Analysis of Dairy Cow Manure Management Systems Regarding to 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories

Juris Priekulis, Laima Berzina
Latvia University of Life Sciences and Technologies

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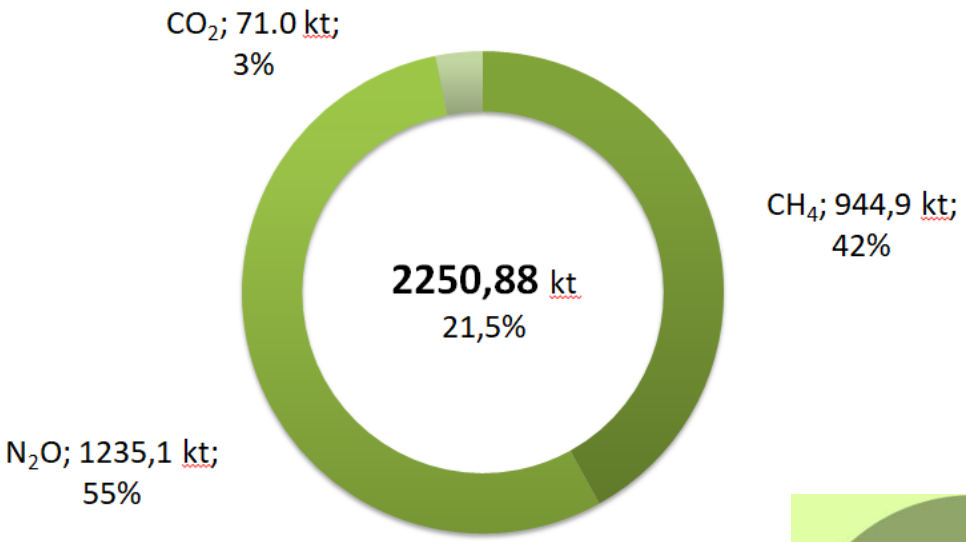
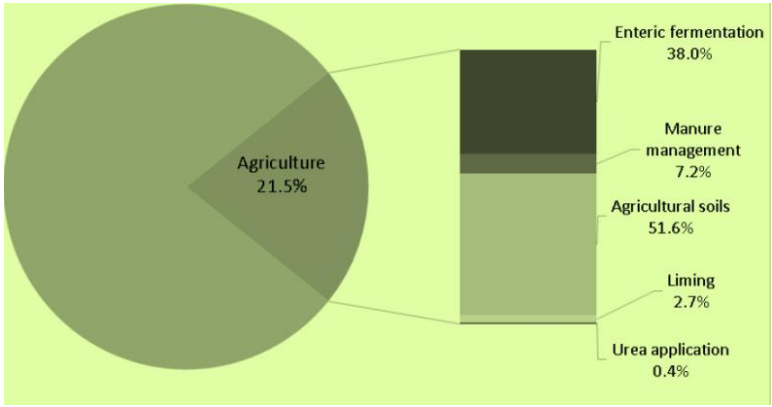
INTRODUCTION

- GHG (greenhouse gas) emission inventory
- The 2019 Refinement versus the 2006 IPCC Guidelines for National Greenhouse Gas Inventories
- Agriculture as source of GHG emissions
- Importance of manure management systems (MMS) in GHG emissions calculations

