Food and Agriculture Organization of the United Nations

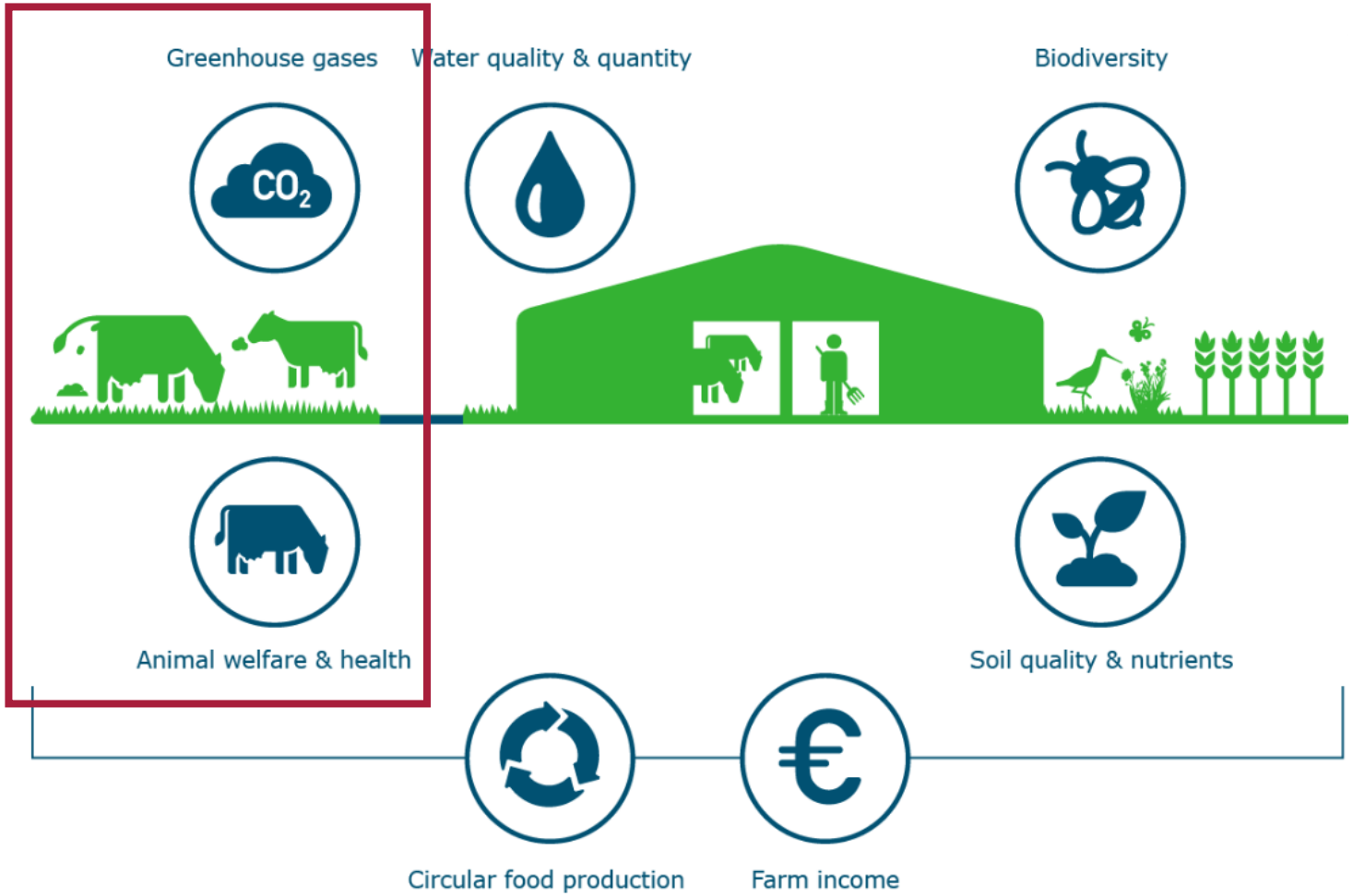
SUSTAINABLE DEVELOPMENT GOALS

ICAR-IDF ExtraMIR - Think outside the box for Milk Analyses

Hélène Soyeurt

Full Professor, Gembloux Agro-Bio Tech, University of Liège, Belgium

hsoyeurt@uliege.be



Sustainable dairy production

Need data …

https://www.wur.nl/en/show/working-towards-sustainable-dairy-production.htm

Extra value

from- smart use of

-MIR spectra

Milk Analysis

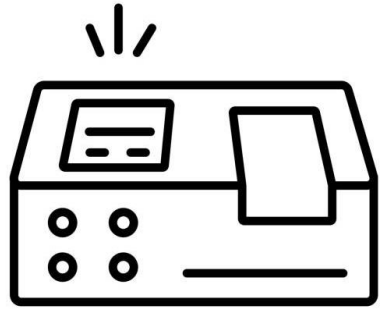
©Avelino Calvar Martinez

©Avelino Calvar Martinez

Milk payment : 1-3 days (Bulk tank milk)
Milk recording : 4-6 weeks (individual cow milk)

