

HOUSING & MANURE MANAGEMENT (NUTRIENT CYCLE & REDUCTION OF GREENHOUSE GAS EMISSIONS –GHGE (Level 1)

Topic	Training & information Content
8.1	Farm structures & housing cows/calves/young stock
8.2	Construct small zero grazing unit (SNV handbook)
8.3	Prevention of heat stress in cow barns
8.4	Cow house ground floor plan design (SNV book)
8.5	Best management practice feed fences.....
8.6	Housing & cow comfort (animal welfare)
8.7	Housing & manure management (nutrient cycle & reduction of greenhouse gas emissions (GHGE)
8.8	Use of sensors (activity meter) in dairy herds



1. You will learn about (learning objectives):

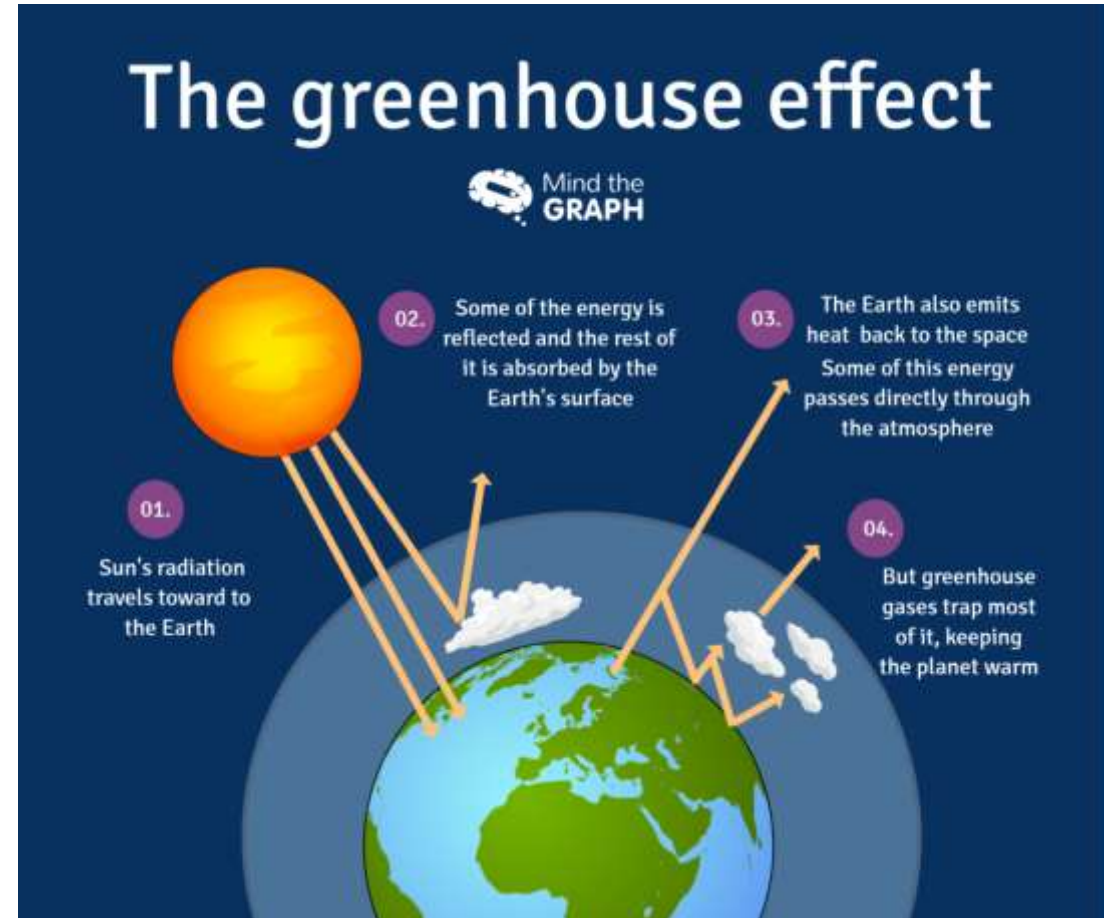
- Greenhouse gas production by dairy cows?
- Effects of poor manure management to dairy & it's environs.
- Management of manure in cow housing.
- How farmers can reduce greenhouse gas emissions through management approaches.

