National Conclave on Sustainable Food Systems 2022

at

Anil Agarwal Environment Training Institute

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Breeding and nutritional strategies to reduce livestock based GHG emissions

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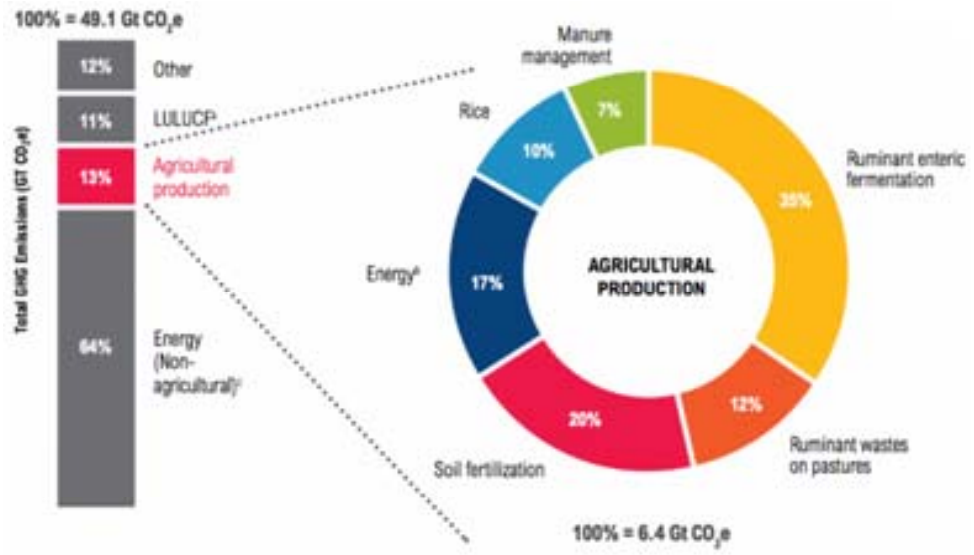
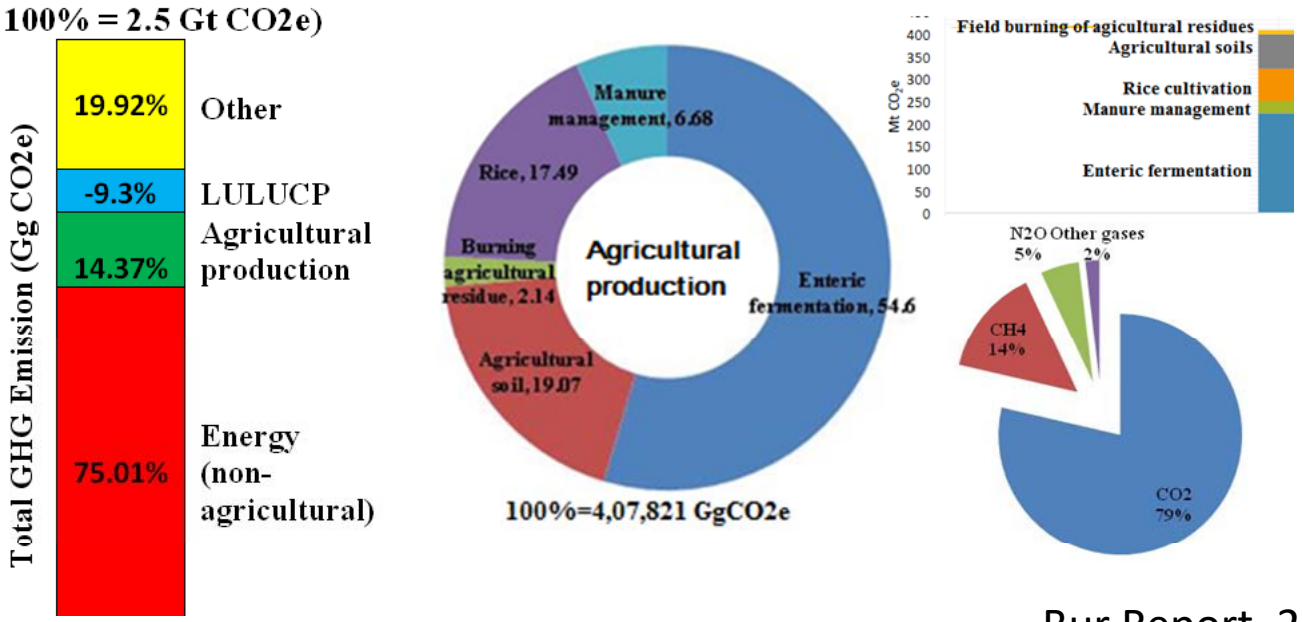
Overall emission scenario in the world *vis-a-vis* India

LCA of GHG emissions globally: livestock contributes about 18% to the global anthropogenic GHG emissions