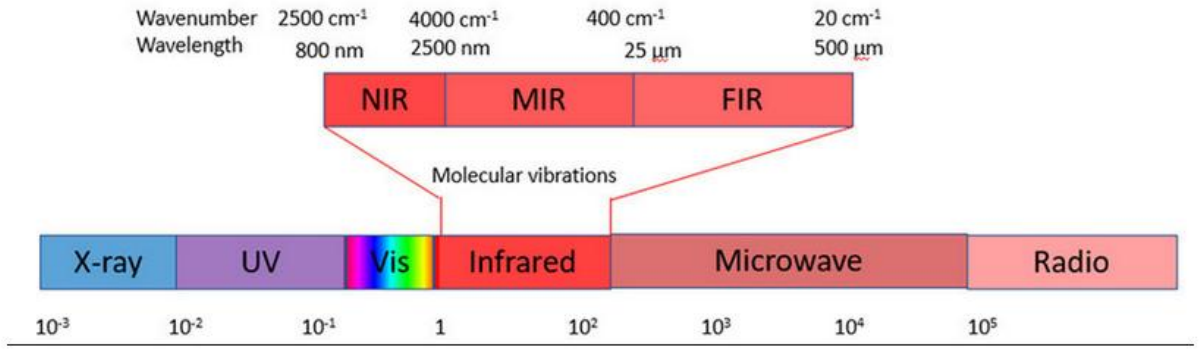
©Soyeurt Hélène

Milk samples



Milk FT-MIR

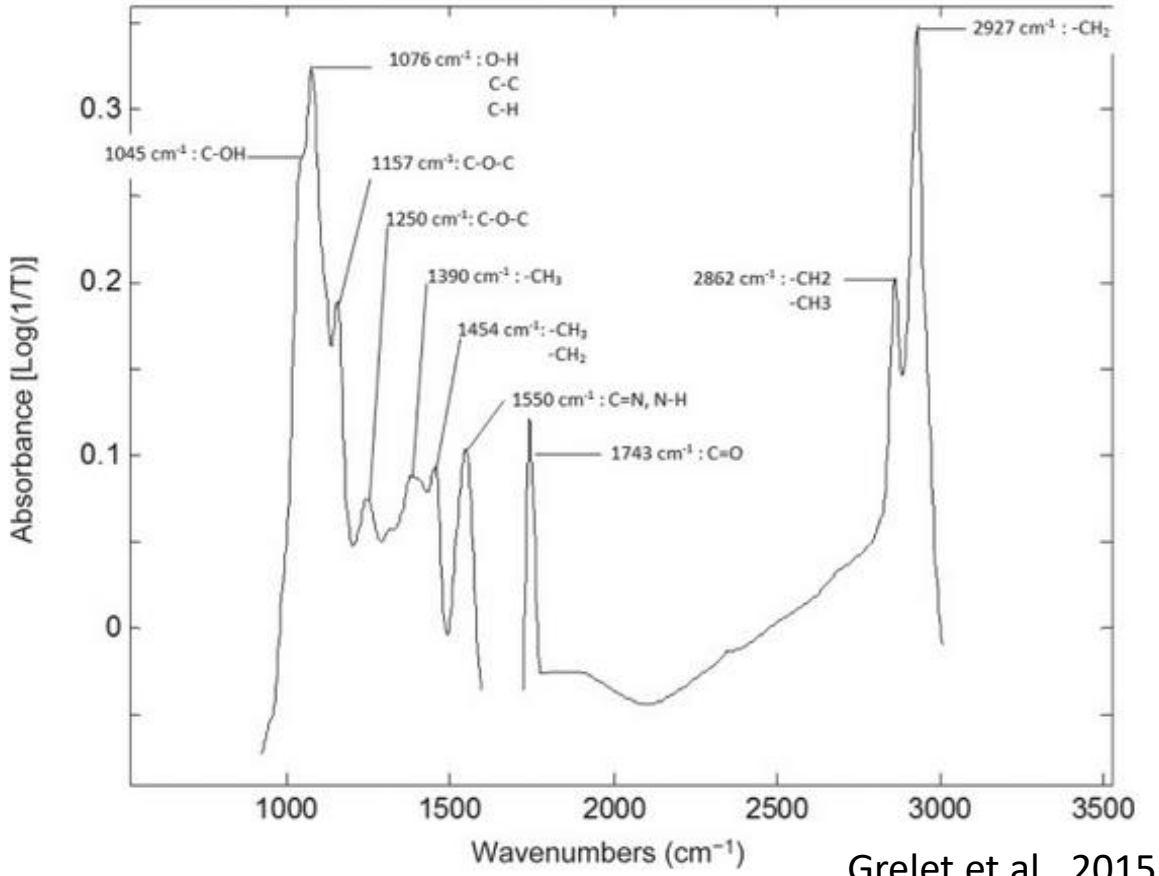
Milk Analysis



Milk MIR spectrum

=

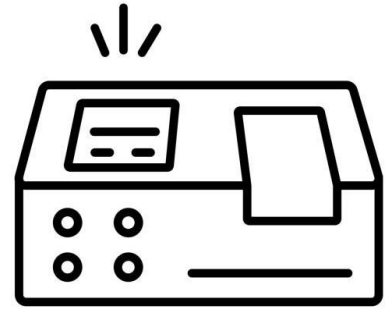
Absorption of infrared ray at frequencies related to the vibrations of specific chemical bounds in milk



Grelet et al., 2015

Milk Analysis

Milk samples

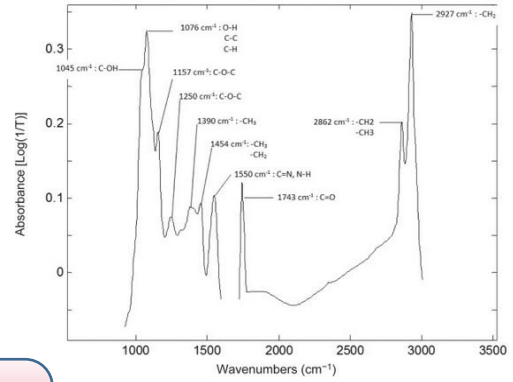


Milk FT-MIR

Milk payment : 1-3 days (Bulk tank milk)
Milk recording : 4-6 weeks (individual cow milk)

But we used the same spectral information, could we go further ?

Usually, Fat and Protein contents



© Grelet et al., 2015

Predictive model = Equation

Extra value

from- smart use of

-MIR spectra

Nutritional quality

Fat, protein, lactose, fatty acids, Ca, lactoferrin,…

Technological properties

Cheese yield, yoghurt yield, butter yield, spreadability …

Animal Health

Na, lactoferrin, Energy balance, body weight, dry matter intake, acetone, BHB, citrate …

