# Pasture as an Element of Sustainable Farming. Part I.

October 6, 2021.

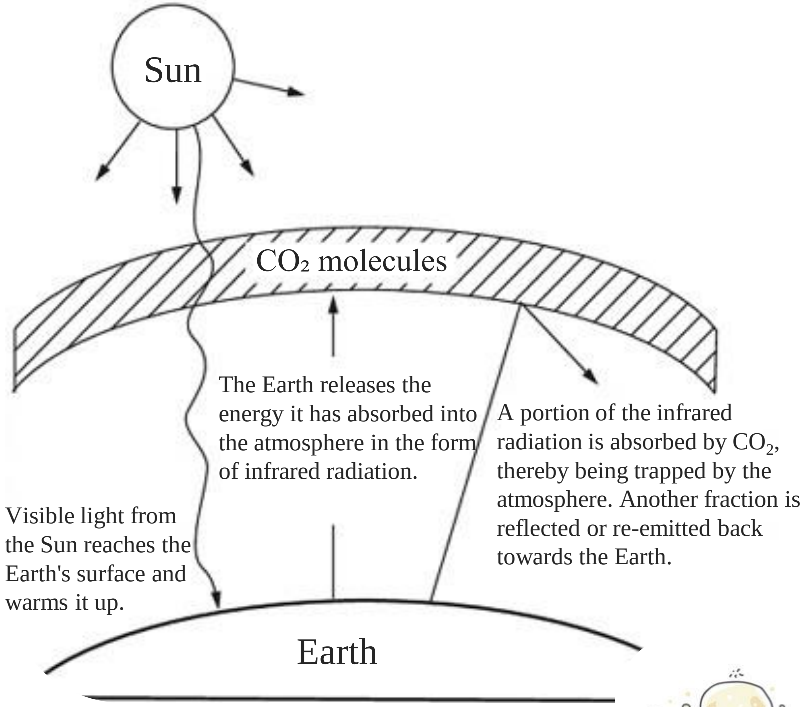
Moscow

PROAGRO LECTORIUM

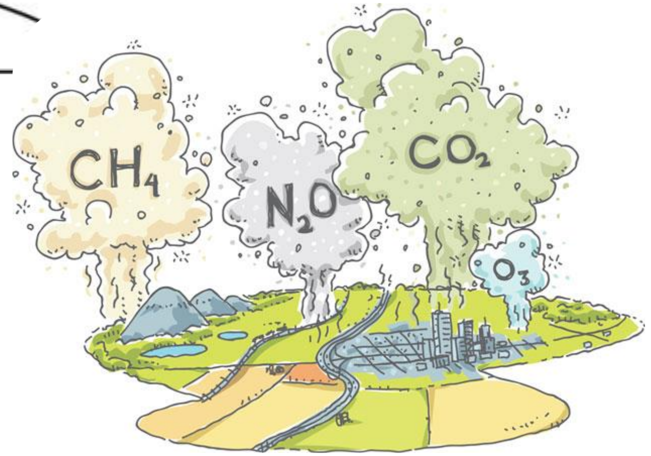
# Contents

# 1. Greenhouse gases. What are they?

- A **greenhouse gas** (abbreviated as GHG) is a gaseous constituent of Earth's atmospheric shell, originating from either natural or human-induced sources, that absorbs and reflects infrared electromagnetic radiation. An increase in the concentration of such gases in the atmosphere results in the **greenhouse effect**.




- The **greenhouse effect** refers to the rise in the Earth's surface temperature caused by the heating of the lower layers of the atmosphere due to the accumulation of greenhouse gases. Consequently, the air temperature exceeds what it should be, leading to irreversible consequences such as climate change and **global warming**.



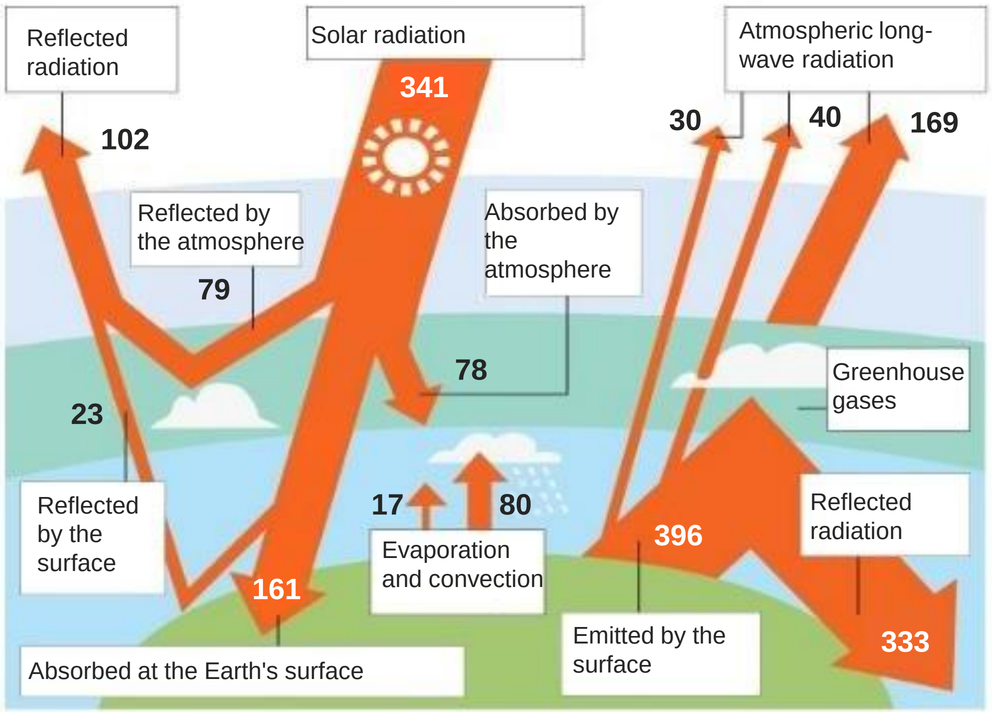
# 1. Greenhouse gases. What are they?

## Types of GHGs:

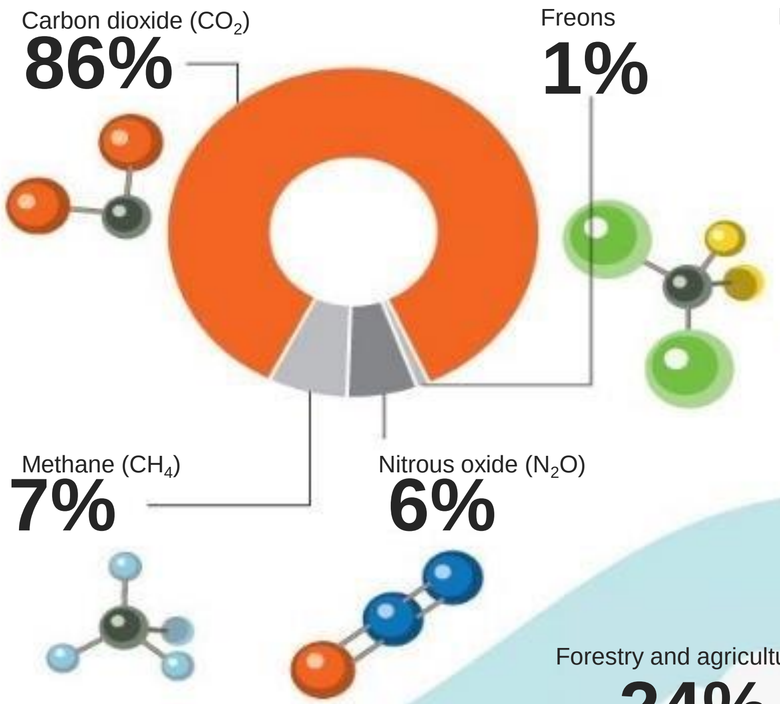
- **Water Vapor ($H_2O$)**: It contributes to over 60% of our planet's thermoregulation. Climate warming triggers an increase in moisture evaporation, thereby enhancing the greenhouse effect. This process results in the formation of clouds that partially reflect direct sunlight.
- **Carbon Dioxide ($CO_2$)**: The sources of carbon dioxide ($CO_2$) in the atmosphere include emissions from substances during and after volcanic eruptions, human-induced factors (industrial processes, fuel combustion), and byproducts of biological processes (metabolism, respiration, decay) in living organisms.
- **Methane ($CH_4$)** is generated by microorganisms, emerges due to biological processes in wetlands, is released during forest fires, and is also derived from livestock and agriculture. In comparison to carbon dioxide, the impact of methane is 25 times more potent.
- **Tropospheric Ozone ($O_3$).** The ozone layer, situated in the stratosphere at an altitude of 20–25 km, shields our planet from UV radiation. Conversely, tropospheric ozone intensifies the greenhouse effect, pollutes the atmosphere, and inhibits the growth of plant biomass. The primary sources of its presence in the atmosphere are transportation, chemical, and industrial emissions.
- **Freons and Halons.** These greenhouse gases are 1,300 to 8,500 times more potent than carbon dioxide in contributing to global warming. The primary sources of freons and halons are refrigeration units, air conditioners, and aerosols. Freons that contain chlorine and bromine are thought to deplete the ozone layer, thereby contributing to the formation of ozone holes.
- **Nitrogen Oxides ($N_2O$).** Nitrogen oxide is emitted into the air from soil and during the production of mineral fertilizers. Its greenhouse activity is 298 times more potent than that of $CO_2$.