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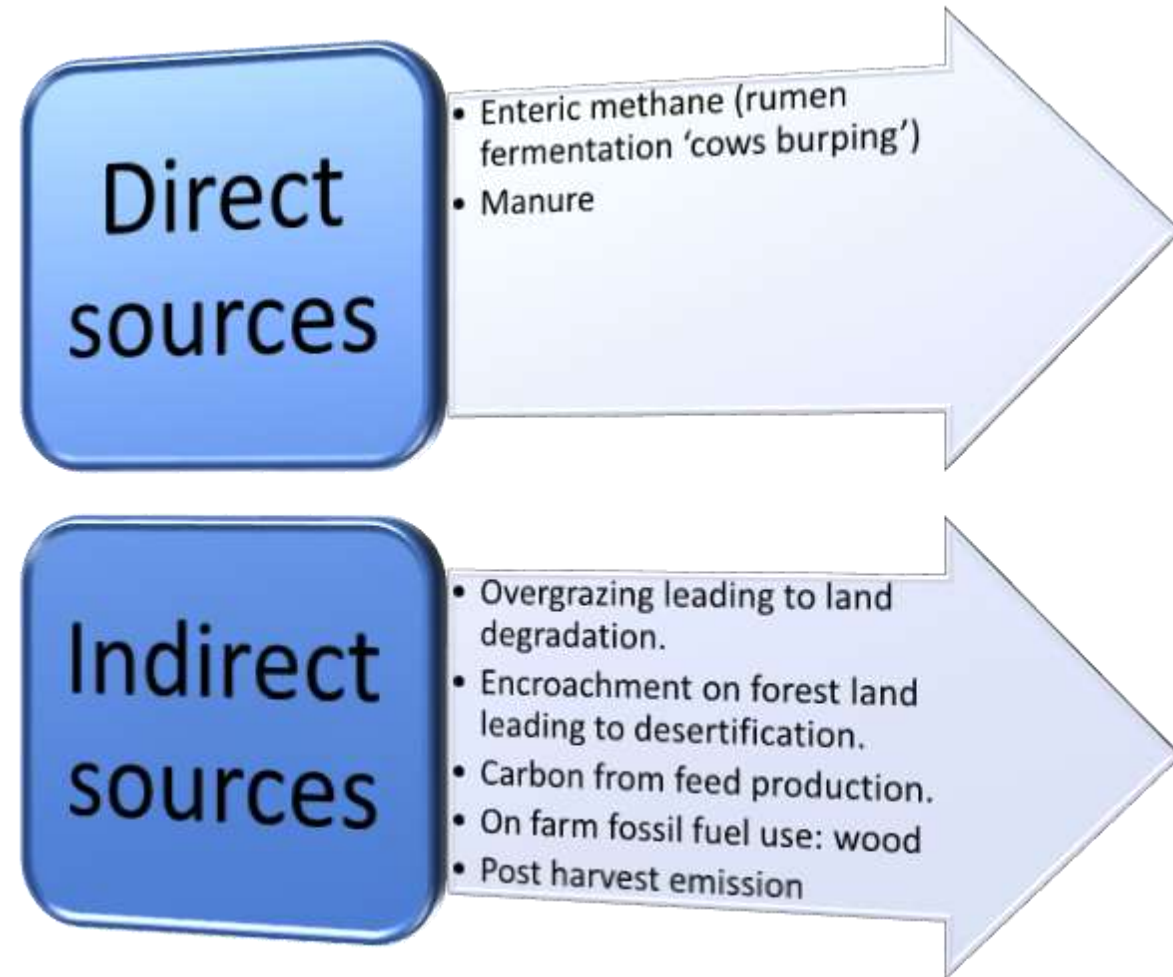
2. Introduction

- Greenhouse gas refers to any gas that has the ability to absorb/trap infrared radiation (net heat energy) produced from Earth's surface and reradiating it back to Earth's surface. Thereby, contributing to the greenhouse gas effect. (See image to the right)
- Greenhouse gases that are important in agricultural production are: carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O).
- Farmers through management like better feeding & feed production, improved breeding, manure & housing management are able to manage produced in the farm.