Environmental fingerprint

Methane, P, urea …

Sustainability

Consumption index, nitrogen efficiency …

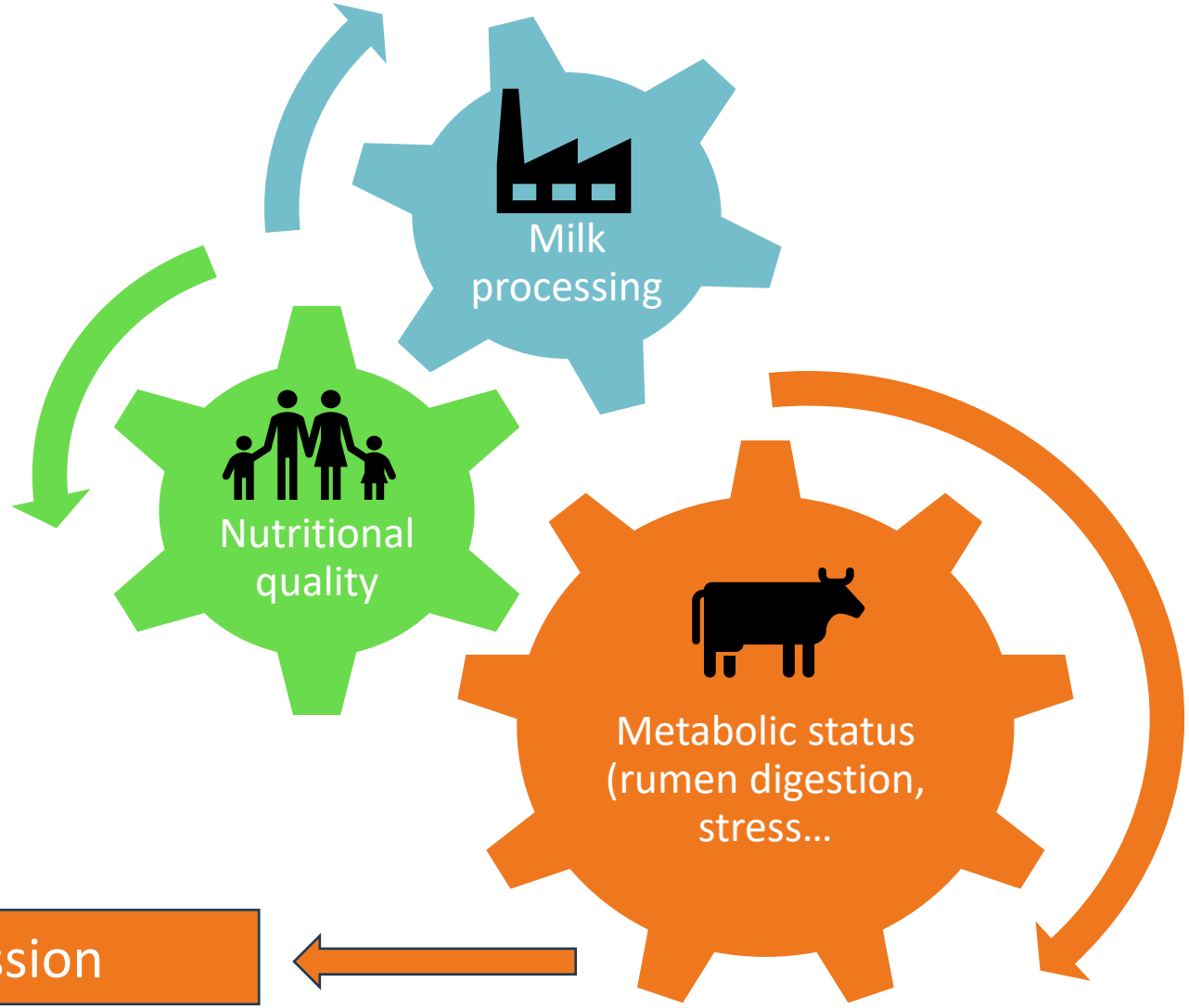
Let’s take an example fatty acids …

Abnormal milk samples, color …

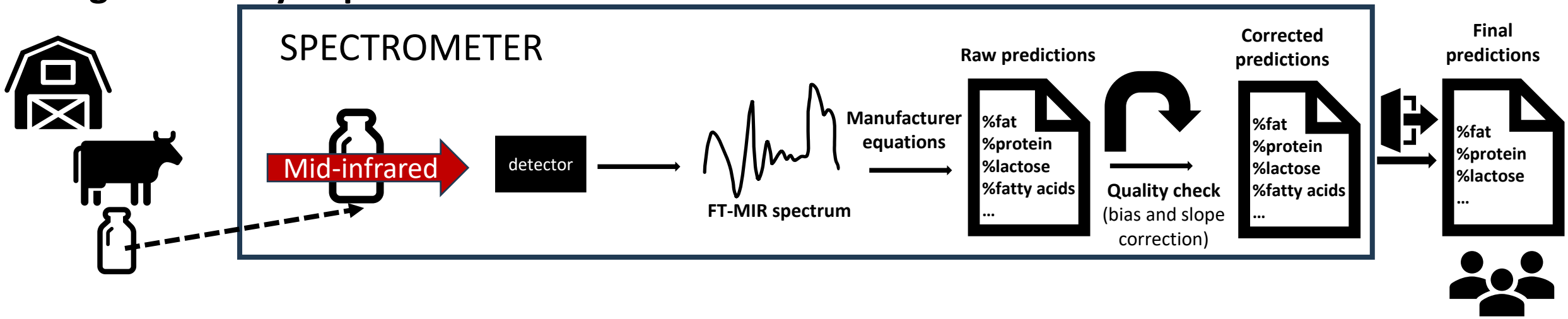
Fatty acid	Name	Range (%)	Central point (%)
C4:0	Butyric	2-5	3.5
C6:0	Caproic	1-5	3
C8:0	Cprylic	1-3	2
C10:0	Capric	2-4	3
C12:0	Lauric	2-5	3.5
C14:0	Myristic	8-14	11
C15:0	Pentadecanoic	1-2	1.5
C16:0	Palmitic	22-35	28.5
C16:1	Palmitoleic	1-3	2
C17:0	Margaric	0.5-1.5	1
C18:0	Steraric	9-14	11.5
C18:1	Oleique	20-30	25
C18:2	Linoleic	1-3	2
C18:3	Linolenic	0.5-2	1.25
		TOTAL	98.75

Up to 400 Fatty Acid but few are mainly present.