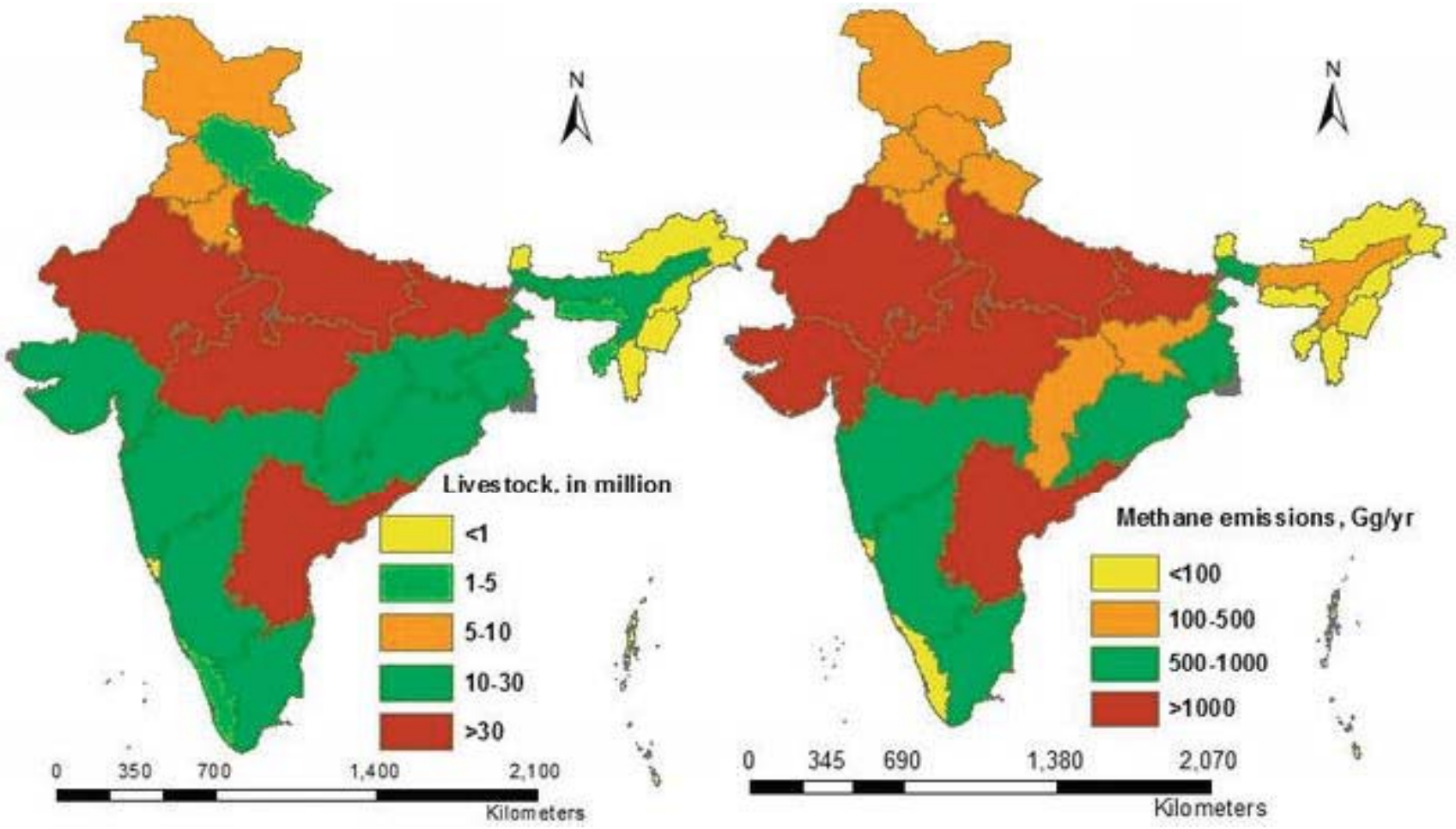
UN Report, 2022

Indian livestock: 15.1% of total global **enteric** methane emission



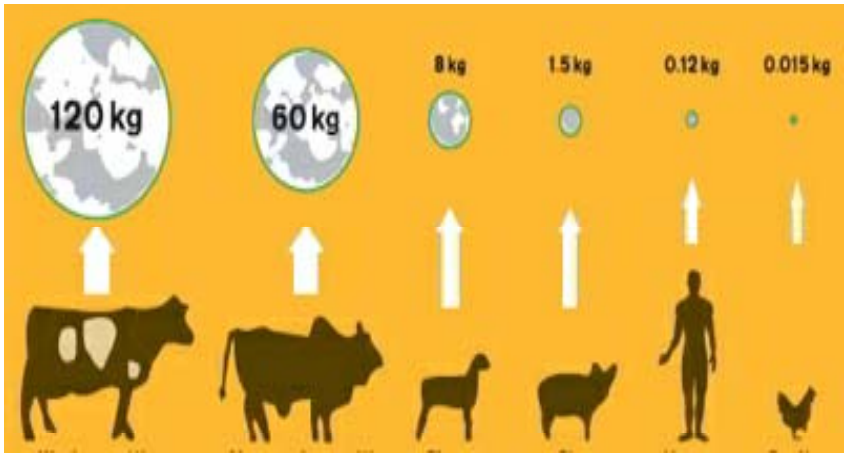
Bur Report, 2021

Spatial distribution of CH_4 emission from livestock in India at state level



Enteric Methane emission (kg ×10^9) and Methane and nitrous oxide emissions (kg×10^6) from manure management