# Interaction between nature and humans

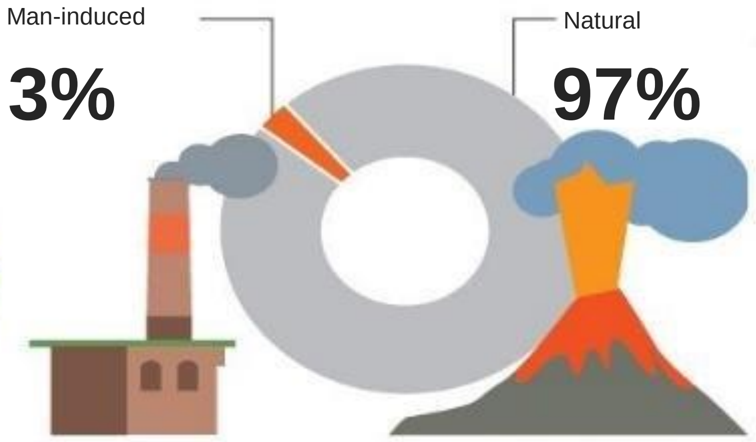
## ENERGY DIAGRAM OF GREENHOUSE EFFECT (W/m²)



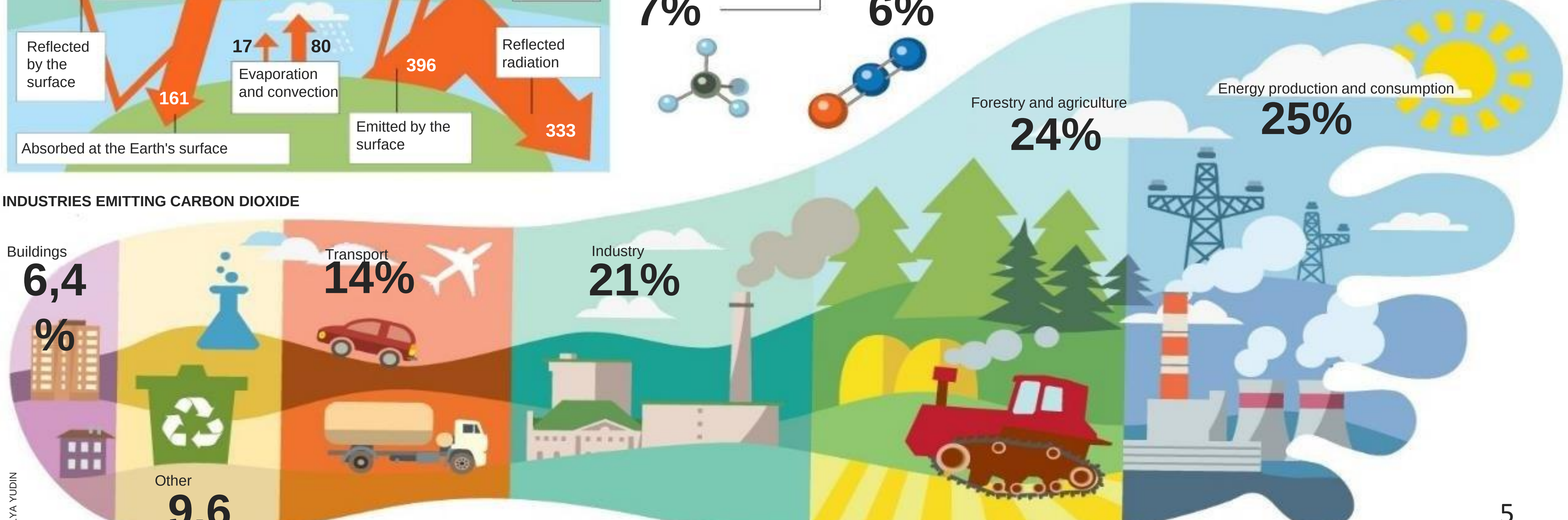

## GREENHOUSE GASES




## CARBON DIOXIDE IN THE EARTH'S ATMOSPHERE



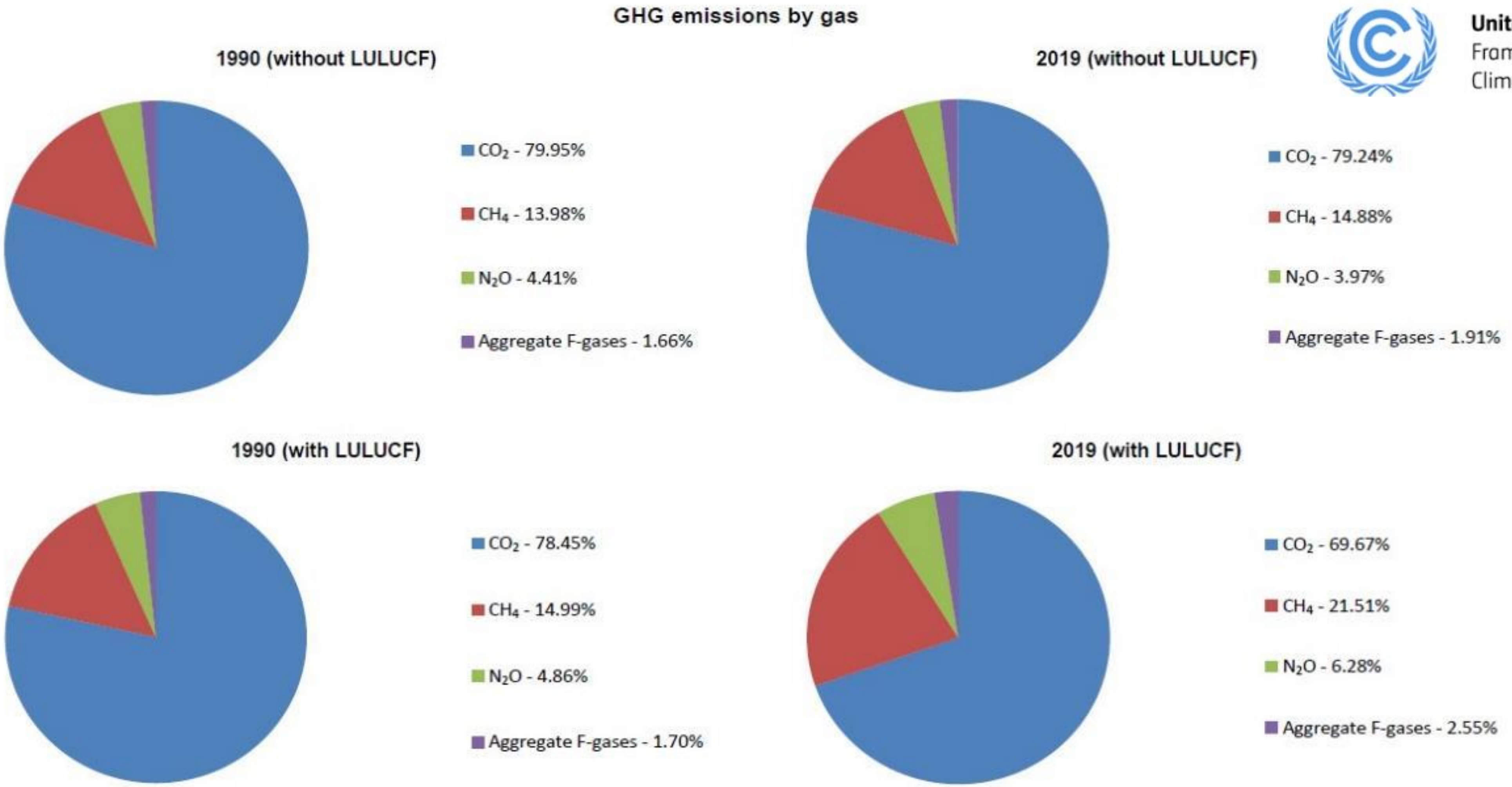

## INDUSTRIES EMITTING CARBON DIOXIDE




Source : https://dogcatdog.ru/kakie-parnikovye-gazy-avlautsa-osnovnymi/

# 1. Structure of GHGs in Russia. Statistics for 29 years

United Nations
Framework Convention on
Climate Change

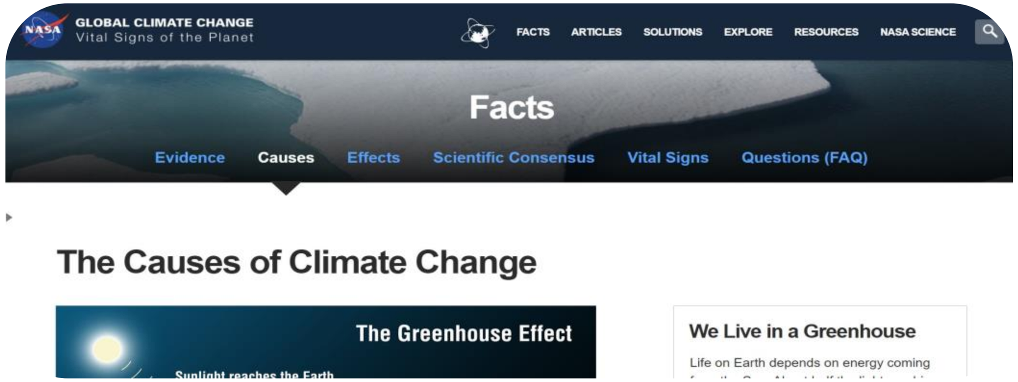



Source: https://unfccc.int/files/ghg_emissions_data/application/pdf/rus_ghg_profile.pdf

# 1. Greenhouse gases. Global impact on climate change

**The most probable outcomes of altering the natural greenhouse atmosphere include:**

- On average, the climate on Earth will **become warmer**.
- Increased warmth will likely result in **greater evaporation and overall precipitation**, but individual regions will experience variations, with some becoming more humid and others more arid.
- An intensified greenhouse effect will heat the oceans and partially melt glaciers and ice caps, leading to a **rise in sea levels**.




**Source: https://climate.nasa.gov/causes/**

- Elevated levels of carbon dioxide ($CO_2$) in the atmosphere can have both advantageous and disadvantageous **impacts on agricultural yields**. Some laboratory experiments indicate that increased levels of $CO_2$ can expedite plant growth. However, other factors such as shifts in temperature, ozone levels, water availability, and nutrient constraints can negate any potential enhancement in yield.
- Extreme climatic events like **droughts, floods, and severe temperatures** can result in crop losses and jeopardize the livelihoods of agricultural producers and the food security of communities globally.
- Lastly, while increased $CO_2$ levels can stimulate plant growth, research has demonstrated that it can also **diminish the nutritional value** of most food crops by reducing the concentration of protein and essential minerals in a majority of plant species.

# 1. PhosAgro's role in combating greenhouse gases and climate change

Since 2018, PhosAgro has implemented a climate strategy, setting the following priority tasks:

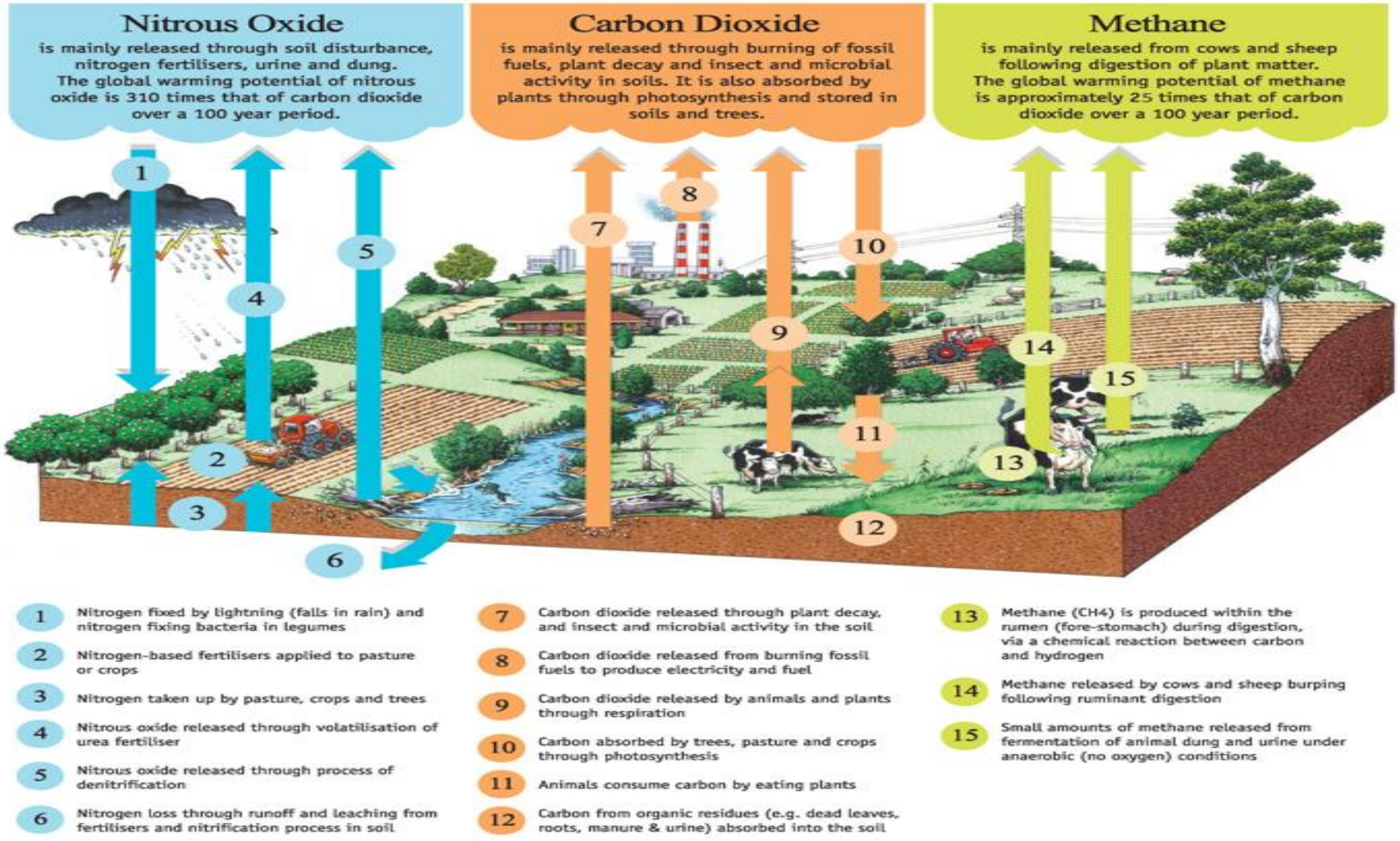
- Reduce greenhouse gas emissions by 14% from the 2018 baseline level by 2028.
- Expand the realm of climate-responsible business in Russia and on a global scale through responsible supplier selection.
- Reduce climate risks in production and business processes, leveraging emerging climate opportunities to expand and fortify the business.
- Enhance the Company's openness and transparency, including through broadened engagement with stakeholders and international platforms to advance the climate agenda.
- Integrating climate-related issues into all of the Company's internal management processes and decision-making

Beginning in 2022, a carbon testing ground project is being initiated as part of the Climate Strategy, in collaboration with the Russian Academy of Sciences and the Government of the Vologda Region.

# 2. The influence of agriculture on the carbon footprint

As they move and transform within our agricultural systems, GHGs are absorbed and emitted at various time scales and in various amounts.

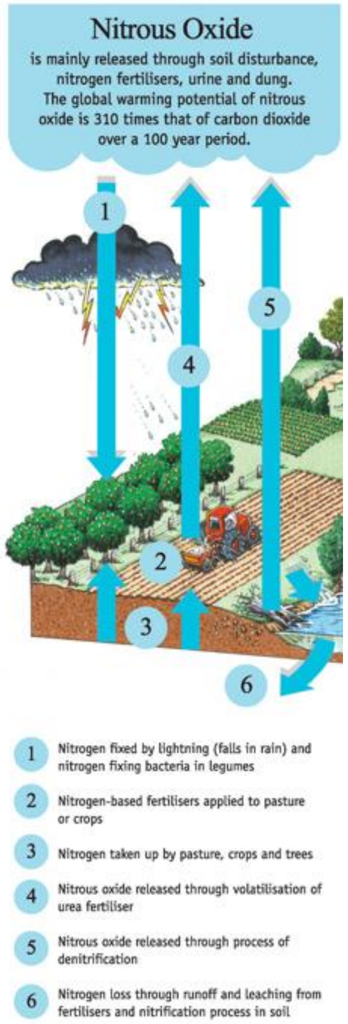
The subsequent graph illustrates the fluxes of greenhouse gases—nitrous oxide, carbon dioxide, and methane—in and out of a typical farming system.




*Note: This information contains greenhouse gas emissions from the agricultural sector. It does not include other emissions from other industries.

Source: https://agriculture.vic.gov.au/climate-and-weather/understanding-carbon-and-emissions/greenhouse-gas-cycles-in-agriculture

# 2. The influence of agriculture on the carbon footprint




**Nitric oxide ($N_2O$)** is mainly released through:

- Soil disturbance
- Nitrogen fertilizers
- Urine
- Dung

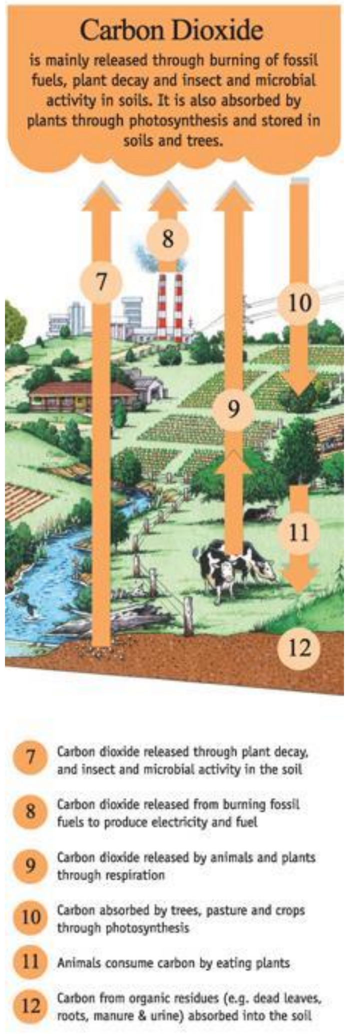
The global warming potential of nitrous oxide is 300 times that of carbon dioxide over a 100 year period.

Nitrogen oxide moves through the atmosphere and landscape in the following ways:

1. Atmospheric nitrogen is converted to inorganic nitrogen compounds by nitrogen-fixing bacteria in legumes, which can be utilized by plants.
2. Nitrogen-based fertilizers are applied to pastures or agricultural crops.
3. Nitrogen is taken up by pastures, crops, and trees.
4. Nitrogen oxide is released through volatization of urea and nitrogen fertilizers.
5. Nitric oxide is released through the process of denitrification.
6. Nitrogen is also lost through runoff and leaching from fertilizers and nitrification process in the soil.

Source: https://agriculture.vic.gov.au/climate-and-weather/understanding-carbon-and-emissions/greenhouse-gas-cycles-in-agriculture

# 2. The influence of agriculture on the carbon footprint




**Carbon dioxide ($CO_2$)** is released mainly through:

- Combustion of fossil fuels
- Plant decay
- Insect and microbial activity in soils

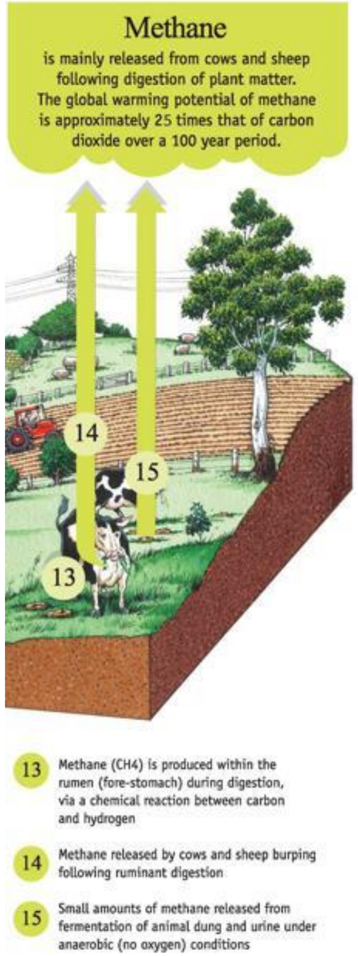
<u>It is also absorbed by plants during photosynthesis and stored in vegetation and soil as carbon.</u>

Carbon dioxide moves through the atmosphere and landscape in the following ways:

7. Carbon dioxide is released from the soil as a result of plant decay and the activities of insects and microorganisms in the soil.
8. Carbon dioxide is released from burning fossil fuels to produce heat and electricity, and from using agricultural machinery.
9. Carbon dioxide is released by animals and plants through respiration.
10. Carbon dioxide is absorbed by trees, pastures and crops through photosynthesis and converted into other complex carbon compounds and oxygen.
11. Animals consume carbon by eating plants.
12. Carbon from organic residues (e.g., dead leaves, roots, manure, and urine) is absorbed by the soil.

Source: https://agriculture.vic.gov.au/climate-and-weather/understanding-carbon-and-emissions/greenhouse-gas-cycles-in-agriculture

# 2. The influence of agriculture on the carbon footprint




**Methane ($CH_4$)** is mainly released from:

- Rice paddies
- Dumps, lagoons, and manure ponds
- Ruminants

<u>The global warming potential of methane is about 25 times that of carbon dioxide over a 100 year period.</u>

Methane moves through the atmosphere and landscape as follows:

13. Methane is produced within the rumen during digestion via a chemical reaction between carbon and hydrogen.
14. Methane is released by cows and sheep burping following ruminant digestion.
15. Small amounts of methane are released from fermentation of animal dung and urine under anaerobic (no oxygen) conditions. Methane is also released from dairy farm wastewater lagoons as well as manure storage facilities.