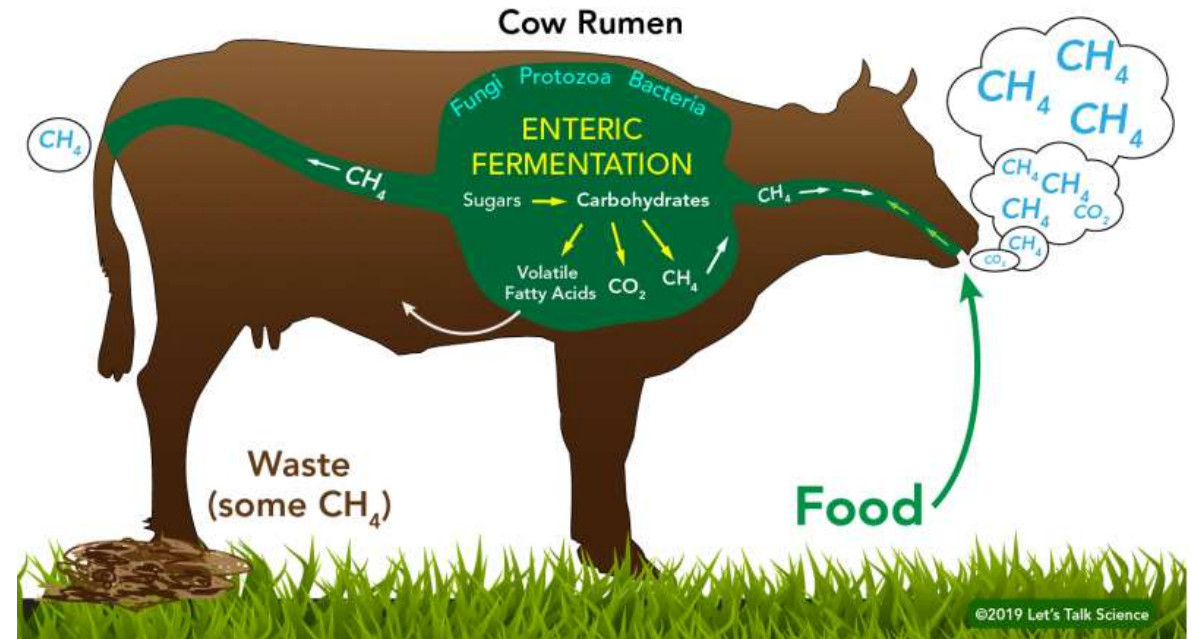
3. Greenhouse gas production from livestock

- Livestock contribute both directly and indirectly to climate change through greenhouse gas emissions. Such emissions like carbon dioxide, methane etc.



4. Enteric fermentation from livestock

- Enteric fermentation is part of the digestive process in ruminants (cows).
- It is where microbes in the digestive tract or rumen decompose and ferment food.
- In this process to release pressure caused when methane is produced as a by-product, the animal burps it out.
- However about 5% of methane also comes out of the other end.



5. Manure production

- Most livestock-associated organic by-products are animal manure.
- Manure produced by livestock (cows) has many recyclable uses.
- It can be used as fertilizer, energy source (biogas or direct fuel) and even construction material.
- The amount and consistency of manures varies with animal type, climate, feed ration, animal age, health and other factors.