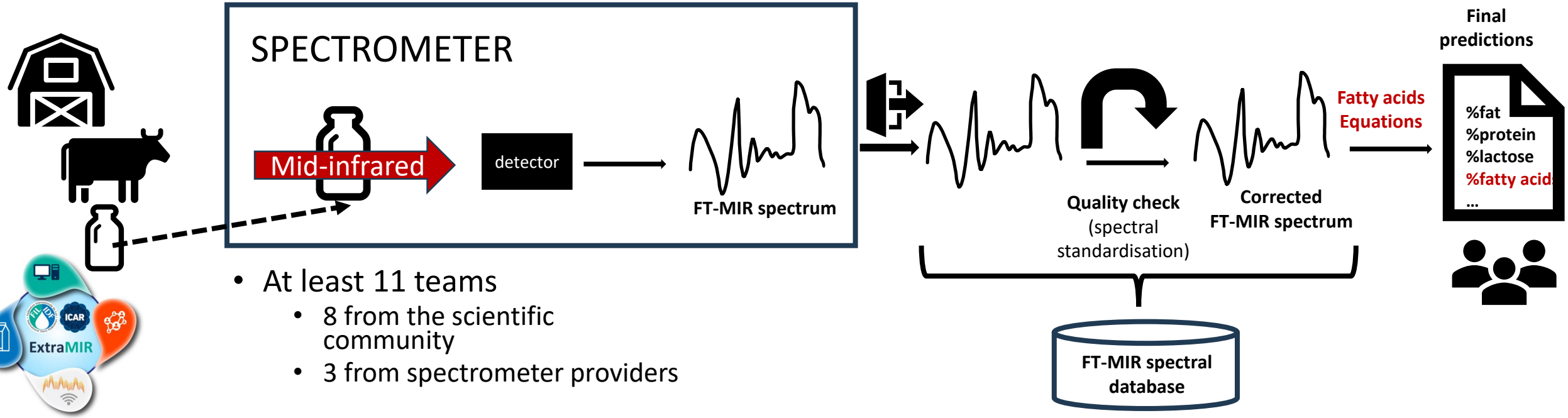
Fatty Acids Interests



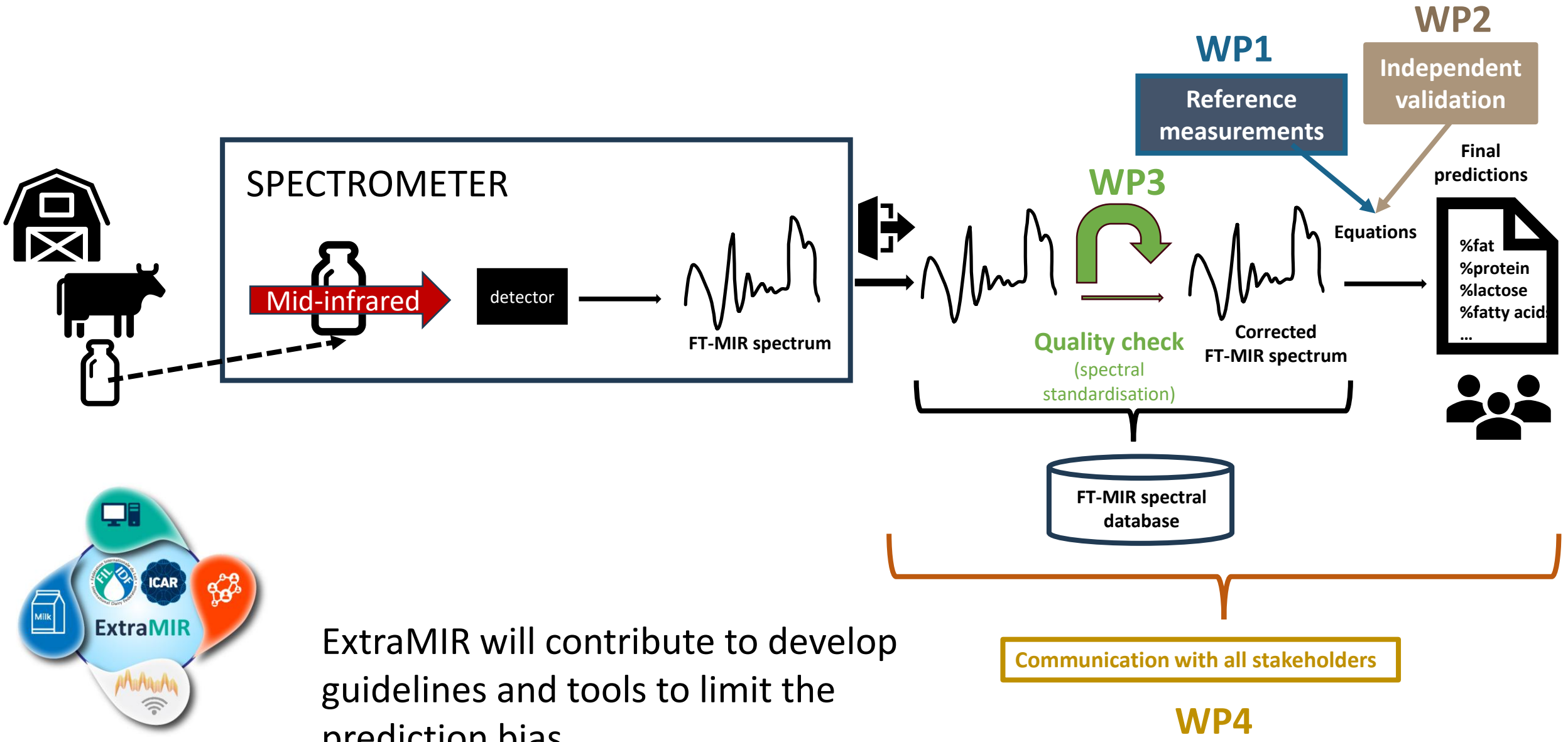
Existing Milk analysis process



Proposal



- At least 11 teams
  - 8 from the scientific community
  - 3 from spectrometer providers



ExtraMIR will contribute to develop guidelines and tools to limit the prediction bias.