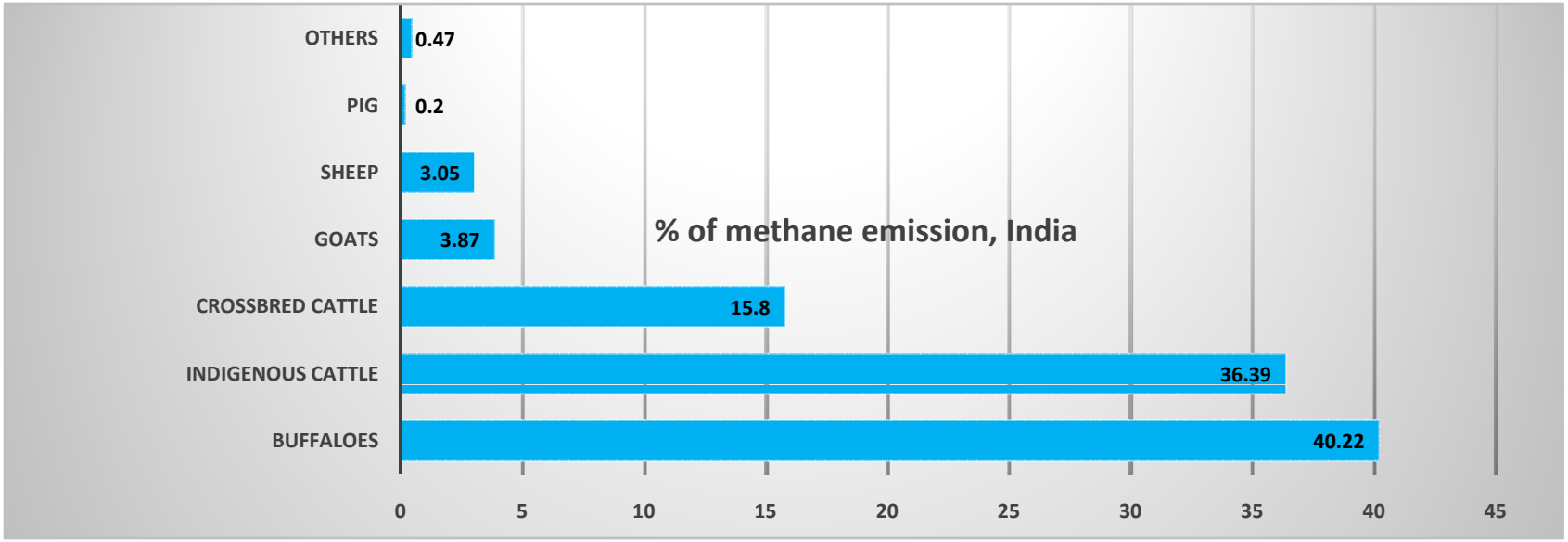
Species	World	India
Enteric Methane emission		
Cattle	69.9 (73.6%)	7.02 (49%)
Buffalo	10.7 (11.3%)	6.12 (42.8)
Total	94.9	14.3 (15.1%)



CH_4 emission per animal per year

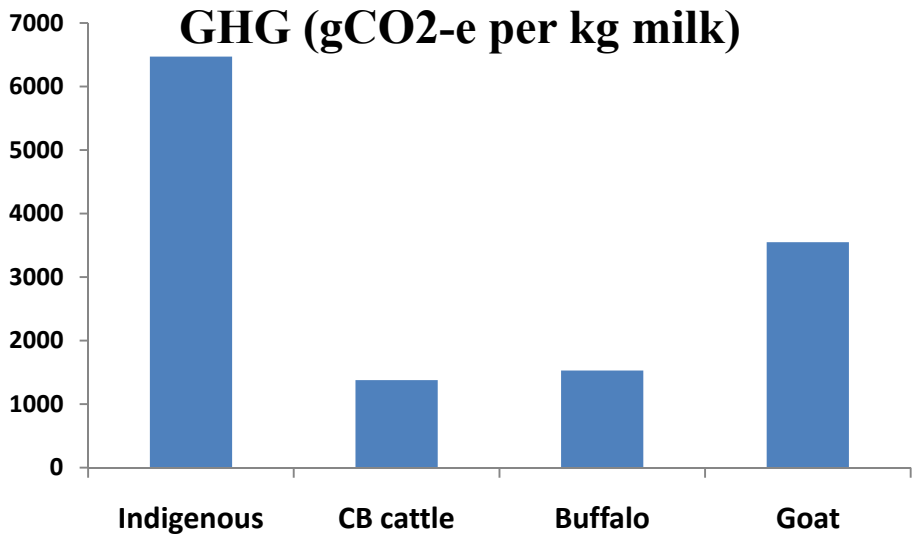
Species	World	India
Methane from manure		
Cattle	6516(57.1%)	434 (39.6%)
Buffalo	828 (0.07%)	557 (50.8%)
Total	11414	1096 (9.6%)
N_2O from manure management		
Cattle	177 (46.2%)	4.1 (26.8%)
Buffalo	29 (7.5%)	4.8 (31.4%)
Total	383	15.3 (4%)

Distribution of methane emission, India



The Indian dairy sector:

- Smallholders keep 70% of India's bovine population.
- Avg. daily milk production (CB 7.0 kg, Indigenous 2.4 kg)

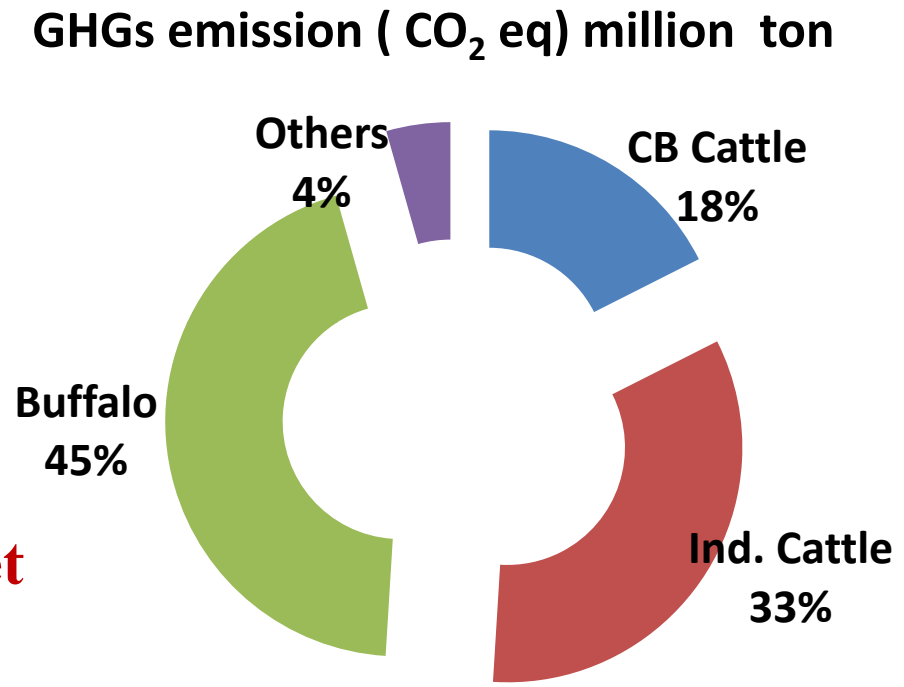


GHG emission from livestock sector

Enteric	Feed production	Manure
CH_4 (30 times) and CO_2	CO_2	CH_4 and N_2O (300 times) and CO_2
•Feed intake •Feed composition •Digestibility	•Land use pattern, •Fertilizers usage, •Manure storage and its application to fields, •Agricultural operations, •Feed production and processing •Transport of feed	•Environmental conditions, •Composition of manure •Management of manure