6. Manure storage in dairy farms

- Farming system influence manure management method. This systems can either be extensive, semi-intensive and intensive systems.
- Farms can either decide to spread manure, store it or use it for both purposes.
- Proper storage of manure ensures that manure is protected against influence from;
 - sunlight
 - wind
 - water/rain

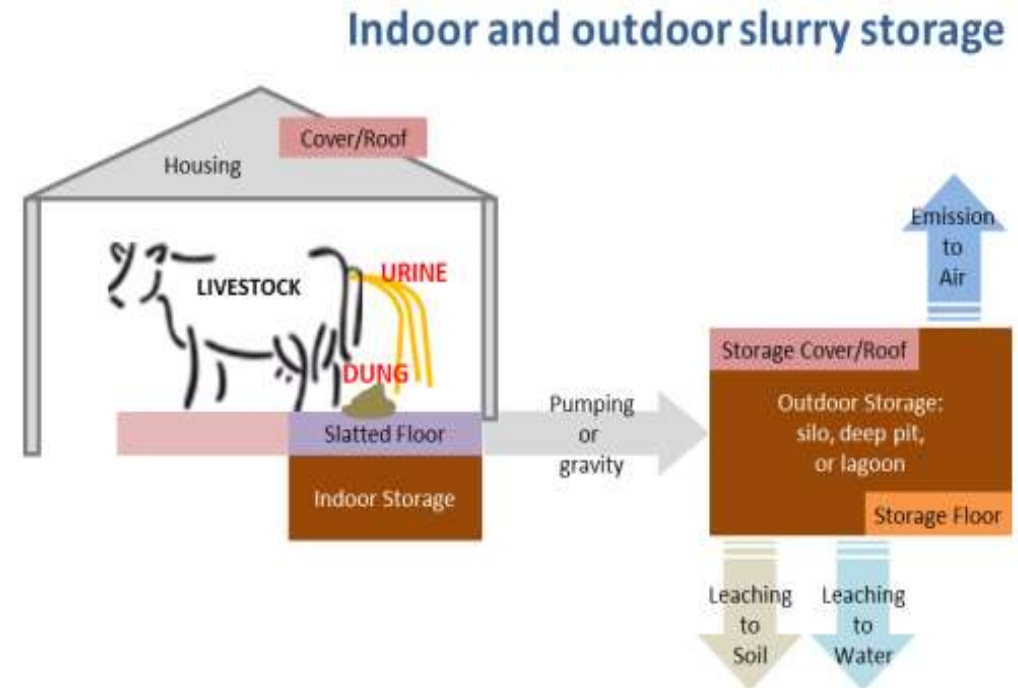
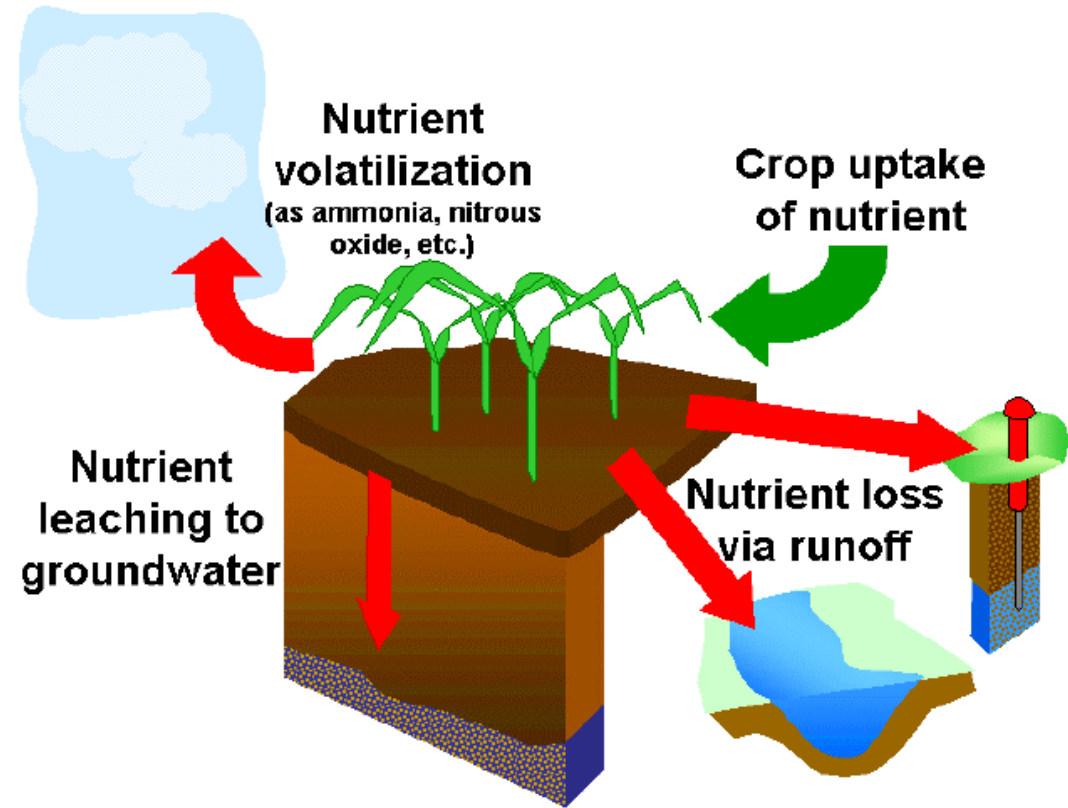