RESULTS

Fatty acids Proficiency Test

Gas Chromatography		Infrared
9 LABS – 2 Methods		15 Labs
ISO 16958| IDF 231 (direct transesterification)	ISO 15885| IDF 184 (extracted fat)	ISO 9622|IDF 141

List of fatty acids - GC

Total Fat
C4:0
C6:0
C8:0
C10:0
C12:0
C14:0
C14:1 c9
C15:0
C16:0
C16:1 c9
C17:0
C18:0
C18:1 c9
C18:2 c9 c12
C18:3 c9,c12,c15
C20:0
C20:3 c8,c11,c14
C22:0
C24:0

fatty acids - IR

C14:0
C16:0
C18:0
C18:1
SFA
UFA
MUFA
PUFA
DENOVO
MIXED
PREFORMED

Nutritional quality

Fat, protein, lactose, fatty acids, Ca, lactoferrin,…

Consumption index, nitrogen efficiency …

Sustainability

Technological properties

Cheese yield, yoghurt yield, butter yield, spreadability …

Many equations were developed by European and American teams …

Methane, P, urea …

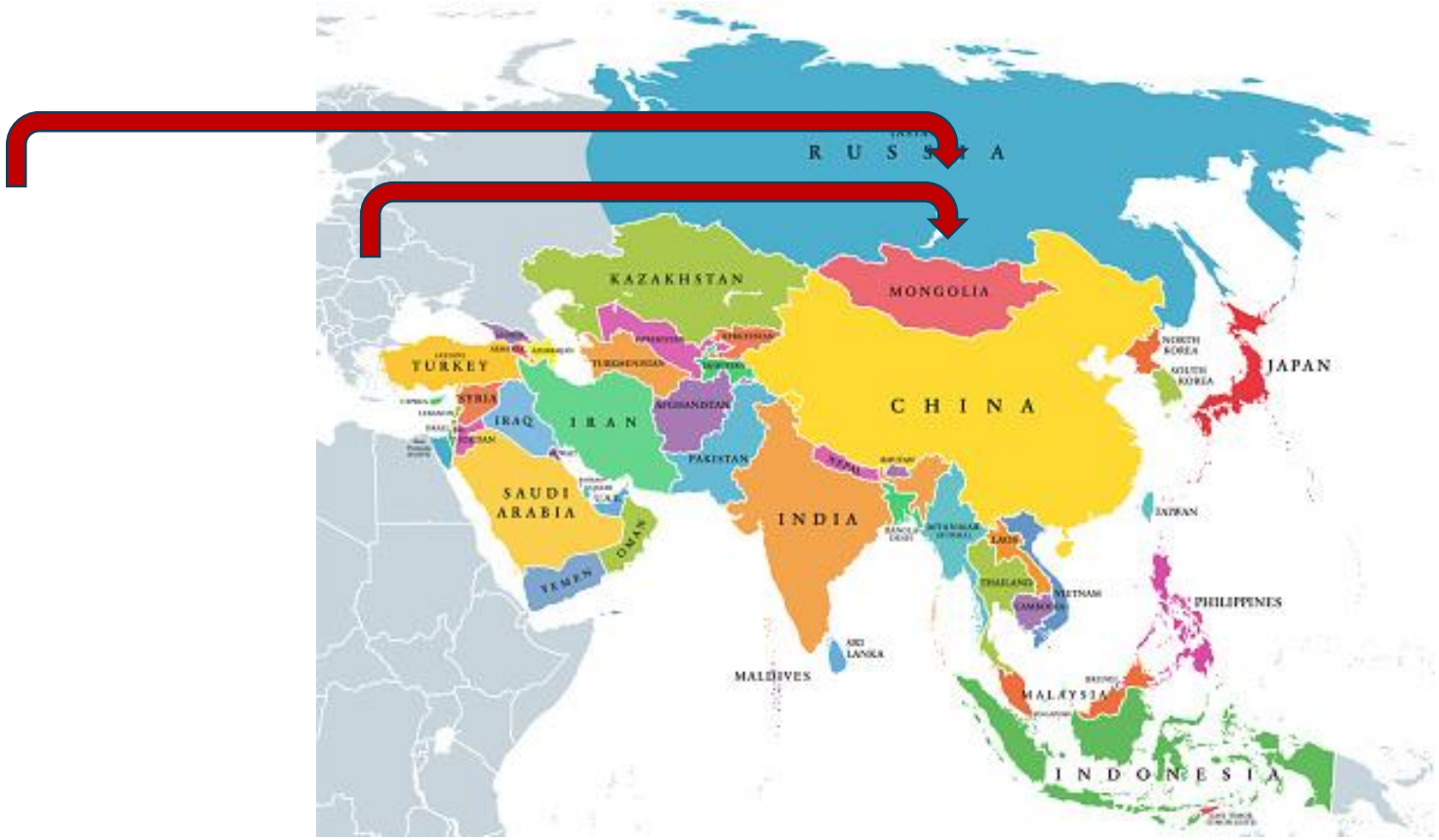
Environmental fingerprint

Animal Health

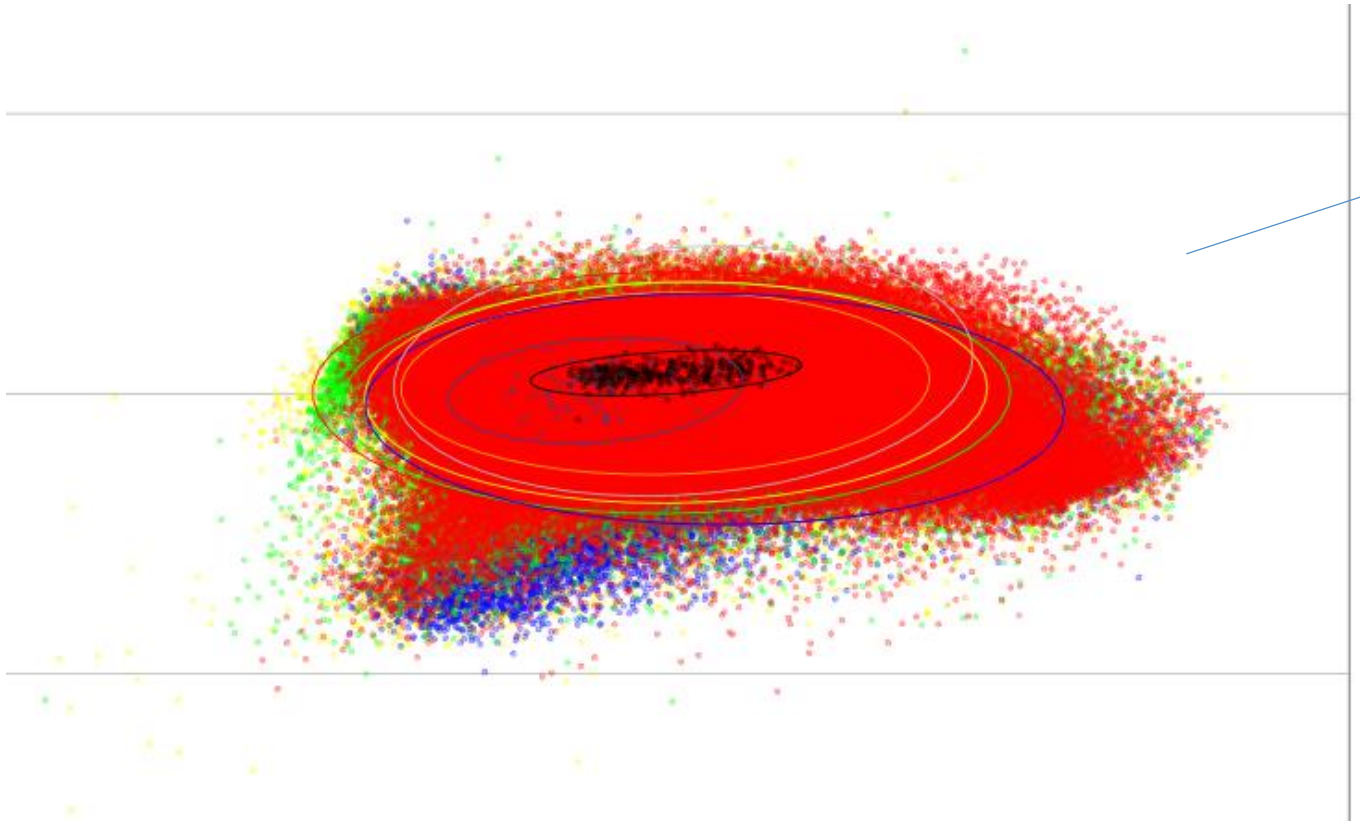
Na, lactoferrin, Energy balance, body weight, dry matter intake, acetone, BHB, citrate …

