Evaluation of soil intake in free ranged domestic animals

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Context

Consumer demand:

respect of animal welfare, « naturally » reared animals,

free ranged animals in contact with the environment

There can exist (ancient or actual) emissions sources of pollutants

Soil can trap deposited pollutants over a long time:

memory effect

Intake of soil from previously exposed areas

Risk of introduction in Food producing animals

Need to evaluate soil intake of free ranged animals and its variation factors

to ensure Food safety

Principle

Soil intake in domestic species reared in free range systems:

Grazing cows

Free ranged poultry

Free ranged sows

Estimate soil intake using a concentration ratio of a marker (AIA)
(Beyer et al. 1994)

$$[AIA]_{Soil} >> [AIA]_{Diet}$$

Diet = ∑ (plants + grains +…)

1- dig DM

$$(AIA)_{Feces}$$

State of the art: grazing cattle

Beef cattle	up to 6% DMi (Mayland et al. 1975)
Heifers & dry cows	0,3 to 3,8 % DMi Fries (1982)
Dairy Cows	0,2 to 1 % DMi Fries (1982)
	0,2 to 2 kg/d Healy (1968)

Cattle: generally ≤0,7 kg of soil/d,

in bad conditions: 1,5 kg of soil

problem: **huge variations**

Soil cover:

Concrete –
vegetation – bare soil

Grazing conditions:

Semi-arid conditions (Texas)
Muddy pastures (New
Winter grazing (W

Feed availability:

Offered grass
(quantity, digestibility)
Feed supply

Realistic values in intensive grazing conditions nowadays ?

Methodology:

Used markers / [marker] soil vs plants

Nutritional needs:

Performance / Dairy – beef

Material & Methods

Jurjanz *et al. (2012,* Animal)

Trial 1: 24 Holstein cows in factorial design 2x2 (Ribeiro Filho et al. 2005)

- pasture allowance (20 or 35 kg DM/d)
- sward type (grass only or mixed sward)

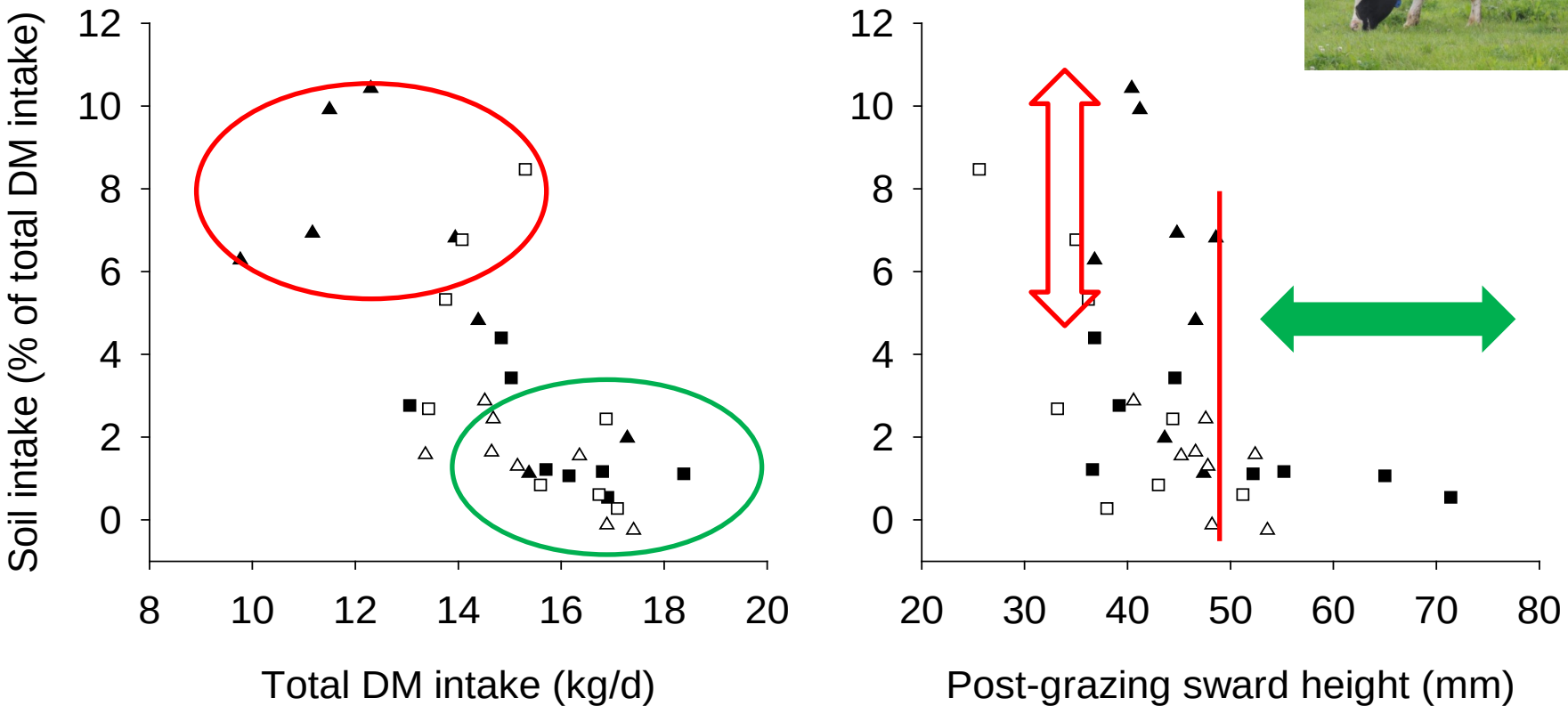
Trial 2: 12 Holstein cows in factorial design 2x2 (Pérez-Prieto et al. 2011)