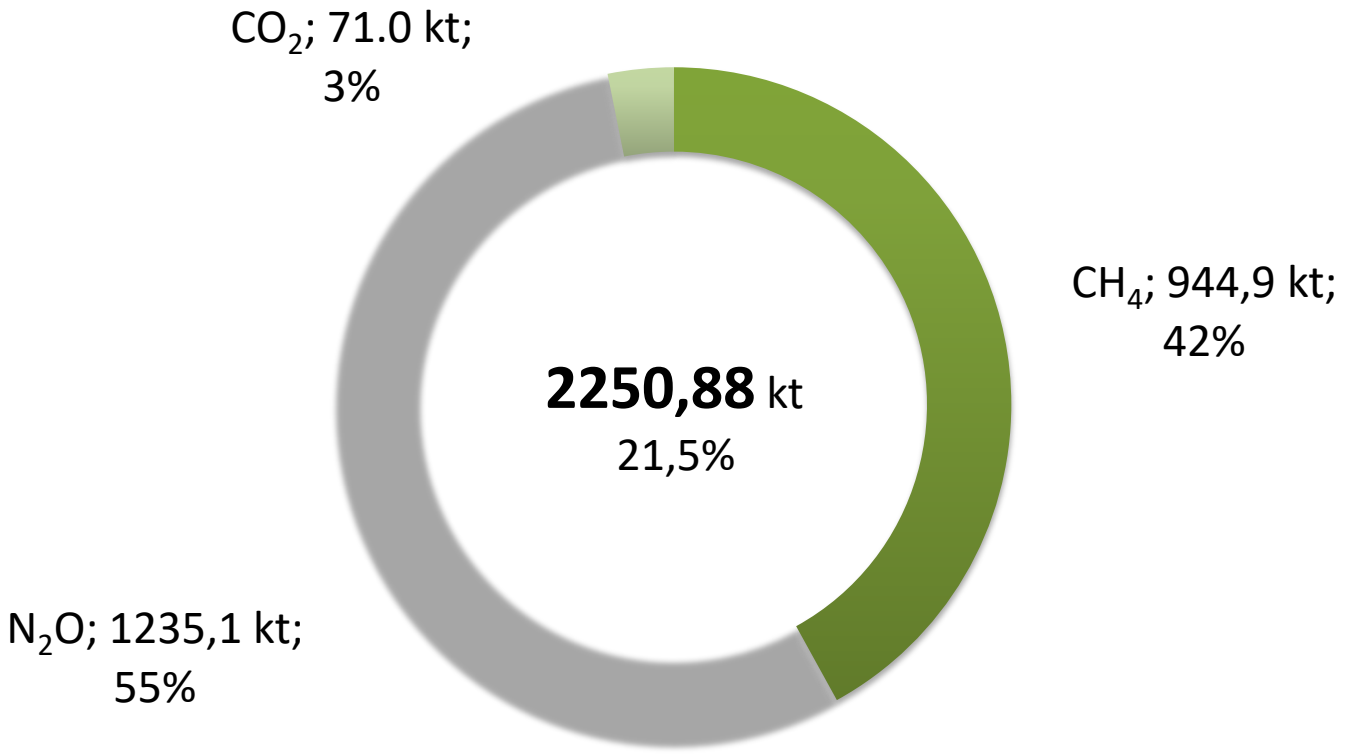
AGRICULTURE GHG EMISSIONS IN LATVIA



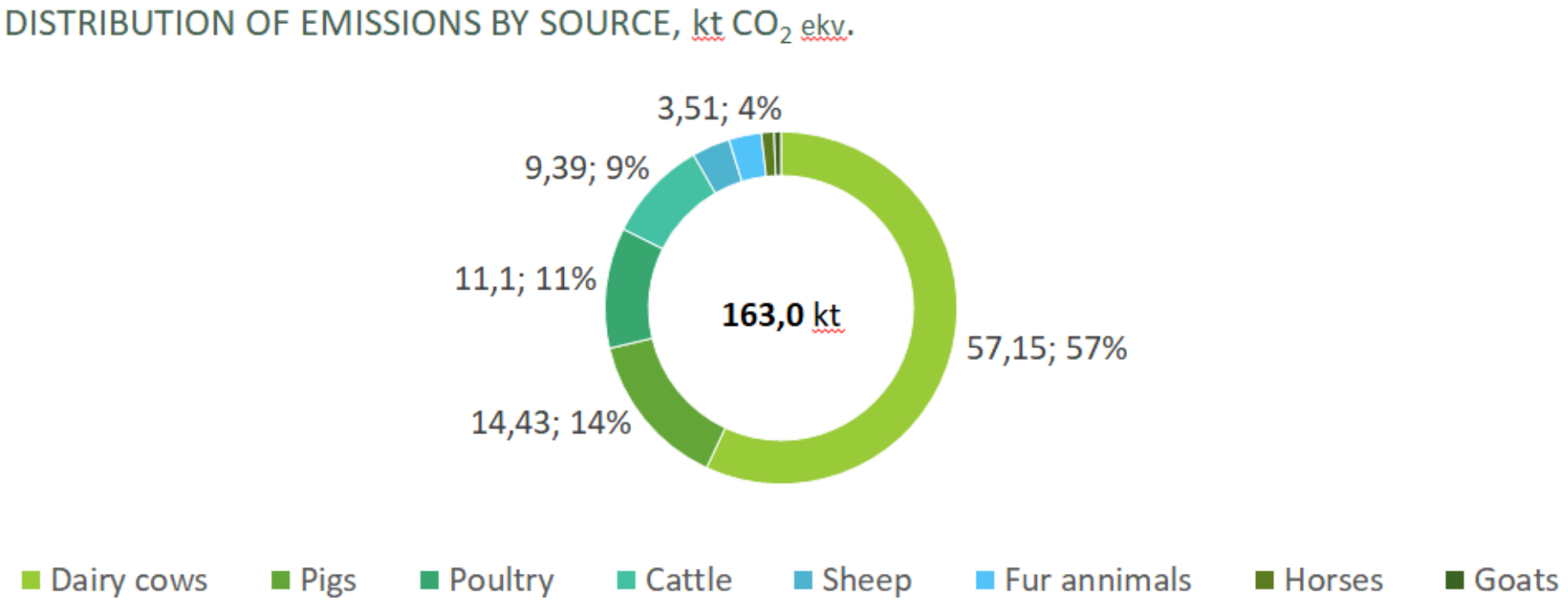


LATVIA'S NATIONAL INVENTORY REPORT, 2022

Distribution of GHG emissions from agriculture 2020



Distribution of GHG emissions manure management 2020



Manure management systems

- Manure management system (MMS)
  - Relative distribution is used for calculation N_2O emissions
- Used MMS in Latvia:
  - Solid manure
  - Slurry
  - Pasture

Manure management system (MMS)

- MMS relative distribution is used for calculation of N_2O emissions
- Used MMS in Latvia:
  - Solid manure (0.41)
  - Slurry (0.54)
  - Pasture (0.05)

  (Year 2020)

THE RESEARCH PROBLEM AND AIM

- According to **2019 Refinement** the dairy cow population should be comprised in segments:
  - **High-productivity systems** are based on high-yielding dairy cows that are concentrated in confinement production systems or grazing on high quality pastures with supplements. The farms are 100-percent market oriented for commercial milk production
  - **Low productivity systems** are based on low-yielding dairy cows, grazing non improved pastures, and using locally produced roughage (e.g. crop residues), and agro-industrial by-products. Local breeds or crossbred cows are bred locally, without intensive selection for milk productivity. Milk production is mostly for local market and local consumption
- Therefore, the purpose of this research is to specify the methodology for calculating the percentage distribution of MMS, based on **2019 Refinement**

MATERIALS AND METHODS I

- General calculations

$$\lambda_{g.gan} = \frac{\sum M_{g.gan}}{\sum M_g} \cdot 100\,,\ \lambda_{g.pak} = \frac{\sum M_{g.pak}}{\sum M_g} \cdot 100\,,\quad \lambda_{g.sk} = \frac{\sum M_{g.sk}}{\sum M_g} \cdot 100\,,\quad \lambda_{g.fk} = \frac{\sum M_{g.fk}}{\sum M_g}$$

(1), (2), (3), (4)

$$\sum M_g = \sum M_{g.gan} + \sum M_{g.pak} + \sum M_{g.sk} + \sum M_{g.fk}\,, \quad (5)$$