Image from: <https://edepot.wur.nl/362491>

6.1 Manure storage in dairy farms Cont'd...

- Proper storage preserves crop nutrients until time of application.
- Storage roofing prevents runoff of nutrients to the soil and water.
- Storage flooring prevents leaching of nutrients into the soil water.
- Covering nutrients in a air-tight storage prevents nutrients from volatilization to the air.



7. Manure management in extensive systems 'grazing'

- For small scale farms with few animals that practice grazing over a large area of land and likely keep the cows in a boma at night are most likely to spread the little amount of manure on farms from the night bomas.
- Caution should be taken to avoid adding manure to saturated soils (soils filled with water) however,
- When considering manure storage farmers should avoid storing manure for a long period.



8. Manure management in intensive or confined systems 'zero-grazing'

- Cows in confined (zero grazing) system compared to other system deposit more manure at a given area.
- The dung and urine collection is easily collected since cows are kept in a particular area which necessitates often cleaning and flooring helps in collection.
- Roofed housing prevent volatilization of nitrogen from manure leading to less nitrogen losses.
- Manure from animal housing is easily directed to biodigesters and provides cheap clean energy for the farm.



9. Manure management in semi-intensive systems 'semi-zero-grazing'

- Semi-zero grazing systems are open to all method of manure management within the farm all depending on management and scale of production.
- Farms can either;
 - Evenly spread manure dropped by cows in grazing fields.
 - Collected manure in animal housing and either;
 - Sell to other farmers.
 - Heap for spreading on the shamba.
 - Direct to a biodigester system.



10. Manure storage options

1. Stockpiling – Involves placing manure in a sealed and compact manner to avoid manure nutrients from leaching into soil.
2. Dry stack – Involves placing manure in storage facilities with impervious floor and three walls used to contain the manure.
3. Composting – Method of collecting and storing manure and other plant materials so that it can decay and later added to soil to improve its quality.
4. Liquid storage – Involves collecting liquid manure into pit structures and afterwards can be pumped and spread on land.
5. Hauling away – Refers to spreading manure to cropland/soil, this is possible for farms producing small amounts of manure daily.