Source: https://agriculture.vic.gov.au/climate-and-weather/understanding-carbon-and-emissions/greenhouse-gas-cycles-in-agriculture

# 2. The influence of agriculture on the carbon footprint

United Nations
Framework Convention on
Climate Change

## United Nations Framework Convention on Climate Change (UNFCCC)

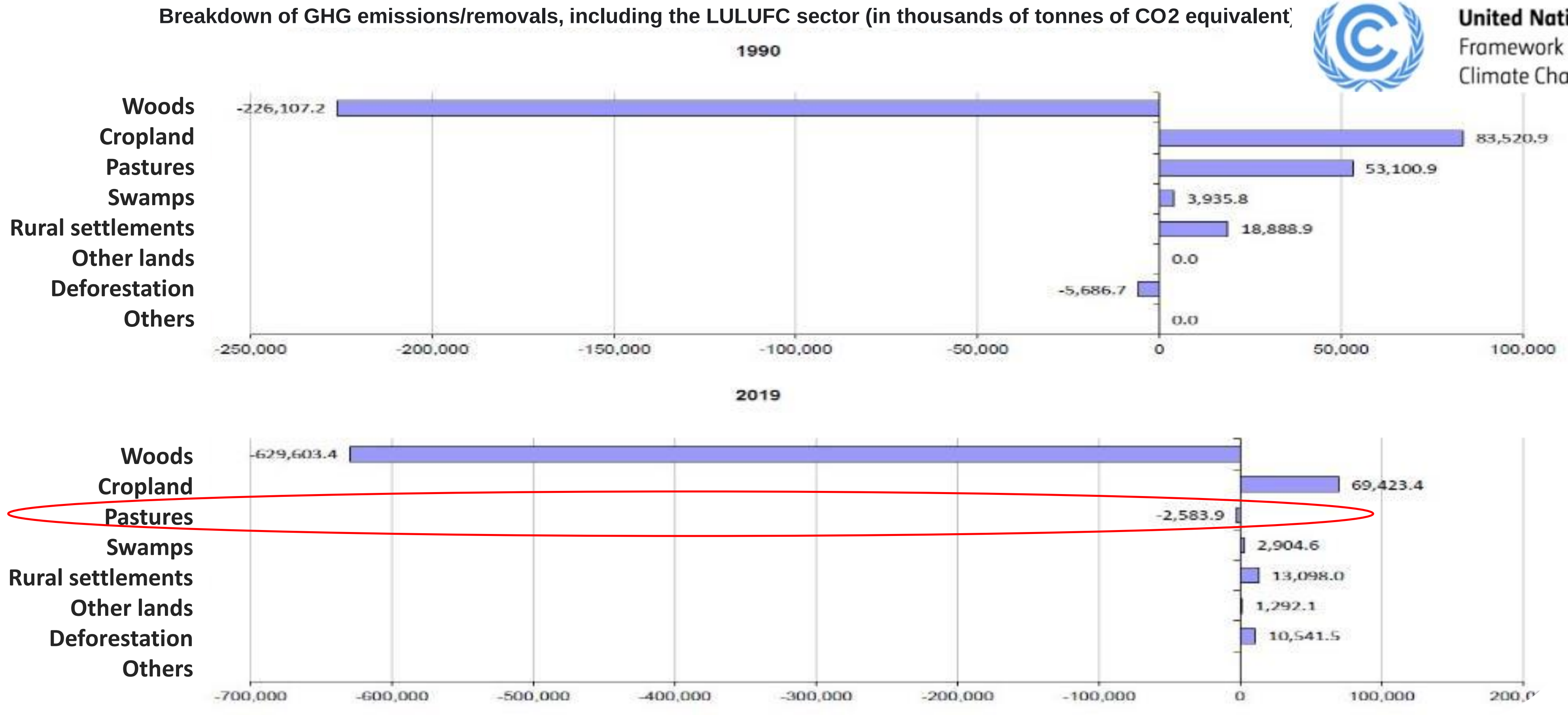
The Convention was adopted on **May 9, 1992**, and opened for signature on June 4, 1992, at the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro, also known by its popular name as the "Earth Summit."

On **June 12, 1992**, 154 countries signed the **UNFCCC**, which, upon ratification, obligated the signatory governments to reduce atmospheric concentrations of greenhouse gases with the aim of "preventing dangerous anthropogenic interference with Earth's climate system."

A "National Communication" is a report submitted by countries that have ratified the United Nations Framework Convention on Climate Change (**UNFCCC**). Developed countries are required to submit national communications every four years, while developing countries may do so less frequently. National Communication Reports encompass a country's efforts to reduce greenhouse gas emissions, as well as a description of its vulnerabilities and the impacts of climate change.

Source: https://en.wikipedia.org/wiki/United_Nations_Framework_Convention_on_Climate_Change

# 2. The influence of agriculture on the carbon footprint

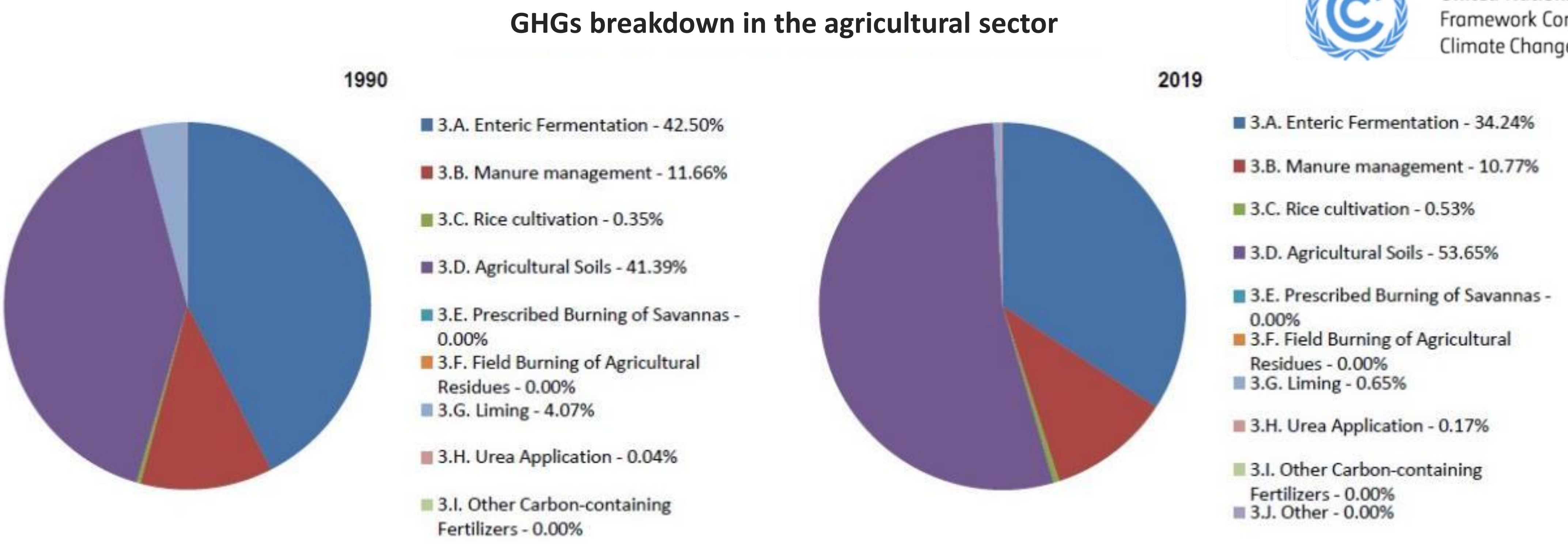



Grasslands and forests exhibit GHG absorption. Interestingly, in 1990, pastures were a source of GHG emissions, due to the intensive cultivation and use of pastures.

Source: https://unfccc.int/files/ghg_emissions_data/application/pdf/rus_ghg_profile.pdf

# 2. The influence of agriculture on the carbon footprint

United Nations Framework Convention on Climate Change

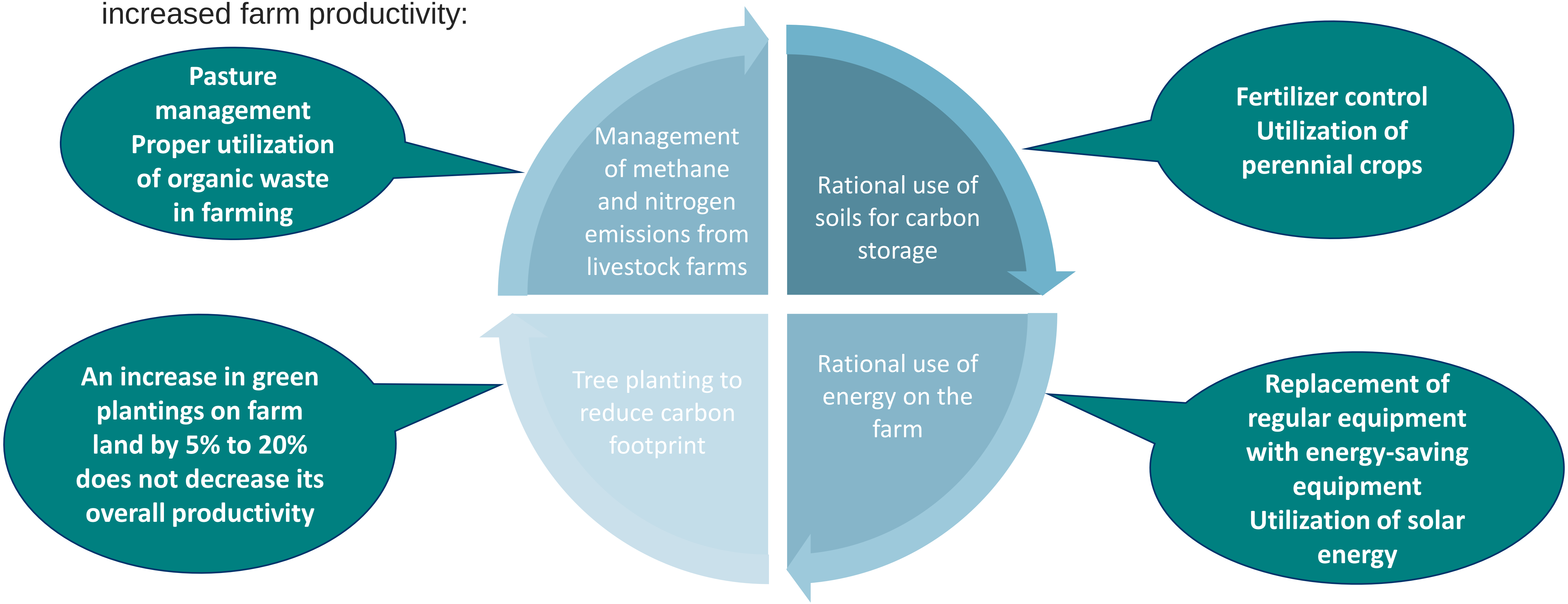



- The majority of emissions, 53.65%, are attributed to soil treatment.
- Following that is enteric fermentation (emissions by animals), namely 34.24%.
- Waste management (manure) accounts for 10.77%.

Source: https://unfccc.int/files/ghg_emissions_data/application/pdf/rus_ghg_profile.pdf

# 2. Actions for reducing emissions in agriculture

There are several practical ways to prevent greenhouse gas emissions that usually coincide with increased farm productivity:



# 3. Pastures and Their Role in the Carbon Balance

## According to the Rosstat data for 2019:

- Pastures constitute 22.3% of the total agricultural land
- 66.2% of these pastures are utilized by farming entities
- Approximately 10% is comprised of fallow land (including areas temporarily designated for hay production and livestock grazing), which can potentially serve as pastures.