- pasture allowance in autumn (40 or 65 kg DM/d)
- supplementation: maize silage & SBM (0 or 8 kg DM/d)

Records & Sampling:

- Sampling of soil, pasture, feed and individual feces
- Individual determination of pasture intake and digestibility (Baumont; Pérez-Prieto et al. 2011)
- Animal performances*: see publications*

Results: dairy cow



Under good "normal" grazing conditions: **≤2% of DMi (≤0,2 kg/d)**

Main risk factors: reduced pasture allowance (i.e. sward height)

Extreme values confirm literature: group 0,8 kg/d; individual 1,3 kg/d

Control means: distribution of supplementary feed, reduced access time

State of the art: free ranged poultry

Hens: ~10 g/d Kijlstra (2004), de Vries et al. (2006)

< 30 g/d Waegeneers et al. (2009)

Chicken: **???** (11 g plant DM/d; Riverra Ferre et al. 2007)

Methodology of evaluation of soil intake

digestibility of **diet DM** need to know the **intake of all ingredients**:

Plant intake

- Crop analysis: only qualitative approach
- Sward cutting: no distinction between trampling and ingestion
- **Marker based method: n-alkanes**

Intake of insects & earthworms: likely small inasmuch as very punctual*; to be confirmed*

Material and methods: poultry

Laying hens

Chicken

Grass (RG-WC) **covered plots** (n=4) of 2840 m² (house 32 m²) for 200 hens

Plots on **grass** (n=2) or **under trees** (n=2) 2500 m² for 750 chicken, access D29 to D84

Summer conditions in W-France

2 dietary treatments:

complete feed vs wheat + marine shell

2 repetitions per treatment

2 time points: weeks 6 and 12

5 successive runs:

(spring, autumn, winter, spring, autumn)

2 ages: **growth (D51)** & finishing (D64)