Factors influencing methane production

- Animal species
- Genetic factors/ breed
- Animal production level
- Level of feed intake
- Feed passage rate
- Type of carbohydrates in diet
- Roughage and conc. ratio
- Type of fat in diet
- Environment, i.e., temperature

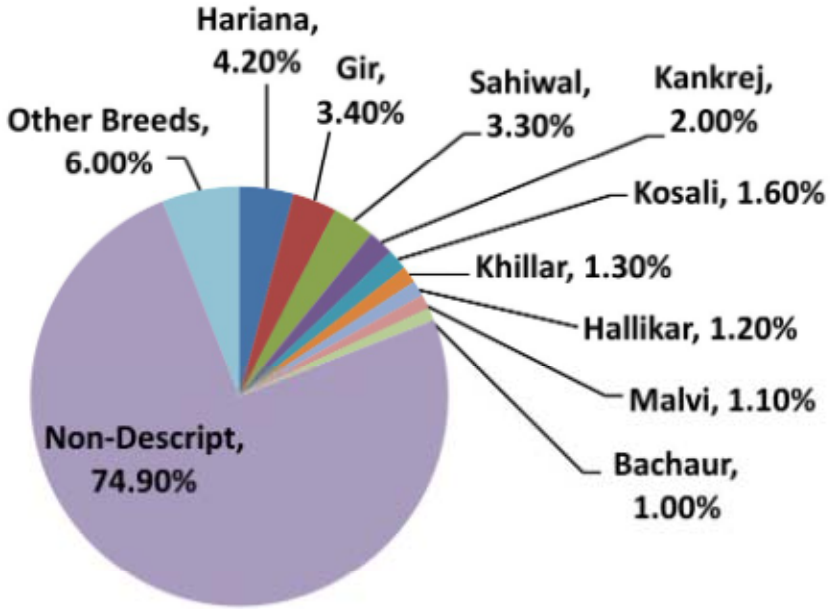


Mitigation Measures in livestock sector

- Adoption of mitigation measures: unless there is **positive economic input on animal production and increased farm profitability**.
- Methane emission from ruminants can be reduced by
  - altering the feed composition, either to reduce the percentage which is converted into methane or
  - to improve the milk and meat yield (MY from 3.6 liter/day to to 9.0 liter/day can potentially half the methane emission under tropical climatic conditions.
- Increasing carbon sequestration (Afforestation / Reforestation / Plantation / Agro-forestry)

Breeding strategies to reduce methane emission

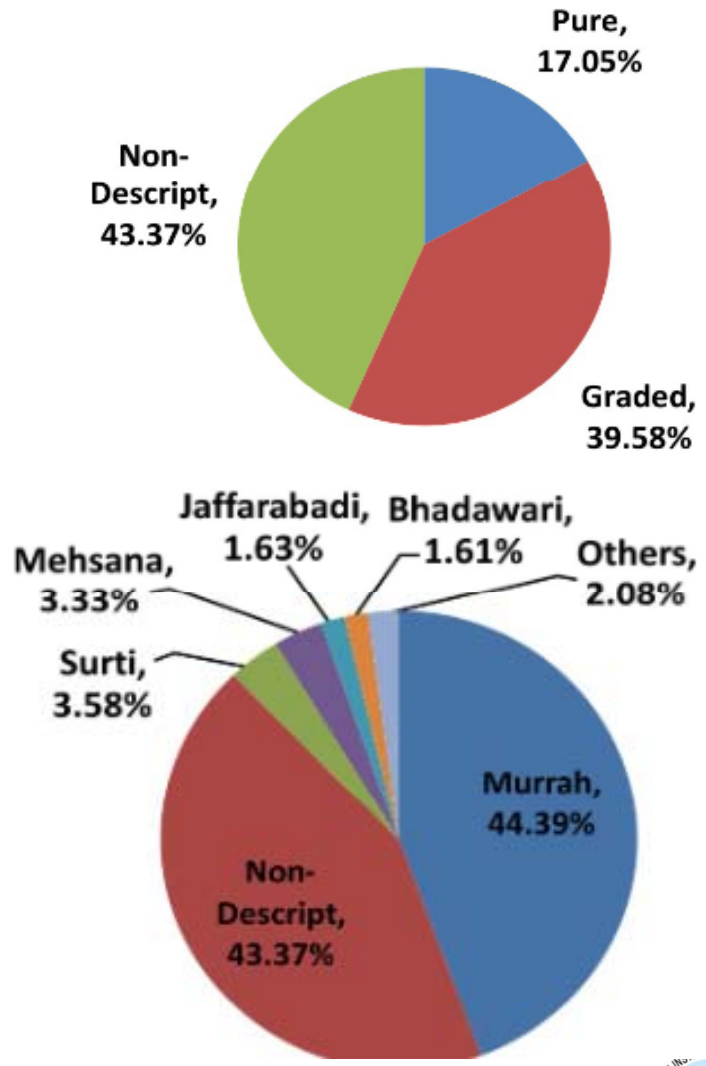
- **Achieving emission reductions without reducing the national herd size represents a significant challenge**
- In India, there has been a gradual increase in the number of crossbred female cattle which is automatically going to reduce emission. (**Green cows-Less feed, less methane, more milk**)



- Selection of **locally adapted breeds** can provide high genetic merit foundation stock for nucleus herd at mandal/ block level.
- Local climate resilient breeds of moderate productivity should be promoted over susceptible crossbreds.