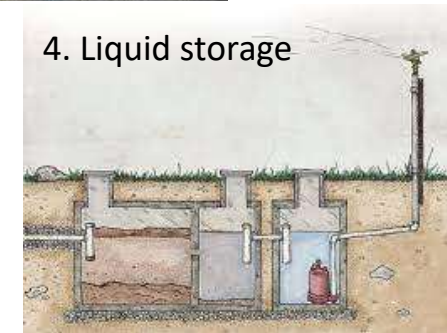
1. Stockpiling



2. Dry stack



4. Liquid storage



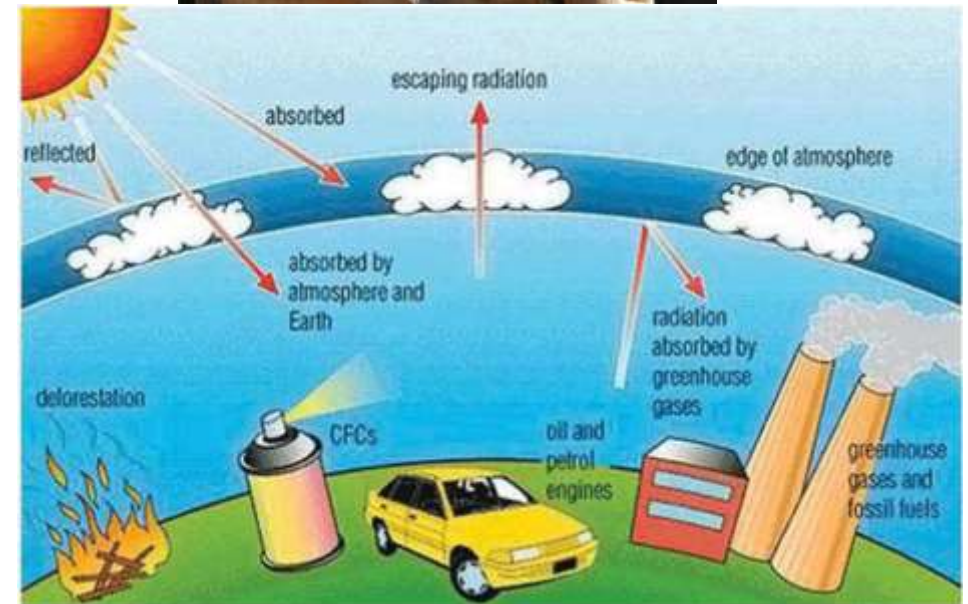
11. Factors affecting methane emissions

Feed quality

- The more fibre a cow eats the more methane it produces.
- Improving feeding makes animals more productive, and more productive animals results in less methane produced per litre of milk.

