Low N loss from a bedded pack barn with intensive composting of a woodchip bedding

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Herman de Boer, Paul Galama, Hendrik Jan van Dooren

LIVESTOCK RESEARCH
WAGENINGEN UR

Why determine level of N loss from a barn?

- In the Netherlands: legislation limits N input at farm level and the allowed level of gaseous NH_3 loss from a barn
- With restricted N input, a high gaseous total N loss (as NH_3, N_2O, NO_x, N_2) results in a declining agricultural and financial productivity
- New barn types have to meet criteria to limit NH_3 loss, otherwise barns are not allowed to be built
- Bedded pack barns (loose housing + actively managed organic bedding) are new in the Netherlands. Information on the level of total N loss and NH_3 loss from these barns is therefore required

How to determine N loss from a barn?

- We did it by calculation of barn N balances:

  $N\ balance = N_{litter} + N_{feed} - N_{milk} - N_{liquid\ manure} - N_{bedding} - N_{animal\ tissue}$

- We also calculated supportive barn P and K balances. Differences on the barn P and K balance indicate the level of error (systematic + random) of the balance calculation/measurements. We used this information to correct N balances for a more reliable calculation of N loss

- NPK balances were calculated for individual commercial dairy farms. Data were collected/measured at the farms and provided by the farmers

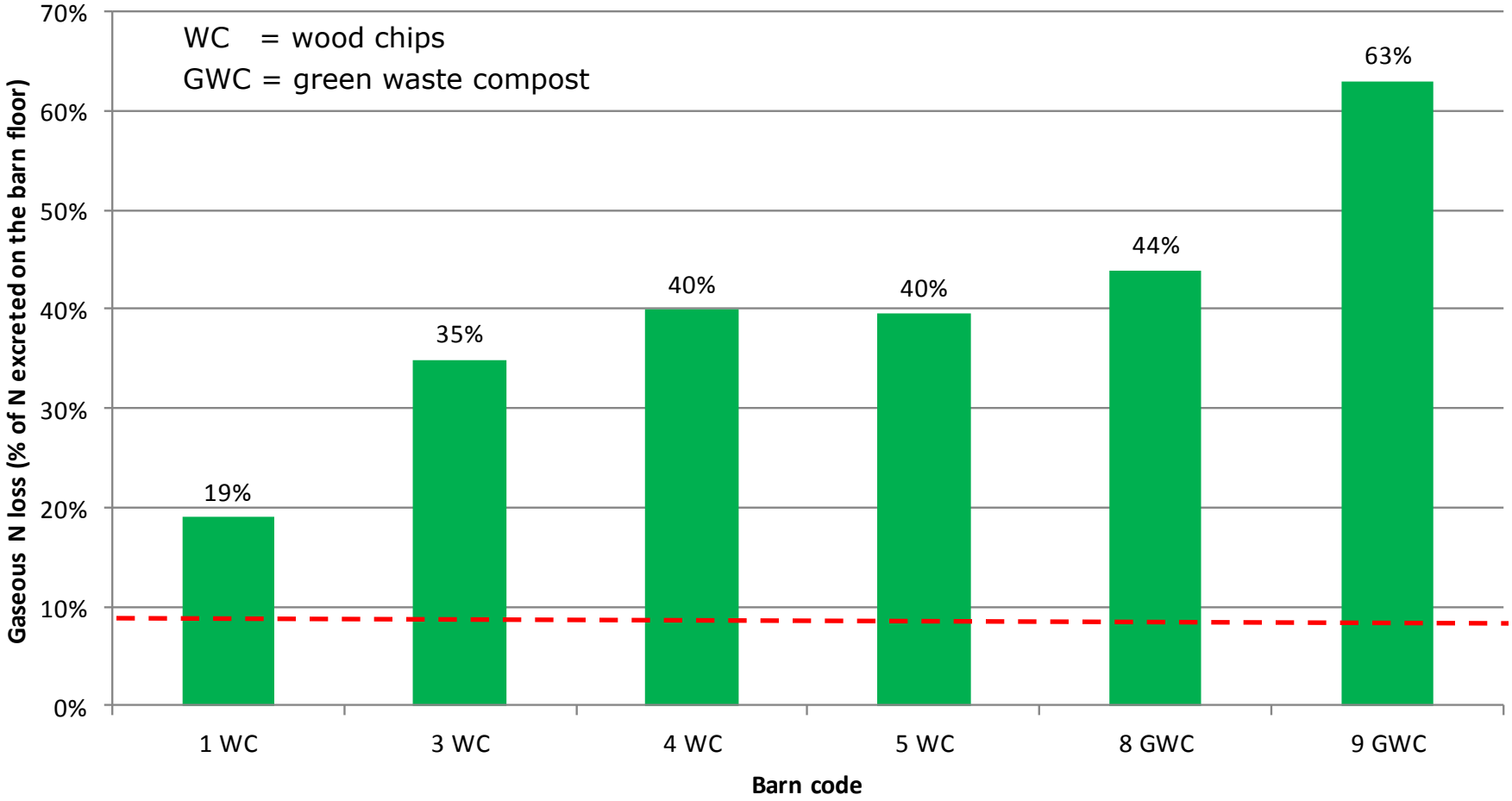
Differences between barns can affect level of N loss