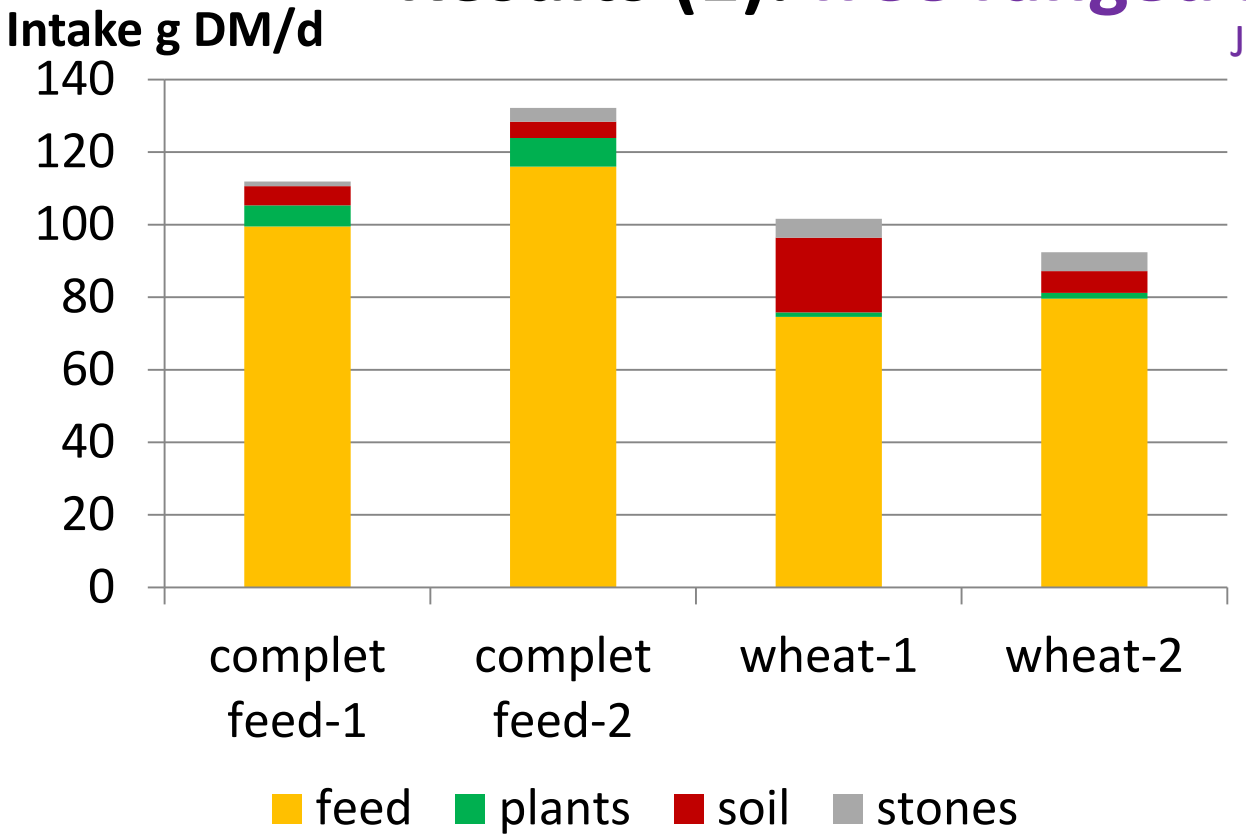
records: feed intake, botanic composition

sampling: soil, plants, feeds, droppings of groups

analyses: n-alkanes (Smith & Strickland, 2007), AIA (van Keulen & Young, 1977)

Results (1): free ranged hens

Jondreville *et al.* (2010)



	CF-1	W-1
Stones	1,3	5,2
Soil	5,3	**20,6**
Plants	5,8	1,2
Feed	99,5	74,6

Soil intake:

Normal exploring conditions: **4% DMi** (~5 g/d), plus stones

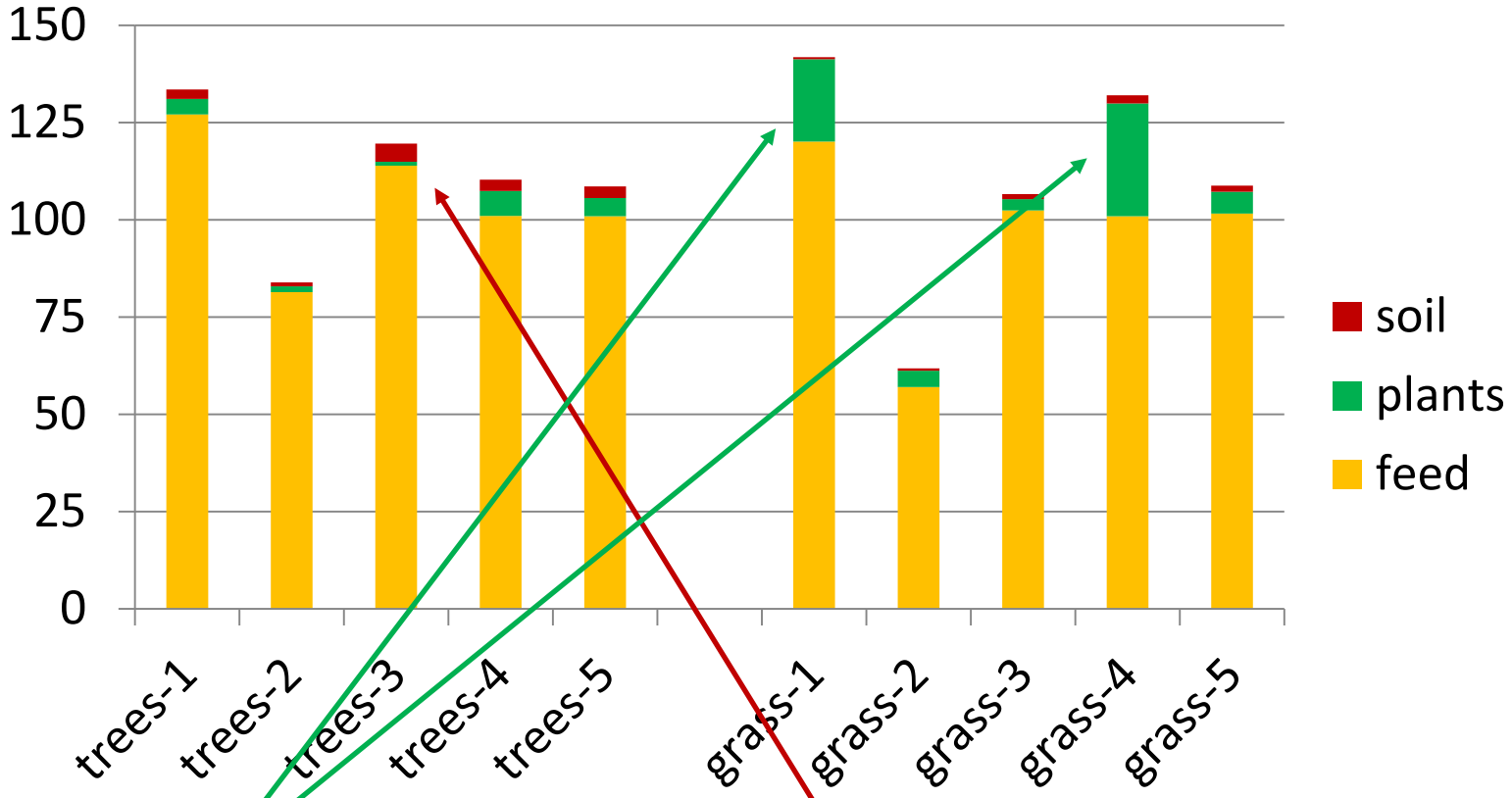
Main risk factor: unbalanced feed (nutritional balance, particle size)