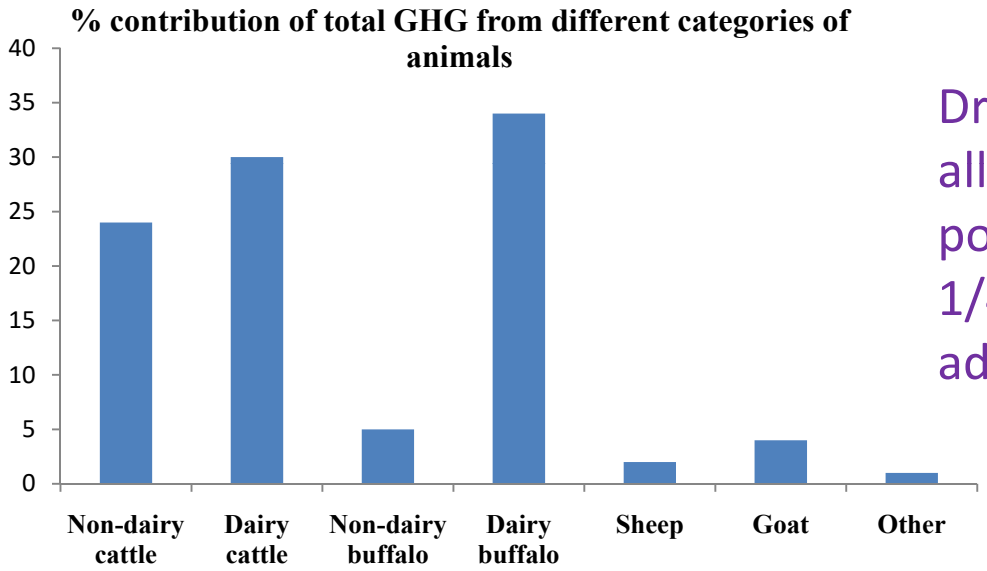
Breeding strategies conti.....

- Availability of semen of local breeds and promotion of AI with indigenous resilient breeds
- Synchronization of breeding period with feed and fodder
- Genetic improvement, to be successful, usually needs to be accompanied by improvements in nutrition, health and management.
- From a mitigation perspective, disease control provides significant co-benefits as improved productivity will reduce GHG emissions.



Dry animal management

Proper management (e.g., feeding, breeding and infertility treatments) of these categories of animals to bring them to the pregnancy and lactation phase could substantially decrease the GHG emissions per unit of milk production.

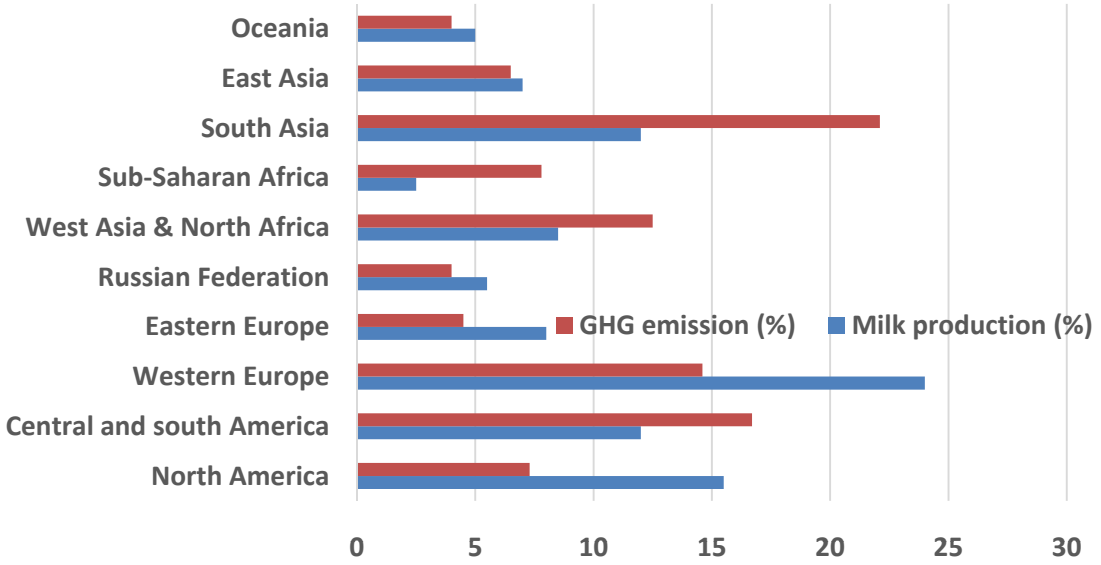


Drying of dairy animals is usually allowed for 2-3m → So, dry dairy population should not > 1/6thto 1/4th (an average of 20.8%) of adult dairy animals.

- However, GHG emissions by the dry-dairy animal population represented an average of 29.8% of GHG emissions by adult dairy cattle and buffaloes in this estimate, which indicates that considerable reduction of GHG could be possible through proper dairy herd management.