- Bedded pack barns differ in:
  - Type of bedding material (woodchips, shredded wood, municipal compost, straw)
  - Management (composting, litter addition only, type/frequency of cultivation, etc.)
  - Intensity of use (m^2/animal), relative area of bedding and hard flooring
  - Type of mechanical ventilation (none, air blowing, air suction)
  - Etc.

- Differences between barns can result in differences in level of total N loss

- We calculated N balances and total N loss for six different bedding pack barns, for a period of 0.5 up to 1 year, in 2011/2012

Range in N loss for six bedded pack barns



In search of management practices to reduce N loss from the bedded pack barn

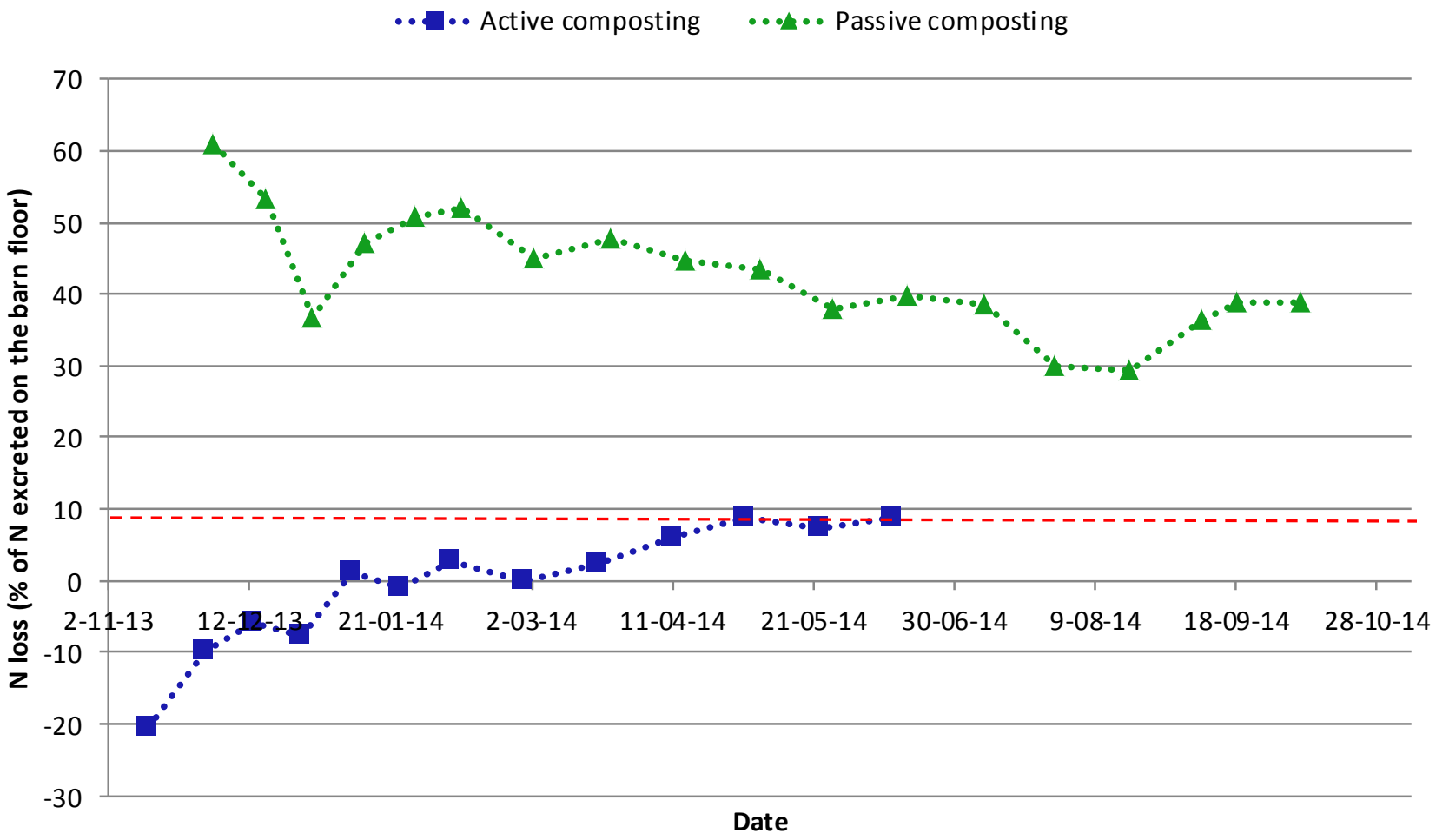
- We observed large differences in N loss from different barns; relatively low N loss from barns with composting of woodchips
- Knowledge on development of N loss over time, especially in relation to bedding characteristics & management practices, may be used to control and reduce N loss
- Therefore, we started research to determine the development of N loss over time, in relation to bedding characteristics & management
- Two different barns with composting of wood/woodchips:
    - Intensive composting at 50-55°C (woodchips)
    - Passive composting at 35-40°C (shredded wood)
- Calculation of NPK balance and N loss every 2-3 weeks for a period of 8 to 11 months, including winter period, in 2013/2014