MATERIALS AND METHODS II

- High-productivity systems

$$M_{g.a.sk} = \frac{\chi_{g.a}}{100} \cdot Z_g \cdot q_{g.sk}, \quad (6)$$

$\chi_{g.a}$ - the percentage of high-yielding cows, calculated from the total number of milking cows in the country (according to statistical data), %;

Zg – the total number of cows in the country, according to statistical data;

$q_{g.sk}$ – regulatory output of liquid manure at the average milk yield of high-yielding cows in the country, t/year

MATERIALS AND METHODS III

- Low-productivity systems

$$M_{g.z.pak} = \frac{\chi_{g.z}}{100} \cdot Z_g \cdot q_{g.pak} \cdot (1 - k_{gan}), \quad (7)$$

$\chi_{g.z}$ - percentage of low-productivity cows, calculated from the total number of dairy cows in the country (according to statistical data), %

$q_{g.pak}$ – normative yield of litter manure, according to the milk yield of low-productivity cows, t/year [6]

k_{gan} – coefficient of pasture utilization

$$M_{g.z.gan} = \frac{\chi_{g.z}}{100} \cdot Z_g \cdot q_{g.pak} \cdot k_{gan} \cdot \frac{S_{g.sv}}{S_{g.pak}}, \quad (8)$$

$S_{g.sv}$, $S_{g.pak}$ – average dry matter content of fresh cow manure (a mixture of feces and urine), %.

MATERIALS AND METHODS IV

- Low-productivity systems

$$k_{g.gan} = \frac{t_{g.gan}}{24 \cdot 365}, \quad (9)$$

t_{gan} – average duration of cow grazing period, h/year

MATERIALS AND METHODS V

MMS pastures, %,

$$\lambda_{g.gan} = \frac{100 \cdot \chi_{g.z} \cdot q_{g.pak} \cdot k_{g.gan} \cdot S_{g.sv} . S_{g.pak}}{\chi_{g.z} \cdot q_{g.pak} \cdot k_{g.gan} \cdot S_{g.sv} + (1 - k_{g.gan}) \cdot \chi_{g.z} \cdot q_{g.pak} . S_{g.pak} + \chi_{g.a} \cdot q_{g.sk} \cdot S_{g.pak}},$$