3. CROP PRODUCTION

**3.1. FARMING AREA DISTRIBUTION BY AGRICULTURAL CATEGORIES as of January 1, 2019 [1)]**

(in thousands of hectares)

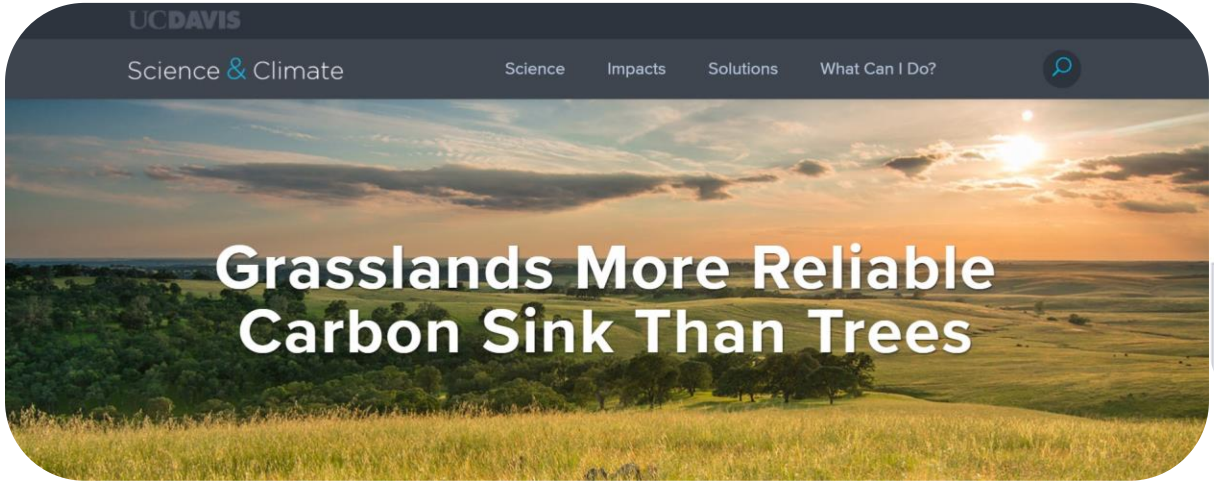
| | Farming entities of all categories | including | | | From households | | | |
|---|---|---|---|---|---|---|---|---|
| | | agricultural organizations | agricultural entities (farms) and individual entrepreneurs | households | personal household plots and other individual households of citizens | non-profit associations of citizens | citizens, owners of land plots | citizens, owners of land shares |
| Agricultural land | 193351[2)] | 114847 | 28637 | 34671 | 8104 | 1866 | 12078 | 12624 |
| including | | | | | | | | |
| Cropland | 115777 | 74348 | 19598 | 21831 | 5625 | 454 | 8865 | 6886 |
| Hayfields | 13936 | 9372 | 1310 | 3254 | 1059 | 75 | 672 | 1447 |
| Pastures | 43172 | 28586 | 7494 | 7092 | 1062 | 269 | 2334 | 3427 |
| Perennial Plantings | 1814 | 375 | 43 | 1396 | 282 | 1063 | 25 | 26 |
| Fallow land | 3456 | 2165 | 192 | 1099 | 76 | 5 | 180 | 838 |
| Average area of agricultural land per organization (farm), ha | … | 1664 | 92 | … | 0.32 | 0,11[3)] | 18 | 7 |

1) According to Rosreestr: lands of users engaged in agricultural production

2) Including lands allocated for temporary use or lease from municipal lands for haying and grazing (15195 thousand ha)

3) Average size of land plots within non-commercial associations

# 3. Pastures and Their Role in the Carbon Balance




- The primary function of pastures in the carbon balance is the sequestration of carbon within the soil.
- With low-intensity pasture management, there's a reduction in carbon and nitrogen discharges that typically result from soil tillage.
- Employing legumes enables effective nitrogen uptake by vegetation and its subsequent storage in the soil.
- The assimilation of carbon and nitrogen derived from animal waste products (manure and urine).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Grassland carbon sequestration and emissions following cultivation in a mixed crop rotation

Bharat Sharma Acharya, Jim Rasmussen, Jørgen Eriksen*

*Department of Agroecology, Aarhus University, PO Box 50, 8830 Tjele, Denmark*

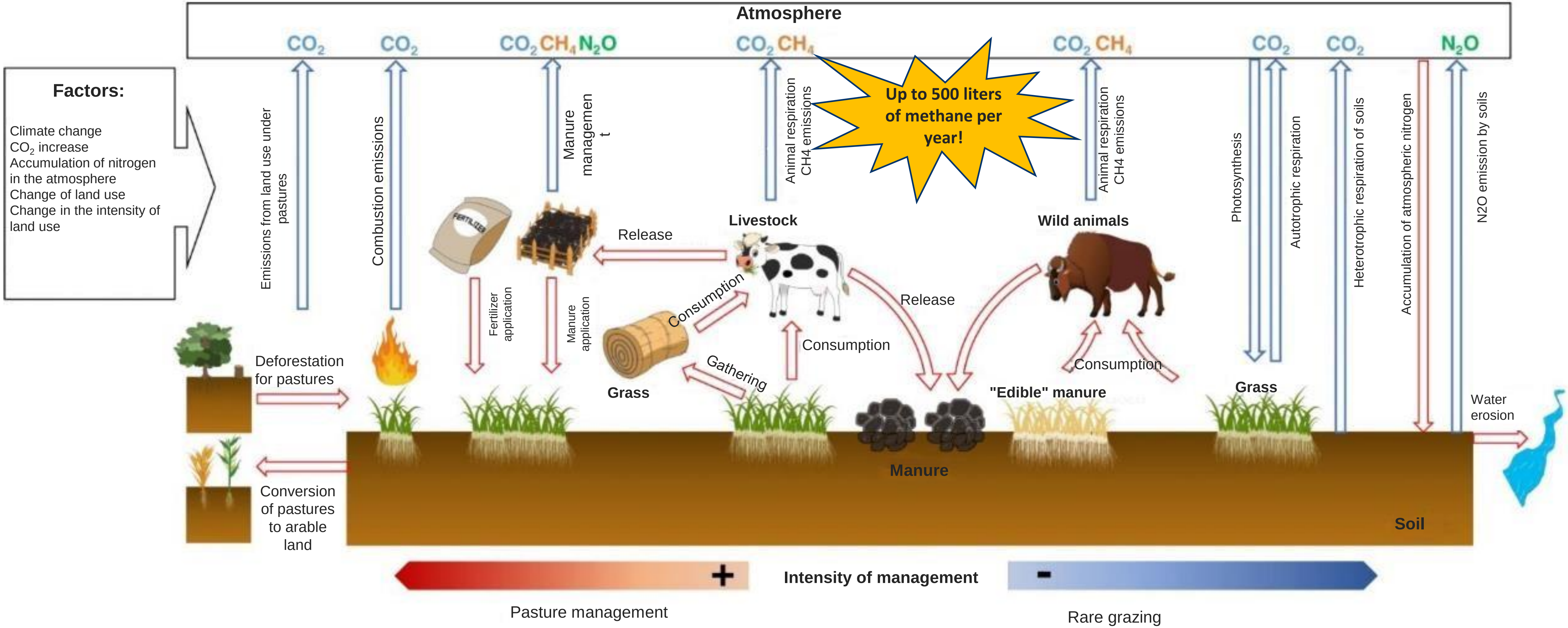
## FAO IN ACTION

*A glimpse of terraces aiding in soil moisture retention and erosion prevention. ©FAO/Giulio Napolitano*

The Three Rivers Sustainable Pasture Management Project in China

The rehabilitation of deteriorated grasslands via sustainable practices enables enhanced carbon sequestration in soils and biomass, augments the soil's water retention ability, and boosts biodiversity in grassland areas. The objective of the Three Rivers Sustainable Pasture Management Project, undertaken in China's Qinghai Province, is to rejuvenate degraded grazing lands and bind carbon in the soil, concurrently enhancing productivity.

# 3. Pastures and Their Role in the Carbon Balance




Source: https://www.nature.com/articles/s41467-020-20406-7

# 3. Pastures and Their Role in the Carbon Balance

Here are some examples of management strategies that influence the carbon levels in the soil of pasture systems:

Soil cultivation / length of grass cycles

- Refrain from soil cultivation that leads to the decomposition of organic substances and carbon loss
- Refrain from transforming pastures into arable land (or alternatively, promote the conversion of arable land into long-term permanent pastures)
- Extend the duration of grass growth (short-term grasslands for up to 4 years)
- Convert grass covers to mixtures of grass and legumes or to permanent grasslands.

Fertilizers / minerals

- Enhance the productivity of pastures that are deficient in nutrients
- Diminish the use of nitrogenous fertilizers on intensively managed pastures
- Implement the process of liming

Grazing methods

- Implement diverse grazing techniques
- Adhere to livestock density norms (headcount/ha): intensive, extensive
- Prevent overgrazing / opt for mild grazing as opposed to intensive grazing

Botanical composition / plant species

- Different carbon binding in different grasses: legumes and cereals

Source: https://ec.europa.eu/eip/agriculture/sites/default/files/fg_grazing_for_carbon_starting_paper_final.pdf

# 4. Pasture-based cattle rearing: advantages and drawbacks.

**Advantages:**

1. Decreased costs for gathering and dispensing feed
2. Prevention of soil erosion due to employment of perennial flora and grasses
3. Diminished costs related to the storage and management of manure
4. Enhanced livestock health due to increased movement
5. Improved milk quality
6. Reduced carbon footprint due to carbon sequestration by forage grasses
7. Regrown grass can be used for forage (haylage, silage or hay)

**Drawbacks:**

1. Ineffective for the management of high milk-producing herds
2. Inability to regulate the consumption of nutrients
3. Increase in labor costs for herd transportation
4. Ineffective for managing herds with a substantial headcount
5. Deficiency of energy and transit protein in the feed
6. Necessity to ensure locations with water sources, supplemental feeding, and protection from unfavorable weather conditions
7. Requirement for extra fencing and barriers for pasture division

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Thank you for your attention!

# Pasture as an Element of Sustainable Farming. Part II.

October 6, 2021.

Moscow

PROAGRO LECTORIUM

# Contents

5. Impact of the pasture-based animal keeping on the quality of animal products.
6. Effective pasture management for optimal production efficiency.
7. PhosAgro's guidelines for enhancing the productivity of pastures.