Some differences in management between intensive/passive composting

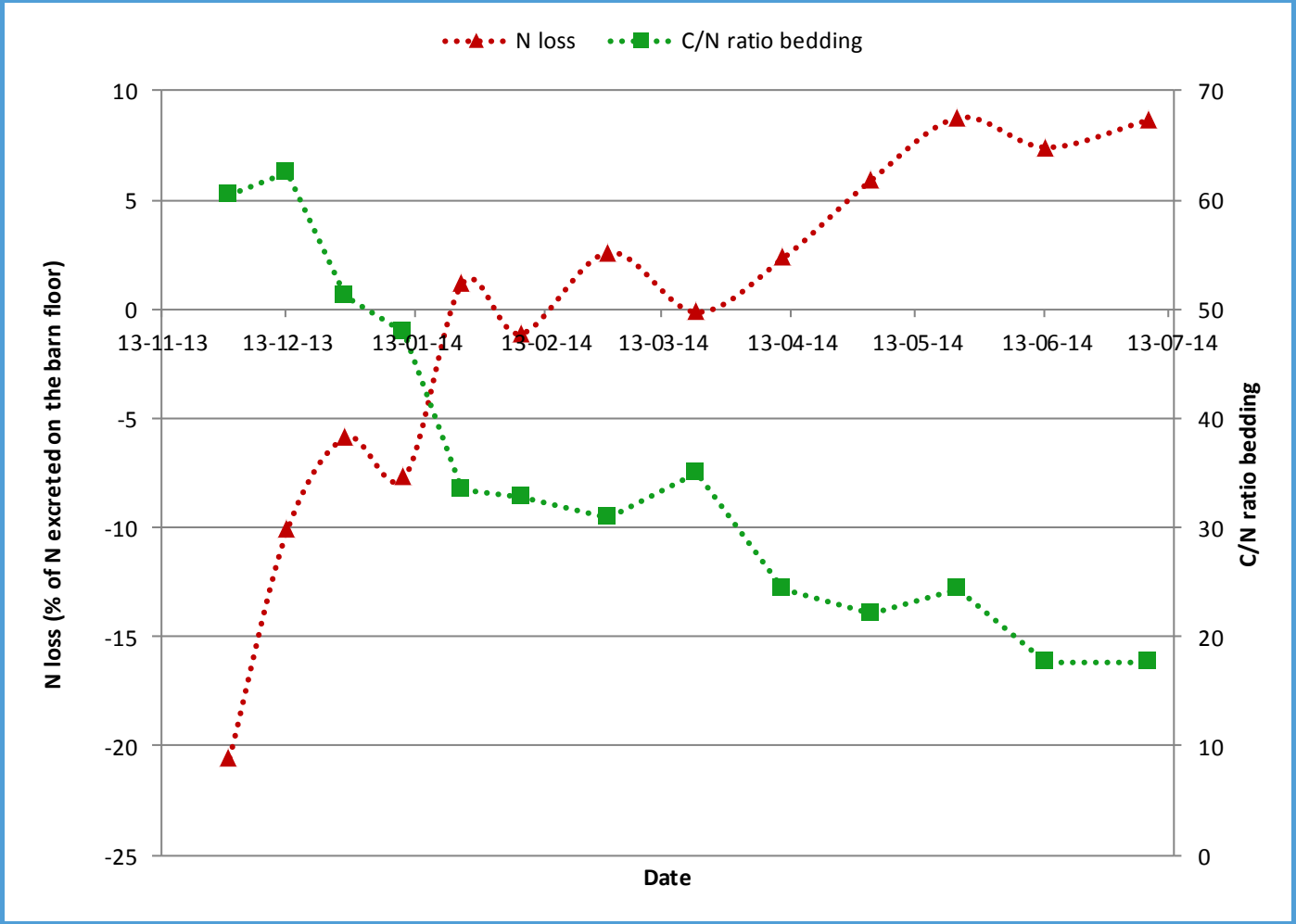
- Intensive composting:
  - Fresh woodchips, C/N >70; frequent supply of new chips to bedding
  - Intensive daily cultivation/mixing with rotary tiller, up to 30 cm deep (40/50 cm deep bedding)
  - Mechanical ventilation by short bursts of air blowing (15 minutes every 6 hours)

- Passive composting:
  - Course wood parts (shredded wood), C/N ~ 40; low supply of new litter
  - Little daily cultivation and mixing with a digging machine/tine cultivator up to 30-40 cm deep (60/70 cm deep bedding)
  - Mechanical ventilation by air suction when temperature exceeded 32/35°C (50% of the balance time)