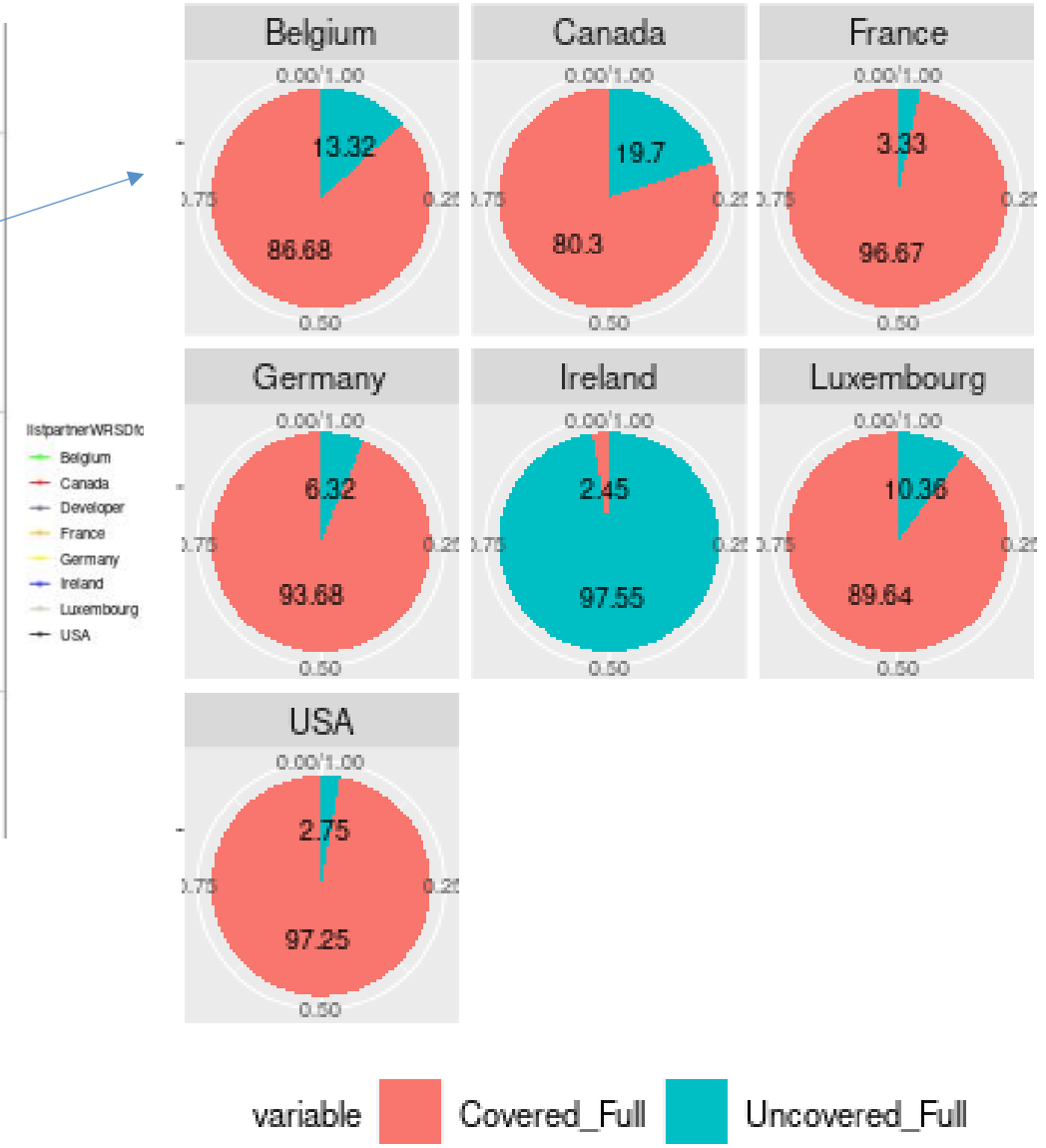
Abnormal milk samples, color …

We imagine to have a transfer of knowledge.



First we need to check if we share the same milk spectral variability





2 WRSD : one for Foss and one for Bentley

For the moment, no asian countries …

Conclusions

- Milk MIR spectrometry is used all around the world on a regular basis
- Many new traits of interest like Fatty Acids or Methane can be predicted at least as an indicator
- No extracost for analysis as we need to apply externally mathematical models.
- However, we need to be sure about the quality of the equations and the spectral data.
- ExtraMIR will contribute to the creation of guidelines and tools.
- Asian and Pacific Regions could have a benefit to obtain Extra value from milk MIR analysis to improve their herd management and breeding selection.

Food and Agriculture Organization of the United Nations

SUSTAINABLE DEVELOPMENT GOALS

ICAR-IDF ExtraMIR - Think outside the box for Milk Analyses

Hélène Soyeurt

Full Professor, Gembloux Agro-Bio Tech, University of Liège, Belgium

hsoyeurt@uliege.be

Thank you

FAO