>20% DMi (21 g/d)

Indicators: increased exploration activity, quality of the plant cover

Results (2): free ranged chicken

Jurjanz et al, Animal, submitted



Intake of soil and plants varied hugely: strong time point effects

Up to 15g plant DM

or 5g of dry soil (generally <3 g/d) Grass covered: < 2g

under trees: winter > spring, autumn

Plant cover: buffer - indicator

spring> autumn > winter

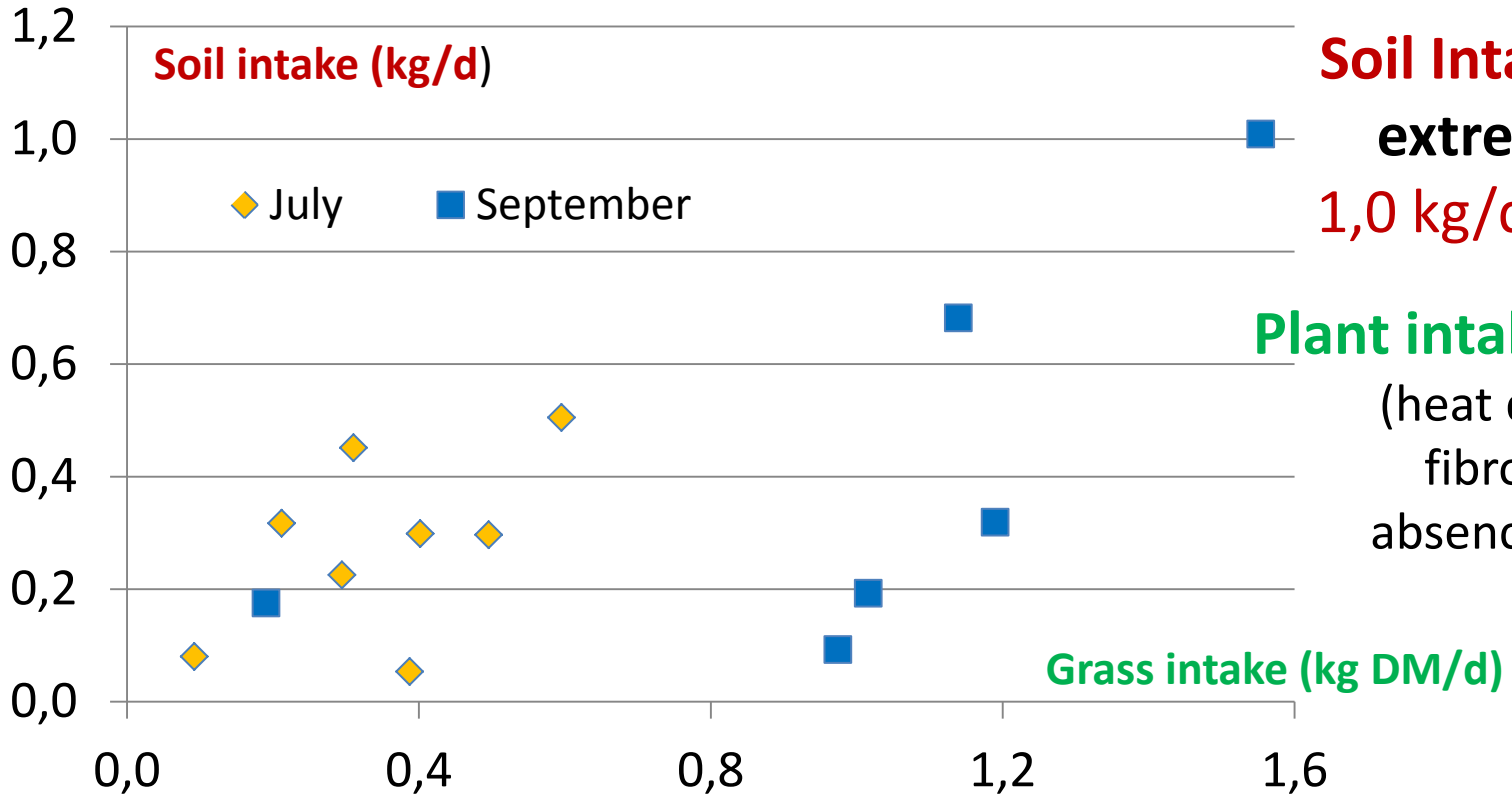
Generally low soil intakes in presence of a balanced alimentation