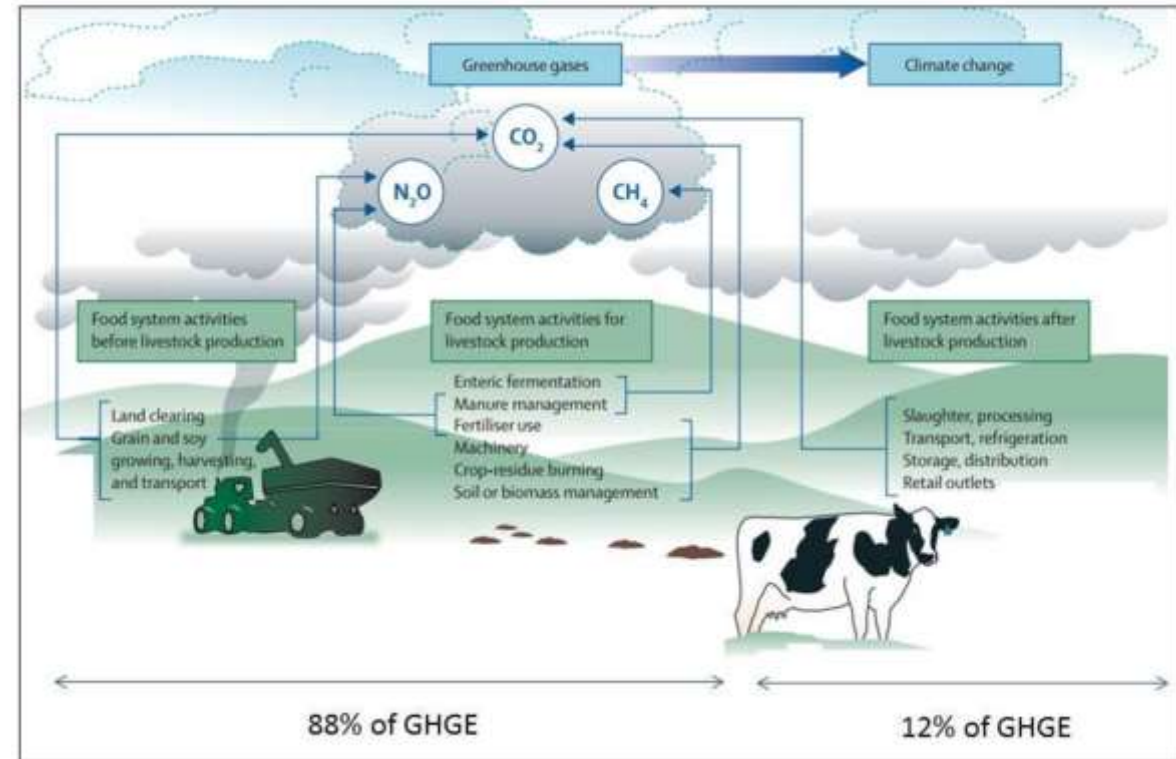
Environmental temperature

- During warm periods, greenhouse gas concentrations are particularly high compared to cold periods.
- Greenhouse gases mainly carbon dioxide causes air temperature increase resulting in climate change (global warming).



12. Reducing greenhouse gas emissions

- ✓ Feed cows based on nutrient requirements.
- ✓ Include additives in the ration to suppress enteric methane production in the rumen.
- ✓ Increase production by keeping the herd healthy and breeding practices.
- ✓ Composting.
- ✓ Implement covered manure storage covers and /or anaerobic digesters (biogas).
- ✓ Include additives in manure to suppress unwanted biological activity.



12.1 Feed cows based on nutrient requirement

- What cows feed on greatly impacts the quality of manure.
- Feeding cows on improved good quality feed improves feed efficiency while reducing enteric methane production.
- By proper feeding for example testing feed to ensure nutrient feed content matches quantity fed to cows manages overfeeding of nutrients and thereby losing them in manure.



12.2 Increasing herd productivity

- Breeding that considers herd health in the long run reduces death/mortality leading to increased production efficiency in cows.
- Unproductive cows contribute methane same as productive cows the difference comes where productive cows contribute less methane per litre compared to unproductive cows that produce more methane per litre at either low to zero production per litre of milk.
- When cows are high producing the amount of methane per litre is reduced.
- Young stock that get inseminated by 14-15 months get to be productive earlier compared to those inseminated at 2 years or more.