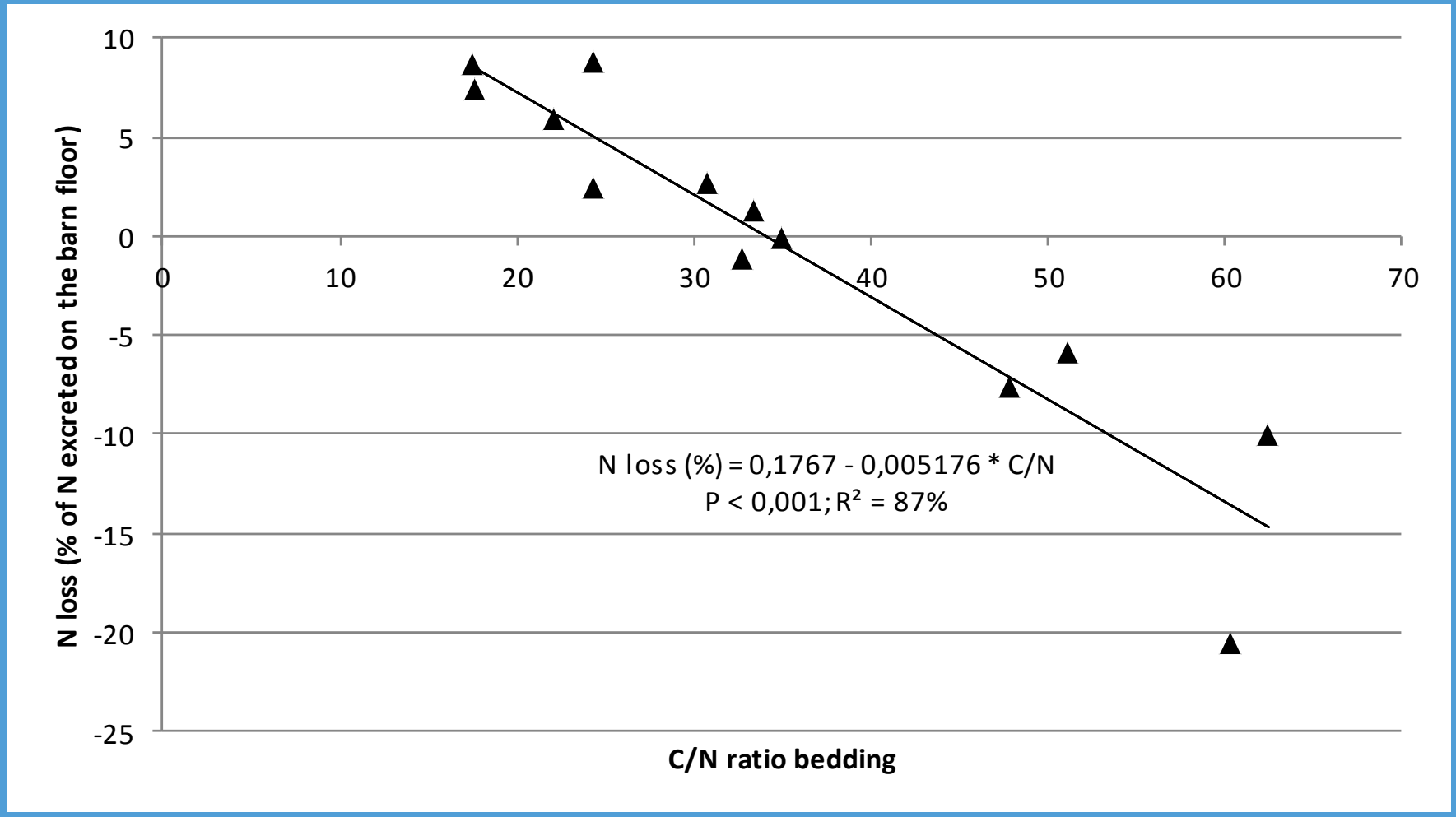
Low N loss with active composting



Intensive composting: strong relationship between development of N loss and C/N ratio (1)



Intensive composting: strong relationship between development of N loss and C/N ratio (2)



Some differences in management between intensive/passive composting

- Intensive composting:
  - Fresh woodchips, C/N >70; frequent supply of new chips to bedding
  - Intensive daily cultivation/mixing with rotary tiller, up to 30 cm deep (40/50 cm deep bedding)
  - Mechanical ventilation by short bursts of air blowing (15 minutes every 6 hours)
  - N loss from the bedding reduced by incorporation of excreted N in bacterial biomass during composting

- Passive composting:
  - Course wood parts (shredded wood), C/N ~ 40; low supply of new litter
  - Little daily cultivation and mixing with a digging machine/tine cultivator up to 30-40 cm deep (60/70 cm deep bedding)
  - Mechanical ventilation by air suction when temperature exceeded 32/35°C (50% of the balance time)
  - Most of the excreted N on the bedding volatilized

Conclusions

- There are large differences in N loss between bedded pack barns with different forms of bedding characteristics & management; N loss from composting woodchip/shredded wood beddings are relatively low
- The lowest N loss was measured for a barn with active composting of woodchips: the level of N loss was equal/lower than N loss of a reference free stall barn in the Netherlands
- N loss during active composting was strongly related to C/N ratio of the bedding; frequent supply of fresh woodchips supressed N loss
- The relationship between N loss and C/N ratio suggests potential to realize a very low N loss when C/N ratio is maintained above a threshold level (~35)
- Bedded packs barns have potential to realize a low level of total N loss, and consequentially also a low NH_3 loss, from the barn

The end