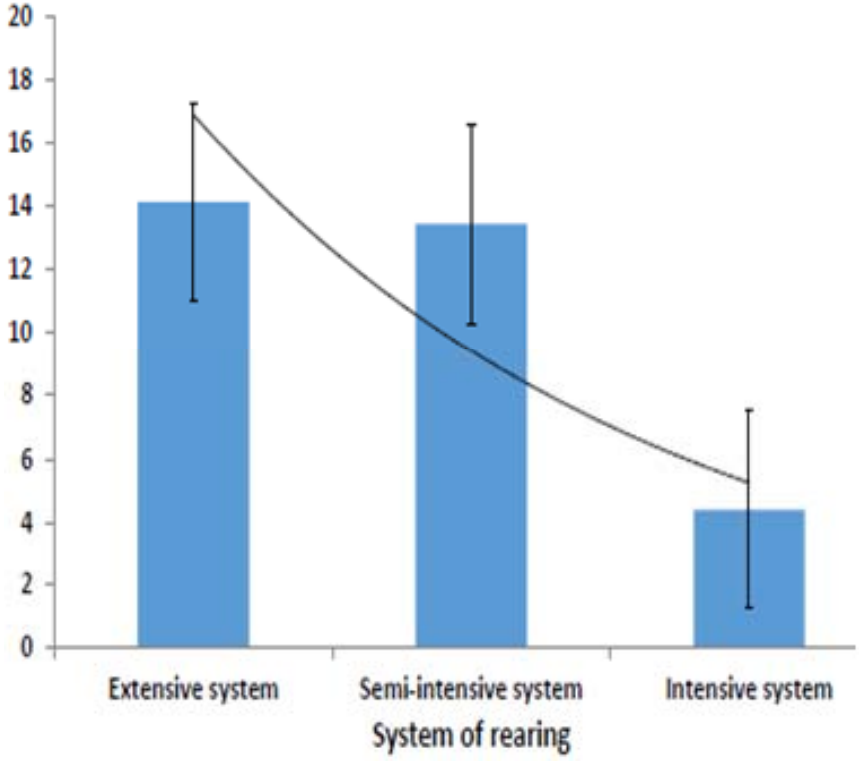
Extensive vs Intensive farming system

- Intensification is challenging within India due to chronic feed shortages.



•Intensification is suggested in marginal areas, but it has many disadvantages like

- Loss of a range of habitats
- •Increased use of purchased feeds,
- •Problems of waste disposal from increasingly larger scale intensive milk systems



Nutritional strategies to reduce enteric emission

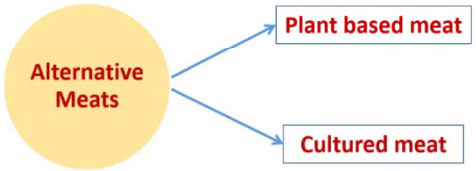
Diet Manipulation (5%-32%)

- Animal &plant breeding
- Rumen pH
- Composition of diet
- Additives (Fe and Cr_2O_3)
  - Fats, oil
  - Synthetic chemicals
  - Natural copmounds
  - Tannins, saponins

Harit Dhara: ↓ by 17-20%, ↑MY

Manegement

- Animal numbers
- Forage quality
- Alternative livestock system
- Efficiency

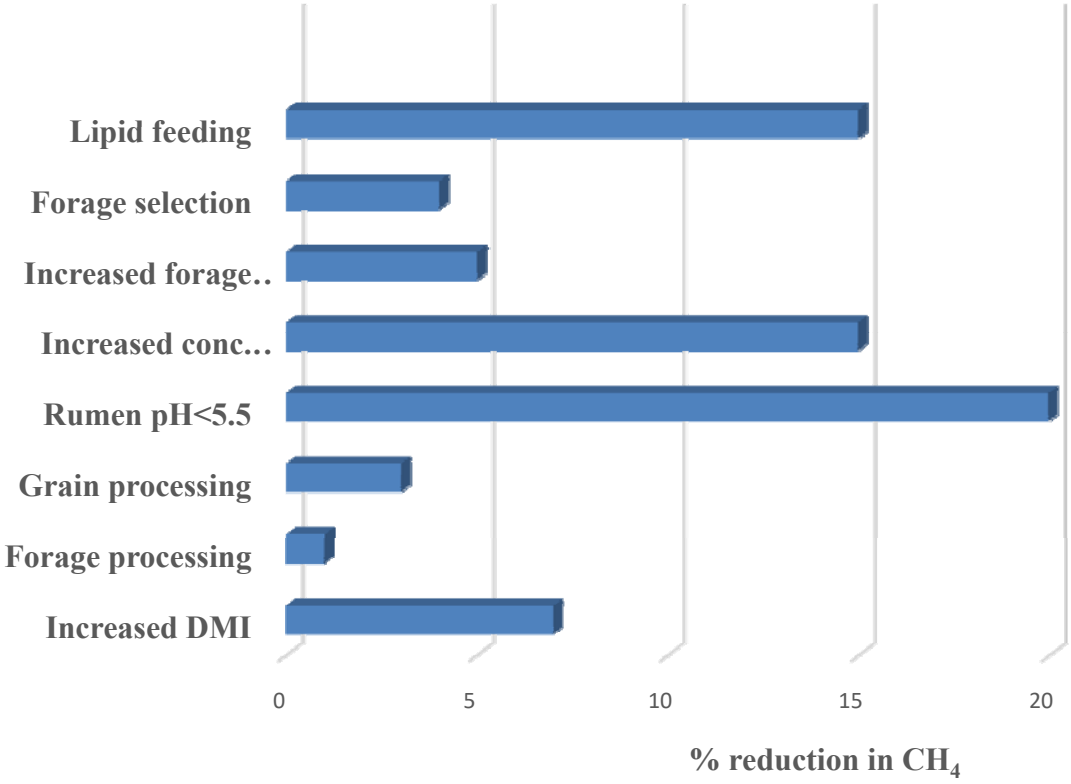


Rumen manipulation

- Natural variations
- Defaunation
- Antibiotics
- Bacteriocins
- Vaccines
  - anti-methanogen vaccines
- Acetogenes
- Archaeal viruses
- Biotechnological approach

Overall strategies to reduce enteric emission

- Pasture quality improvement: ↑ Productivity, less energy lost as CH_4 (CF/Tannin content/rate of passage from rumen).
- Area specific diversification farming system
- Peri-urban dairy farming+TMR
- Hydroponics and Azolla Production