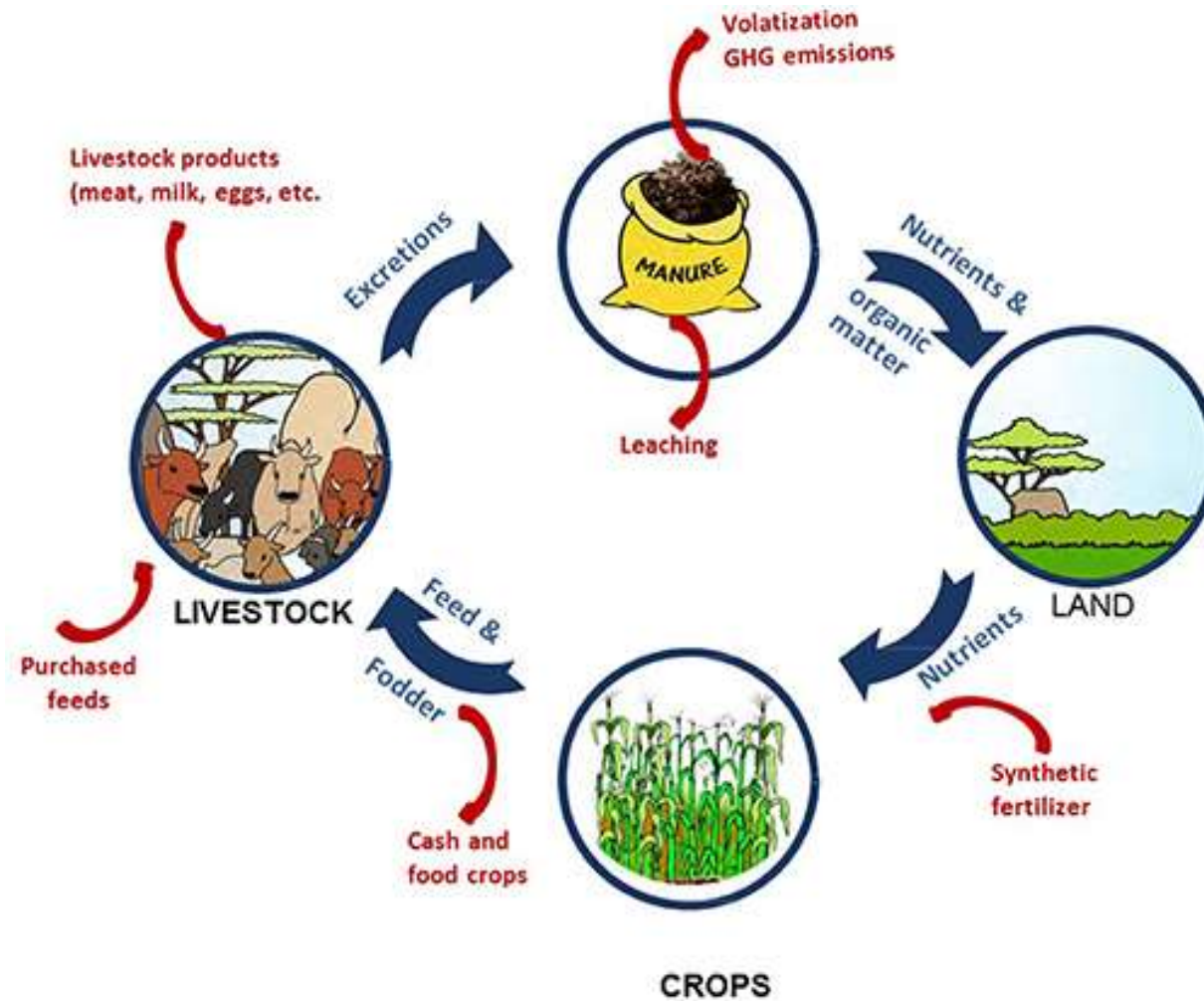
12.3 Composting

- Composting is a biological process in which organic portion of refuse (manure) decomposes under controlled conditions.
- Composting imitates the decomposition of organic matter on the soil surface to turn manure into humus.
- Composting reduces methane emissions by making the compounds in manure more stable and reduces amount released in air.
- **See module on: Use of natural resources compost making**



12.3 Composting Cont'd...

Nutrient (manure) cycle



12.4 Manure storage covers

- It is important to reduce exposure of manure to the environment, that is farmers should minimize air/wind movement over manure, rain and sunlight to reduce ammonia emissions.
- Heaping together manure and covering reduces contact with air.
- Ensuring that solid manure is covered helps prevent loss of nutrients in the manure and reduce odour in the air.
- Covers can be as simple as straw/hay, synthetic covers or permanent covers.

Manure storage tank



13. Biogas and animal housing

- Directing manure from housing to a biogas digester is an important way of managing manure in dairy farms.
- Biodigester has to be fed with fresh manure every day.
- Biogas is directly burned for heating application, captured and combusted to generate electricity in dairy farms.
- The gas produced in biogas digestors has to be used (burned) otherwise if released to the environment it still poses the same threat by releasing greenhouse gases to the environment.



14. Storing manure in the air (aerobic decomposition)

- Aerobic processes are most common in nature
- Manure exposed to the air also gets exposed using aerobic microorganisms that breakdown organic matter.
- There is no accompanying bad smell when there is adequate oxygen present.
- During oxidation of carbon to produce carbon dioxide a lot of energy is released in the form of heat.