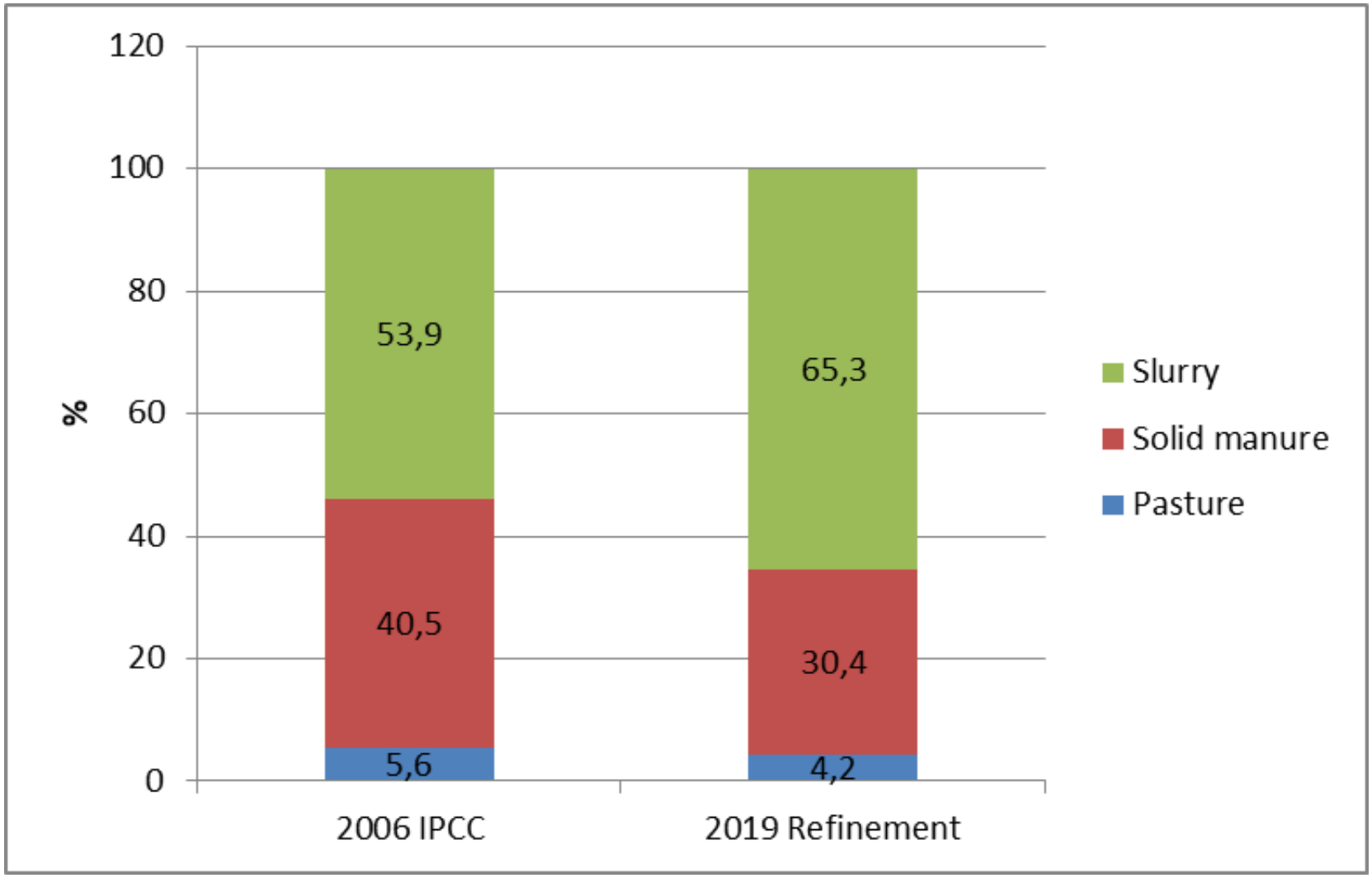
MMS solid manure, %

$$\lambda_{g.pak} = \frac{100 \cdot \chi_{g.z} \cdot q_{g.pak} \cdot S_{g.pak} \cdot (1 - k_{gan})}{\chi_{g.z} \cdot q_{g.pak} \cdot k_{g.gan} \cdot S_{g.sv} + (1 - k_{g.gan}) \cdot \chi_{g.z} \cdot q_{g.pak} . S_{g.pak} + \chi_{g.a} \cdot q_{g.sk} \cdot S_{g.pak}},$$

MMS slurry, %

$$\lambda_{g.sk} = \frac{100 \cdot \chi_{g.a} \cdot q_{g.sk} \cdot S_{g.pak}}{\chi_{g.z} \cdot q_{g.pak} \cdot k_{g.gan} \cdot S_{g.sv} + (1 - k_{g.gan}) \cdot \chi_{g.z} \cdot q_{g.pak} . S_{g.pak} + \chi_{g.a} \cdot q_{g.sk} \cdot S_{g.pak}}$$

RESULTS AND DISCUSION



CONCLUSION

- In 2021, 50.18% of the total number of dairy cows in Latvia met the requirements of high-yielding animals, while 49.82% were low-yielding ones
- Moving to the new methodology for calculating the MMS, it was found that the amount of liquid manure will increase by 11.5%, but the amount of litter manure obtained will decrease by 10%. The amount of manure left in pastures will also decrease by approximately 1%.

Thanks for attention

Contact information :

Laima Berzina

Researcher, assistant professor

Laima.Berzina@llu.lv

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