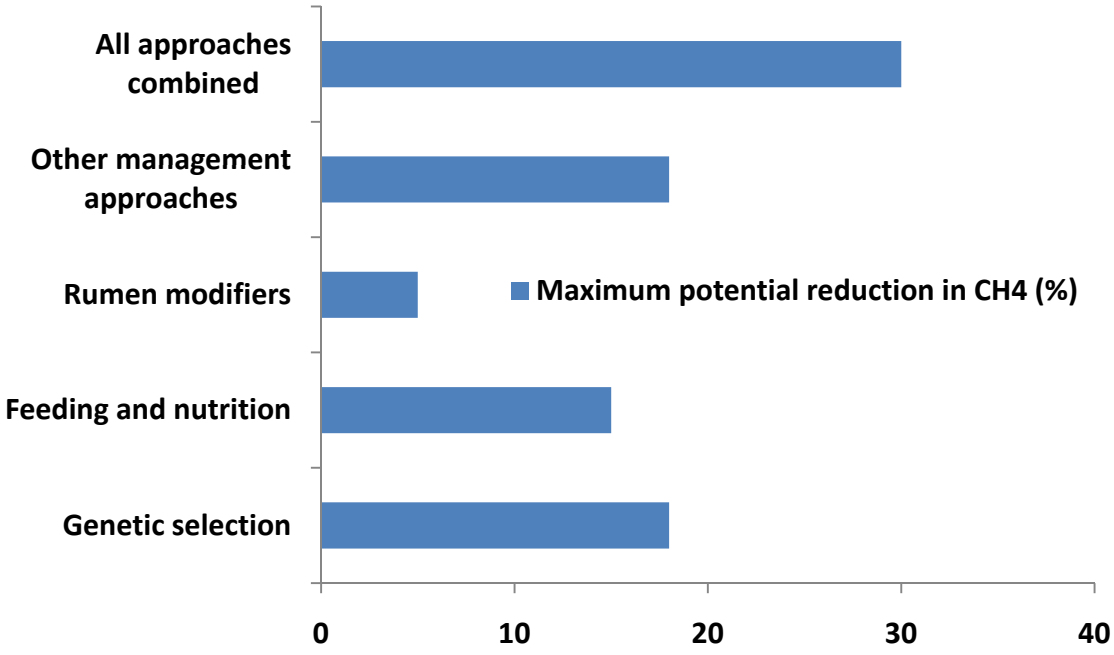
- Seed availability of forage crops (15-20% of national requirement) - need to be improved.

Manure management

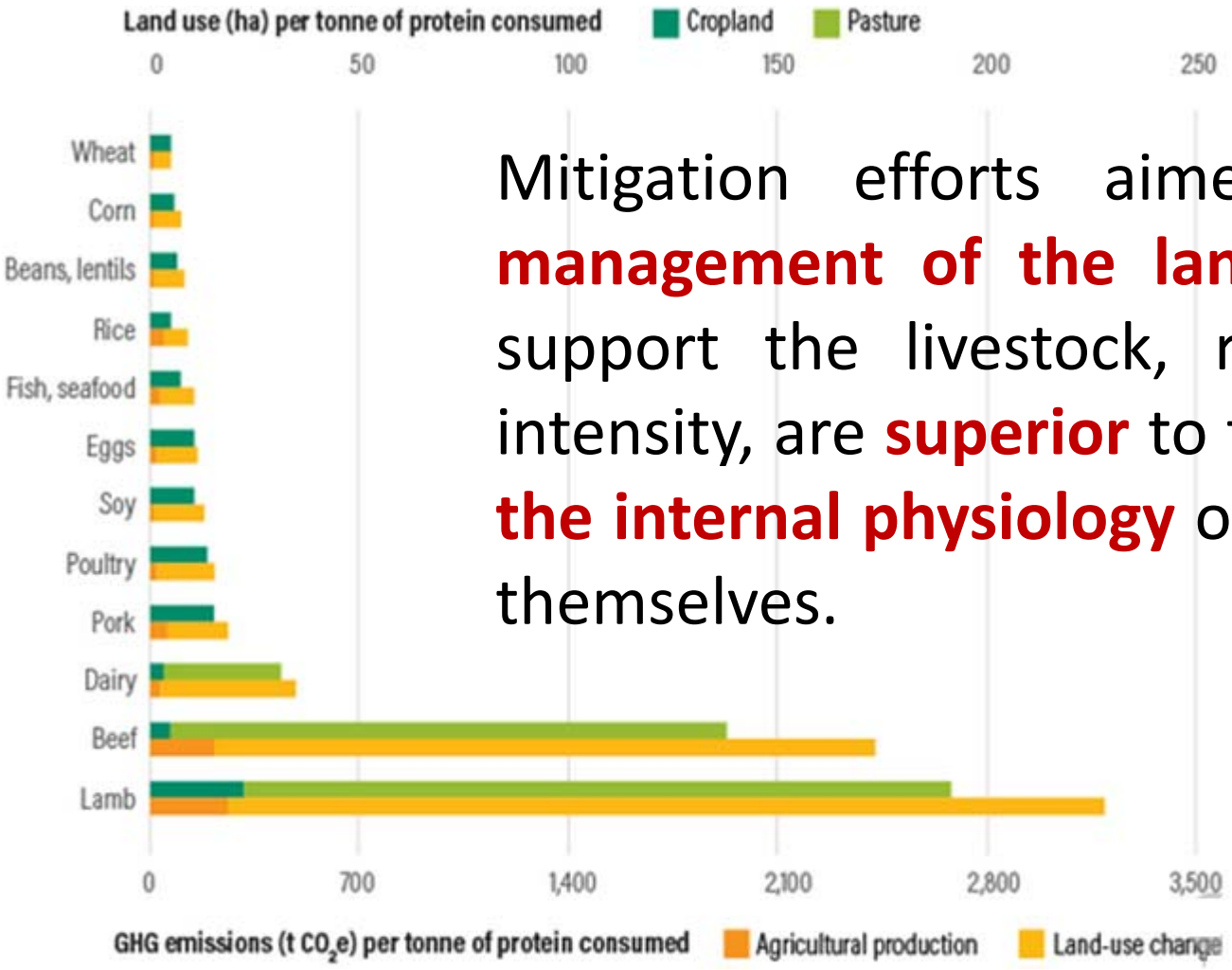
- Promotion of **community biogas plant** can achieve 50-75% reduction in methane emissions from manure. Application of fermented manures like biogas slurry in the place of unfermented farmyard manure can help in reducing GHG emissions.
- NATURAL FARMING/ ORGANIC FARMING
- Supplements (tannins) have the potential to reduce emissions as they displace the nitrogen excretion from urine to feces to produce an overall reduction in emissions
- The inclusion of forage legumes in cattle production systems can contribute to mitigating GHG emissions due to the reduction in the use of nitrogen fertilizers.
- Soil health card based suitable dose of fertilizer application on feed and fodder crops can reduce nitrous oxide emissions.