# 5. Impact of the pasture-based animal keeping on the quality of animal products.

## Grazing versus indoor feeding: effects on milk quality

Elgersma A.[1], Wever A. C.[1] and Nałęcz-Tarwacka T.[2]

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[2]*Warsaw Agricultural University, Animal Sciences Faculty, Animal Breeding & Production Department, 8 Ciszewskiego St., 02-786 Warszawa, Poland.*

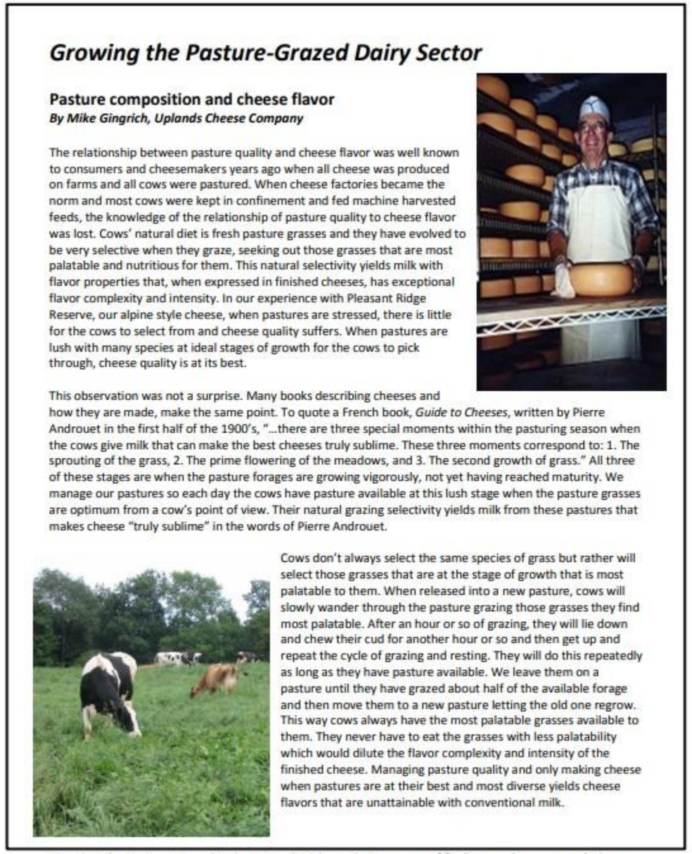
**Abstract**

Changing societal drivers and consumer demands request systems that provide desired products through improved, sustainable production processes.
In this paper dairy product suppy chains were analysed, with emphasis on milk quality in relation to feed. Milk fatty acids were analysed in milk produced in different regions, various seasons, and with different feeding systems and also in forages and concentrates.A rapid screening method for conjugated linoleic acid (CLA) in milk fat was developed. Milk from cows on fresh green forage, especially grazed grass, had a much higher unsaturated:saturated fat proportion with more poly-unsaturated FA (beneficial for heart diseases) and more conjugated linoleic acid (CLA isomer rumenic acid, C18:2 c9,t11, possible anti-cancer effects) than milk from silage-fed cows. The FA composition of milk has recently become less favorable than before, e.g., in the 1960s, due to different feeding practices and nobody is aware because it was never monitored, but essential FA and CLA levels have dropped substantially. With low-fat dairy products, human intake of these is declining even further, as ruminant products are the main source of CLA intake.
Farmers from some dairy cooperatives in The Netherlands that produce milk from grazed grass now receive a premium on top of their milk price, so compared with farmers that keep their cows indoors year-round, these primary producers benefit from the higher market value at the end of the production chain.
Keywords: forage, silage, feeding system, seasonal change, milk fatty acids

- Research conducted by scholars from Wageningen University (Netherlands) and Warsaw Agricultural University (Poland) revealed that milk from cows on grazed grass had a higher content of unsaturated fatty acids and linoleic acid, than milk from silage-fed cows.
- In the Netherlands, dairy cooperatives that produce milk from grazed grass now receive a premium on top of their milk price compared with farmers that keep their cows indoors year-round.

# 5. Impact of the pasture-based animal keeping on the quality of animal products.

- The innate diet of cows consists of fresh pasture grasses. Animals selectively consume those herbs that are most appealing and nutritious to them. This inherent selectivity results in milk with flavors that reflect in the finished cheeses with an exceptional complexity and intensity of flavor.
- Citing from the French book, Guide to Cheeses, written by Pierre Androuet in the first half of 1900s, "...there are three special moments within the pasturing season when the cows give milk that can make the best cheeses truly sublime. These three moments correspond to: 1. The sprouting of the grass, 2. The prime flowering of the meadows. and 3. The second growth of grass."
- The management of pasture quality and cheese production are interconnected, and when pastures are well-maintained with a variety of crops, it results in a cheese flavor that surpasses that of conventional milk.



***Growing the Pasture-Grazed Dairy Sector***

**Pasture composition and cheese flavor**

***By Mike Gingrich, Uplands Cheese Company***

The relationship between pasture quality and cheese flavor was well known to consumers and cheesemakers years ago when all cheese was produced on farms and all cows were pastured. When cheese factories became the norm and most cows were kept in confinement and fed machine harvested feeds, the knowledge of the relationship of pasture quality to cheese flavor was lost. Cows' natural diet is fresh pasture grasses and they have evolved to be very selective when they graze, seeking out those grasses that are most palatable and nutritious for them. This natural selectivity yields milk with flavor properties that, when expressed in finished cheeses, has exceptional flavor complexity and intensity. In our experience with Pleasant Ridge Reserve, our alpine style cheese, when pastures are stressed, there is little for the cows to select from and cheese quality suffers. When pastures are lush with many species at ideal stages of growth for the cows to pick through, cheese quality is at its best.

This observation was not a surprise. Many books describing cheeses and how they are made, make the same point. To quote a French book, *Guide to Cheeses*, written by Pierre Androuet in the first half of the 1900's, "...there are three special moments within the pasturing season when the cows give milk that can make the best cheeses truly sublime. These three moments correspond to: 1. The sprouting of the grass, 2. The prime flowering of the meadows, and 3. The second growth of grass." All three of these stages are when the pasture forages are growing vigorously, not yet having reached maturity. We manage our pastures so each day the cows have pasture available at this lush stage when the pasture grasses are optimum from a cow's point of view. Their natural grazing selectivity yields milk from these pastures that makes cheese "truly sublime" in the words of Pierre Androuet.

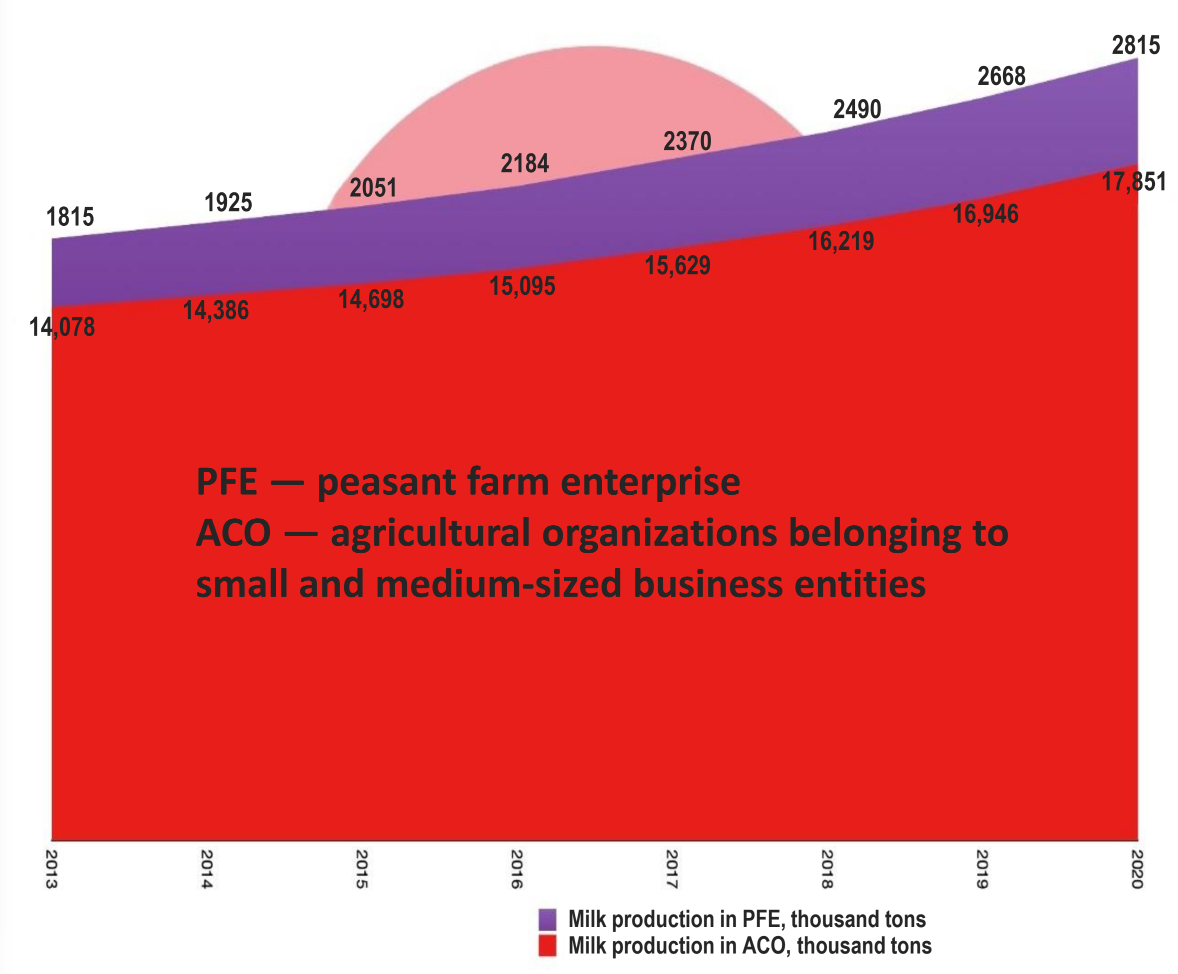
Cows don't always select the same species of grass but rather will select those grasses that are at the stage of growth that is most palatable to them. When released into a new pasture, cows will slowly wander through the pasture grazing those grasses they find most palatable. After an hour or so of grazing, they will lie down and chew their cud for another hour or so and then get up and repeat the cycle of grazing and resting. They will do this repeatedly as long as they have pasture available. We leave them on a pasture until they have grazed about half of the available forage and then move them to a new pasture letting the old one regrow. This way cows always have the most palatable grasses available to them. They never have to eat the grasses with less palatability which would dilute the flavor complexity and intensity of the finished cheese. Managing pasture quality and only making cheese when pastures are at their best and most diverse yields cheese flavors that are unattainable with conventional milk.

***Growing the Pasture-Grazed Dairy Sector in Wisconsin: Summary of findings and recommendations***

*Report author: Laura Paine, WI Department of Agriculture, Trade, and Consumer Protection*

*608-224-5120, laura.paine@wi.gov*

# 5. Impact of the pasture-based animal keeping on the quality of animal products.




Source: https://www.dairynews.ru

An overwhelming majority of consumers presume that all dairy cows are grazed. This poses a hurdle for distinguishing pasture milk, as it necessitates the marketer to initially educate the consumer about conventional dairy farming methods so they can comprehend how pasture milk varies.

When queried about which pasture-raised dairy products they would prefer to have accessible for purchase, consumers replied in accordance with their existing buying habits: milk, butter, yogurt, and artisanal cheeses.

Numerous chefs are on the lookout for handcrafted ingredients to rejuvenate the role of these foods in traditional recipes. Jack conducted experiments with classic French and Italian dishes and discovered that pastured meats and dairy significantly enhance the flavor. These foods accentuate and complement the other flavors in these traditional dishes. In his words, it's a one plus one effect that equals three.

