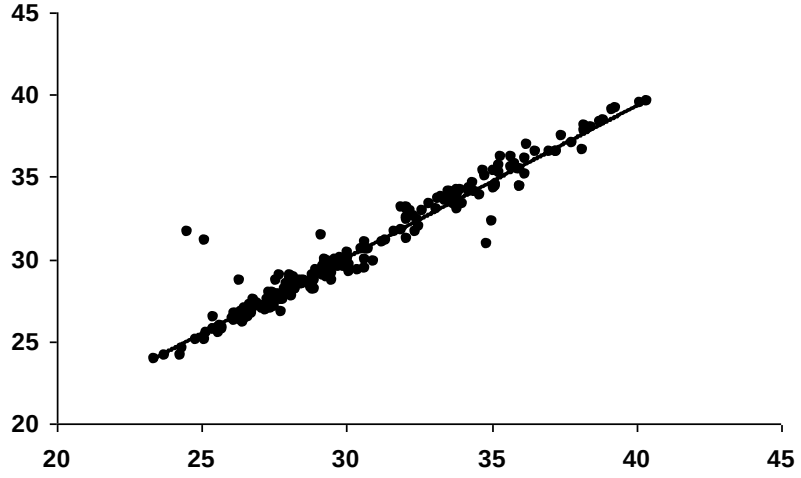
(averaged data: N = 220)

variables	GLOBAL		LOCAL		impropement,%	
	SE_c	R^2	SE_c	R^2	SE_c	R^2
Total CH_4, l/d	39	80	21	94	**46**	**15**
Efficience CH_4, l/kg DMI	1,5	85	0,9	95	**40**	**10**

SE_c = standard error of calibration ; R^2 = coefficient of determination



GLOBAL



LOCAL

Conclusions

Help to modify diet composition

Predict total methane production

Predict methane efficience of a diet

High improvement with Lobal calibration

High accuracy on animal group prediction

Help to improve management on farm level

Perspectives

① Make real reference data from *in-vitro* and *in-vivo experiments* ⇒ Develop fecal NIRS prediction model for methane emmision

② Evaluate zootechnique and enviromental efficiency of cattle production in Vietnam

③ Study on techniques to reduce methane emission

④ Paralell with reduction in Nitrogen excretion

⇒ Appropriate diets maintaining animal performance but reducing both CH4 emission and N excretion

PROFIL FECAL DE RATION

Commémoratifs échantillon:

Code demandeur: Nature:

Date prélèvement: NIRS Number: test fec pr

Demandeur: Sample Date: 08/08/2008 19:38:55

Objet: Product Code: (26) Prédiction FECES VL

Paramètres		Unités	Resultats	GH
MS totale ingérée	DMi	KG/jpur	**19.6**	*1.1*
Qté de mati"re sèche de complément	DMIcon	Kg/j	**14.0**	*1.2*
Pourentage de complément	pDMcon	% MS	**68.3**	*1.2*
Qté d'UFL totale	UFLtot-j	UFL/j	**16.6**	*1.1*
Qté de PDI totale	PDItot-j	PDI/j	**1 855.7**	*1.3*
Digestibilité de la matière organique rati	OMDp	%MO	**64.2**	*1.9*
UFL par kg de MS Ration	UFL-kg_ration	UFL/Kg MS	**0.8**	*1.9*
UFL par kg de MS Fourrage	UFLkg_fourr	UFL/kg MS	**0.7**	*1.7*
UFL par Kg de complément	UFL_kgCC	UFL/kg	**0.9**	*1.5*
Proteines en pourcent de la MS ration	CPpDM	%MS	**15.8**	*1.4*
Fibres NDF en % de la MS ration	NDFpDM	%MS	**40.4**	*1.4*
NDF fourage en pourcent	pNDFfour	% MS	**52.3**	*1.6*
Digestibilité du NDF	dNDF	% NDF	**47.4**	*1.7*
ADF en pourcent matière sèche	ADFpDM	% MS	**24.0**	*1.8*
Quantité de Méthane émise quotidienner	CH4total	lit./jour	**552.2**	*1.1*

THANK YOU
FOR
YOUR ATTENTION