Mitigation: Issues to ponder upon

- CO_2 remains for 100-1000 years. No immediate benefit.
- But it takes only about a decade for CH_4 to break down. So, reducing CH_4 emissions - an immediate impact.

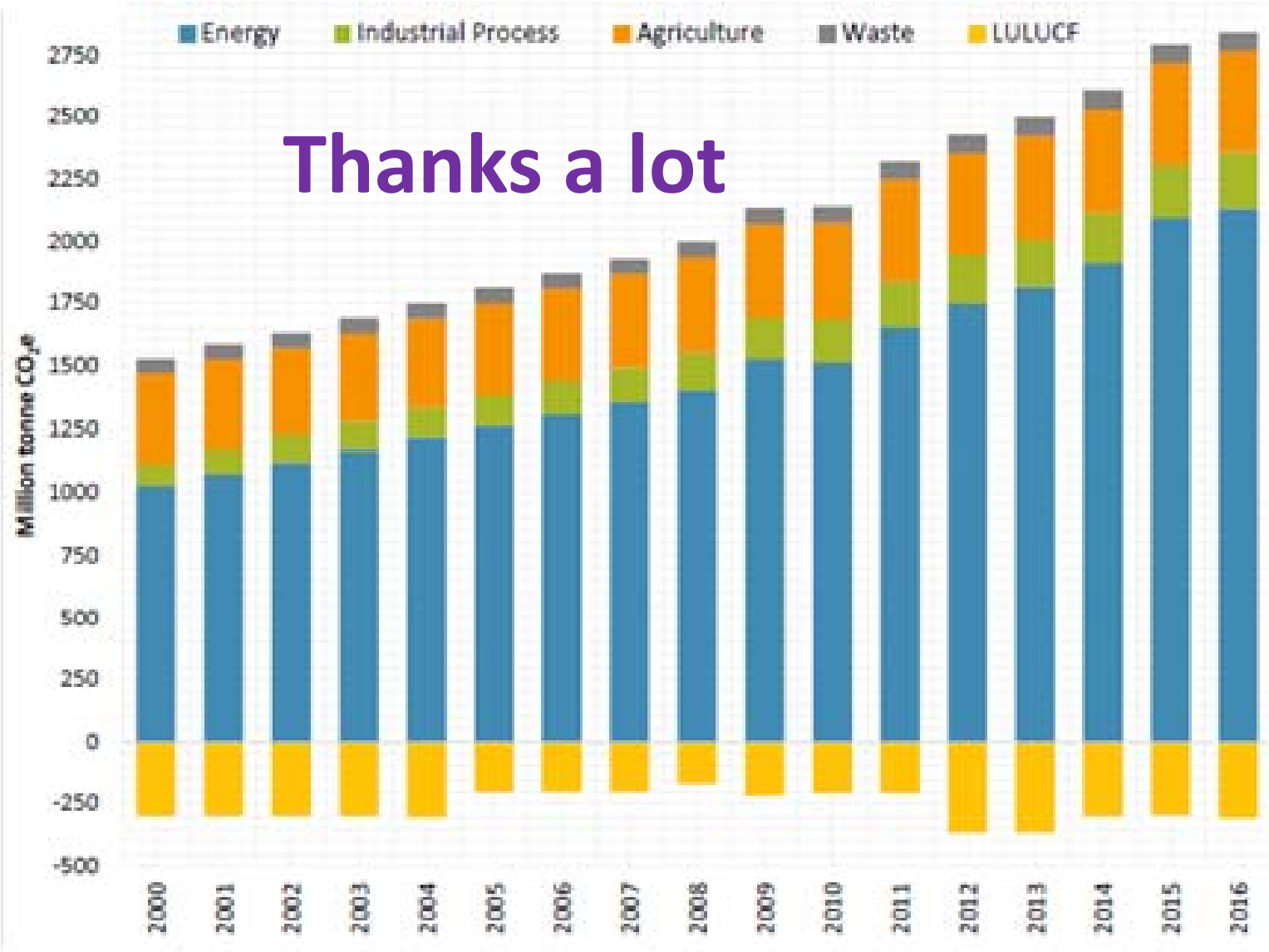


- Enteric CH_4 is a biogenic gas (of non-fossil origin) which can naturally reintegrate into the system through photosynthesis.
- Combine the mitigation strategies for soil, plant, and animal components to ↓ emissions and ↑ carbon sequestration



Mitigation efforts aimed at **good management of the land base** that support the livestock, regardless of intensity, are **superior** to those **targets the internal physiology** of the animals themselves.

- **NICRA-TDC – 151 CRVs to be upgraded to cluster of villages**



Thanks a lot