Free ranged sows

Very sparse literature available

Exploratory work (ICOOP): need to be precised

8 lactating crossbreed (LW x LR) organic **sows** (1 to 7th lactation) on **grass covered plots** (RG-WC) of Trinottière (W-France), 500 m² per animal, two time points Sampling and calculations: cf. poultry model



Soil Intake 0,3 kg/d

extreme value:

1,0 kg/d (9,7% DMi)

Plant intake: July < Sept

(heat depression, fibrous grass, absence of clover)

Conclusions

Free ranged animals will ingest soil, even when outside conditions are very good

to be integrated in risk assessment purposes

This intake can be limited on

2 % DMi (<0,4 kg/d) in dairy cows

possibly 3% DMi (0,3 kg/d) in sows

4 % DMi in poultry (laying hens 5 g/d, chicken 3 g/d)

strong increase of soil intake can easily happen

also in nowadays intensive conditions,

especially when gap between offered feed and requirements

(amount / quality)

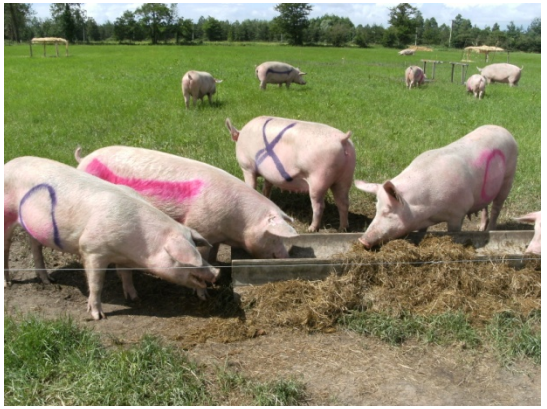
quality of the plant cover is a reliable indicator

remediation means: supplementary feed or limit access time outside

Merci de votre attention

! ?0A81> 70 2=8<0=85

Thank you to your attention



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Danke für ihre Aufmerksamkeit

Free ranged sows

Very sparse literature available

Exploratory work: need to be precised

Trial (project ICOOP, Trinottière, W-France) on **grass covered plots** (RG-WC), 500 m² per animal, two time points (July & September)

8 lactating crossbreed (LW x LR) organic **sows** (1 to 7th lactation)

Sampling and calculations: similar poultry model

(kg DM/d)	Feed intake	Grass Intake	Soil Intake	(% DMi)
July	7,6	0,4 **b**	0,27	3,6
September	8,1	1,0 **a**	0,14	1,4
Effects	**parity**		**grass > grass & clover**	

One very extreme value: 1,0 kg/d (9,7% DMi)

July: only RGA on plots, more fibrous, heat depression on intake

Material & Methods: poultry

Calculations based on indigestible markers (Jurjanz et al. AFST, *in review*)