Source: https://foodsci.wisc.edu/

# 6. Effective pasture management for optimal production efficiency

- ✓ Choosing the best-suited crops for pastures
- ✓ Appropriate soil preparation for pastures
- ✓ Correct schedule of fertilizer application (PhosAgro recommendations)
- ✓ Selection of the method for pasture usage
- ✓ Estimation of the livestock count per 1 hectare of pasture
- ✓ Water supply management
- ✓ Management of feed supplements
- ✓ Yearly and regular upkeep of pastures

# 6. Characteristics of grass mixtures

**Based on the method of use, they are classified as:**

- Hay mixtures
- Pasture mixtures
- Combined hay and pasture grass mixtures

**Based on the duration of use, they are classified as:**

- Short-term (for 2–3 years)
- Medium-term (for 4–6 years)
- Long-term (for 7–10 years or more) mixtures

Short-term grass mixtures are utilized in both crop rotation systems and on non-rotation plots with occasional reseeding. Medium-term mixtures are utilized for feed and hay, as well as pasture rotations. Long-term mixtures are exclusively sown on non-rotation areas with soils susceptible to water and wind erosion.

- **In terms of species composition, a distinction is made:**
- Cereals
- Cereals and legumes
- Cereals and grasses
- Cereals, legumes and grasses
- Herbaceous grass mixtures.

The most common are cereals and legumes mixtures.

# 6. Characteristics of grass mixtures

**Types of grass mixtures.**
Grass mixtures sown on cultivated hayfields and pastures vary in terms of complexity, method of use, duration of use, and species makeup.

**Based on complexity, grass mixtures are classified as:**
Simple (comprising 2–3 types of grasses)
Semi-complex (comprising 4–6 species)
Complex (comprising more than 6 types of grasses)

Comparative studies on pasture grass mixtures have demonstrated that the most productive and mineral-rich are simple grass mixtures, composed of <u>one legume and two to three cereal components, or two legumes and one cereal</u>. For long-term usage, the component composition is expanded to 5–6 species, incorporating short-term and medium-term legumes and loose-leaved cereals, along with long-term rhizomatous cereals in the grass mixture.

In the context of pasture utilization, low-stemmed plants, known for their high pasture resilience and robust regrowth after grazing, are included alongside upland plants.

# 6. Choosing the best-suited crops for pasture

**Perennial grasses**
- Timothy
- Fescue
- Ryegrass
- Brome grass
- Cock's-foot
- Wheatgrass, etc.

Perennial grasses have a well-developed coarse root system, which is located mainly in the upper soil layer, at a depth of up to 20 cm.

| Herb name | Contents | | | |
|---|---|---|---|---|
| | Crude protein, % | Nitrogen-free extract, % | Crude fiber, % | Crude fat, % |
| Meadow fescue | 9.3 | 49.5 | 29.6 | 3.1 |
| Timothy | 9.0 | 44.7 | 31.1 | 2.2 |
| Awnless brome grass | 10.5 | 48.4 | 30.4 | 2.8 |
| Tall ryegrass | 8.0 | 50.0 | 31.0 | 2.8 |
| Wheatgrass | 11.9 | 47.8 | 28.9 | 3.3 |
| Slender wheatgrass | 8.7 | 45.2 | 25.9 | 4.4 |

**Perennial leguminous grasses**
- Clover
- Alfalfa
- Deer vetch
- Sainfoin, etc.

The root system is characterized by a primary taproot and side roots that branch off from it.

A key characteristic of legumes is the nodules with bacteria that aid the plant in absorbing atmospheric nitrogen.

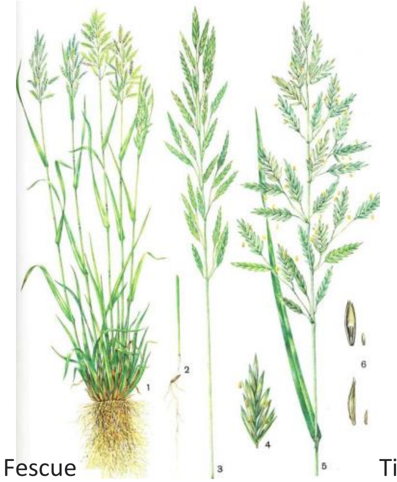
Leguminous plants are rich in protein. In the hay of leguminous grasses, the digestible protein content is 5%–6%, but it can sometimes reach up to 10%, especially prior to flowering.

The palatability of leguminous plants is also attributed to the fact that many of them have an extended flowering period. Legumes frequently bloom and bear fruit incessantly throughout the summer, and even post-flowering and fruiting, they tend to be less rough and are more eagerly consumed than cereals during these stages. The feeding duration for legumes is 1.5–2 times longer than that of cereals, a factor that is particularly significant for pasture utilization.

# 6. Choosing the best-suited crops for pasture

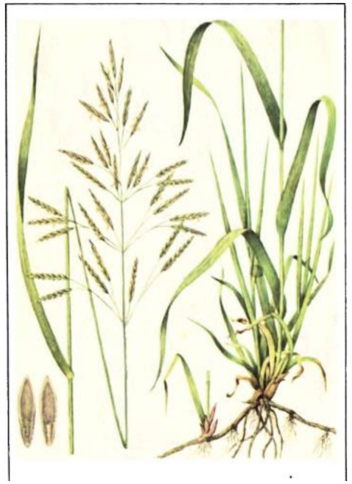
## Perennial grasses

Cock's-foot



Fescue

Timothy



Brome grass

Slender wheatgrass

Ryegrass

## Perennial leguminous grasses

Clover

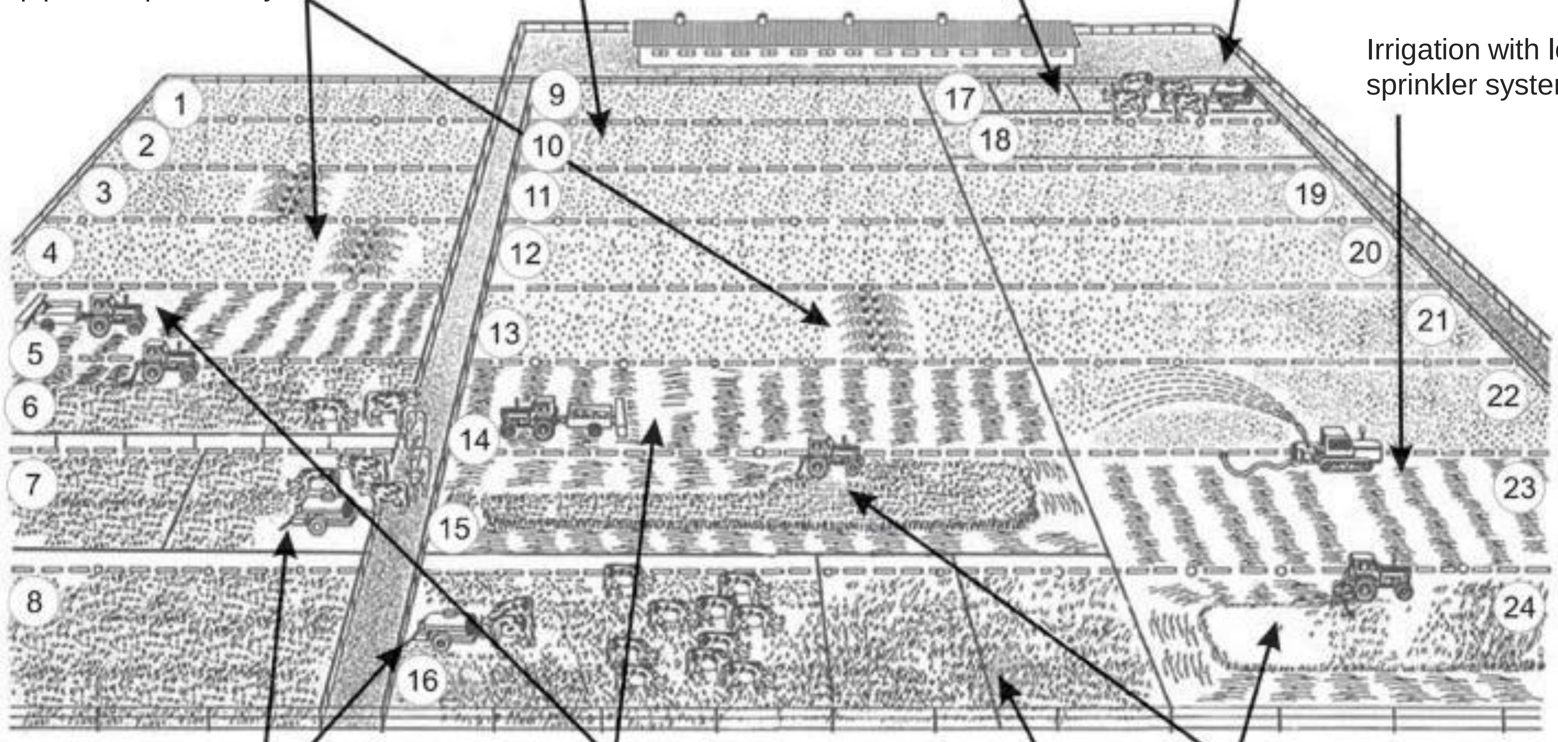
Alfalfa

Deer vetch

Sweet clover

Sainfoin

# 6. Choice of pasture utilization method




**1–24: paddock numbers** **Paddock boundaries** **Electric fence** **Movable water line hydrants**

Source: agroinfo.kz

# 6. Choice of pasture utilization method

The **approach to pasture usage** can be unsystematic (free-range grazing) or systematic (tethered or enclosed grazing).

- With unsystematic grazing, the pasture lacks a respite from grazing. This type of grazing leads to substantial forage losses due to trampling and severe contamination of the grass by feces and urine. Care for the grass stand is greatly limited as cattle selectively consume the most nutritious plants. All these factors render the mowing of surplus forage grasses unfeasible, resulting in low productivity of such pastures.
- The benefit of systematic grazing lies in the fact that a brief period of cattle occupancy in one paddock (section) of pasture is followed by a pause in its use, during which plant care is conducted and regrowth occurs. The greater the number of paddocks, the shorter the duration of cattle occupancy in a single paddock, and consequently, the longer the rest period from grazing.
- With systematic grazing, the pasture experiences less pollution, losses from trampling are minimized, uneaten remnants are mowed and subsequently utilized for fodder. Furthermore, the opportunity for selective consumption of pasture plants is restricted or eliminated. As a result, systematic grazing ensures the maximum possible productivity of pastures.
- Having animals remain in the same paddock for over six days equates to free-range grazing, as the grass consumed by the animals on the first day manages to regrow to such an extent that it can be grazed on again. This leads to a decrease in pasture productivity when compared to well-structured paddock grazing.

# 6. Estimation of the number of animals per 1 ha of pasture

| Species of farm animal | Load based on the number of animals per 1 ha of cultivated pastures, headcount per year* |
|---|---|
| Calves being fattened | 5.0 |
| Other cattle less than one year old | 5.0 |
| Bulls from one to two years old | 3.3 |
| Cows and heifers from one to two years old | 3.3 |
| Bulls over two years old | 2.0 |
| Breeding heifers | 2.5 |
| Heifers being fattened | 2.5 |
| Dairy cows | 2.0 |
| Culled dairy cows | 2.0 |
| Other cows | 2.5 |

Source: GOST R 56508-2015 ORGANIC PRODUCTION. Appendix D

The **pasture capacity** refers to the number of animals that one ha of pasture can sustain during the grazing period. It is calculated using the formula:

**E=(U*K)/(B*P)**, where

**E** is pasture capacity, head/ha;
**U** is yield of pasture green mass, deciton/ha;
**K** is grass consumption coefficient , %;
**V** is daily need in green mass for one head of cattle, kg;
**P** is duration of pasture period, days.

Grass consumption coefficient on pasture is determined by the mowing method, which involves weighing the uneaten residues from a 10 m2 area. After the cattle have grazed, the remaining grass stand is trimmed to a height of 5 cm (uneaten remnants). By knowing the previously determined yield of the pasture (t/ha) and identifying the quantity of uneaten remnants (t/ha), it is easy to calculate the percentage (completeness) of grass consumption.

# 6. Pasture grazing technique

A **GRAZING CYCLE** refers to the time span during which the grass cover of a pasture is grazed down to a level that doesn't fully meet the animals' requirements for green fodder.

The order of grazing.

Initially, it's recommended to graze those sections where the grass has grown the most. With regular grazing, plants primarily lose their leaves, leading to a significant reduction in the speed of nutrient reserve accumulation in subterranean parts. Consequently, the grass enters the winter season without the necessary nutrient reserves. However, when grazing is infrequent, the vegetation becomes overgrown and coarse, resulting in it being poorly consumed by livestock, and thus, the pasture's grass stand isn't fully utilized.

With low grazing (3–4 cm), the productivity of pastures decreases in the following years, while at high grazing (10–15 cm), a significant portion of the grass stand remains unused. Given the biology of grasses and the impact of various climatic conditions, it's advised to graze grass stand on pastures down to no less than 5–6 cm.

After mowing or grazing, plants replenish their above-ground mass. This characteristic of grasses, attributed to their biological traits, is referred to as regrowth capability. Grass stand **regrowth capability** is of great importance when managing the use of pasture lands.

The calendar start dates for grazing pastures vary across different zones. These dates can also vary considerably within the same zone, depending on the year's meteorological conditions and the type of grass stand. Typically, spring grazing should commence 12–20 days after the start of grass regrowth, aligning with the tillering/branching phase of most species when the plants reach a height of 12–15 cm.

# 6. Management of Watering

**Management of animal watering**

Efficient organization of watering is a key factor for achieving high productivity in animals during the summer. In the spring and fall, each cow consumes 45–50 liters of water, in the summer this increases to 60–70 liters, and on hot days, the water requirement can surge to up to 100 liters. Young cattle need 30–50 liters of water per animal daily.

The optimal sources for watering are storage tanks that supply water to the watering troughs. Decking or another solid surface is installed at the troughs to ensure easy access.

The estimated length of troughs with a two-way approach is 20–30 centimeters per animal.

When setting up watering from ponds and lakes, it's essential to install water lifting equipment that supplies water to storage tanks and troughs. In the absence of water sources on the pasture, it's necessary to arrange for water transportation based on the animals' daily needs.

It's prohibited to force cattle to drink by driving them into swamps, lakes, and ponds, as this can lead to diseases of the digestive tract, limbs, udders, and can infect the animals with diseases.

To prevent excessive cattle movement, it's essential to establish watering points for all animal groups, not only within the campgrounds but also in the grazing areas.

# 6. Management of Feed Supplements

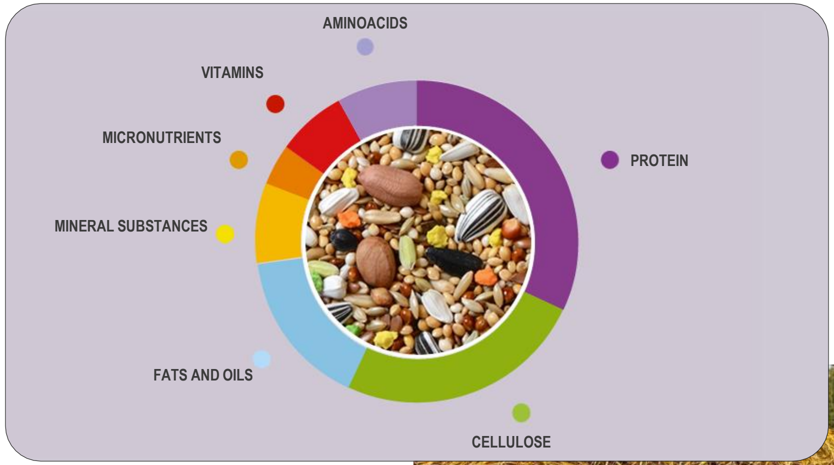
**Management of feed supplements**

1. With proper pasture management, cows yield an equal or slightly higher amount of milk compared to those fed indoors.
2. The consumption of dry matter from feed on pastures and when fed indoors shows minimal variation.
3. Dairy cows grazing in pastures consume feed that is more digestible.
4. When feeding green mass, it's crucial to ensure cows are provided with easily digestible carbohydrates, raw fiber, and crude fat.
5. Pasture feed doesn't fully supply high-yielding animals with energy, phosphorus, and micronutrients, as well as fiber at certain growth and development stages of plants.

Pasture grass stand typically contains more protein and less exchangeable energy than what cows require according to their diet. When nitrogen fertilizers are introduced, the protein to energy ratio in the grass stand worsens even further. Therefore, the cow should be fed silage, haylage, mixed fodder, molasses during the pasture period.

**The main types of feed supplements:**

- Concentrated feed (grain, oilcakes, meal, mixed fodder)
- Vitamin and mineral premixes
- Salt licks
- Hay, haylage, silage
- By-products of the food industry




# 6. Annual Care for Pastures

The annual care involves:

1. Taking inventory of pastures after the snow has melted
2. Reseeding of grass
3. Applying nitrogen, phosphorus, and potassium fertilizers
4. Performing harrowing
5. Initiating the first grazing during the tillering phase
6. Mowing uneaten grass remnants, applying nitrogen fertilizers, spreading excreta, and conducting irrigation if needed
7. Cutting overgrown grass for haylage, green feed, hay, silage, etc.
8. Final grazing
9. Application of phosphorus-potassium fertilizer (excluding spring application)
10. Soil slotting if necessary

# 6. Ongoing Pasture Care

**Mowing.**

Mowing is an efficient method for eradicating weeds and uneaten grass on pastures, contributing to the maintenance of a healthy grass stand composition. Typically, cattle avoid consuming overgrown grass, harmful plants, or plants situated in areas contaminated with animal manure. Uneaten remnants are mowed at a height of 5–6 cm with a hay mower following grazing. Cut grass is usually left in place as it quickly withers and does not adversely affect the grass stand. If there is a significant amount of uneaten remnants, they are removed.

**Spreading.**

This technique guarantees a uniform grass stand. Manure should be uniformly distributed across the entire pasture, ideally after each cycle of grass mowing, as vegetation often dies where manure lands, and thick grass that cattle do not consume grows nearby. For this, special drags and harrows are utilized.

# 7. PhosAgro's recommendations for enhancing pasture productivity: Treatment

When establishing seeded irrigated pastures using the accelerated grassing* method, a combined soil treatment is recommended: disking (or milling) of the turf, followed by plowing with subsequent layer cutting using heavy disk harrows, surface leveling, and rolling for grass sowing. A 2–3 week interval should be maintained between turf disking and the subsequent plowing, which stimulates the regrowth of wild grasses and ensures their more thorough eradication.

On newly reclaimed lands, it's advisable to perform treatment with a heavy mulcher before deploying plows or heavy disks:

- For tussock meadows and light shrub coverage, for instance, a trailed rotary mower-mulcher can be used;
- For tussock meadows and medium shrub coverage, mulchers with horizontally rotating shafts equipped with V-shaped blades are needed;
- For bringing into operation fallow lands with shrub coverage and with a tree coverage of up to 8 cm thick, the use of a heavy cutter is recommended.

After grazing, livestock manure is spread using harrows or special meadow rollers (if creeping clover is present).

*Grassing refers to the overgrowth of land plots with herbaceous vegetation

# 7. PhosAgro Recommendations: Nitrogen Fertilizers

Nitrogen supplements are applied in the spring and after each grazing cycle when the share of legume grasses in the grass stand is less than 30% (*more than a month should remain before the start of grazing*).

When applying supplements after grazing, account for the nitrogen contribution to the soil from animal manure.

Nitrogen fertilizer forms for pasture fertilization:

- **NITRIVA ammonium nitrate**
- **NITRIVA urea**: except for slightly alkaline soils (due to gaseous losses of nitrogen as ammonia)
- **Ammonium sulphate:** required with sulphur deficiency in soil (sulphur dose = 20 kg S/ha/year)

# 7. PhosAgro recommendations: APAVIVA NPK(S) 08:20:30 (2) is an ideal brand of complex phosphorus-containing fertilizer for pastures

The minimal nitrogen content allows this brand to be utilized across all types of grass stands (regardless of the proportion of leguminous grasses).

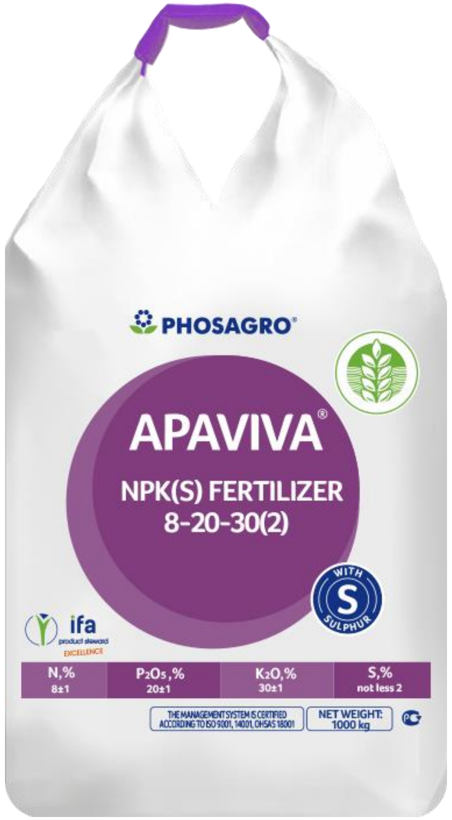
The ratio of phosphorus to potassium aligns with the requirements of most grass stands.

The inclusion of sulfate sulfur enables a partial adjustment of the plants' mineral nutrition in cases of insufficient soil sulfur supply.

Universal application timelines:

- Spring *(grazing after 3 weeks or following rainfall/irrigation);*
- Fall *(during the primary soil treatment when establishing pastures, after the final grazing).*

When calculating the doses of phosphorus and potassium, account for their contribution to the soil from animal manure.




The brand containing boron is recommended for soils with an insufficient supply of boron.
Leguminous grasses are sensitive to boron deficiency.

PROAGRO LECTORIUM

# Thank you for your attention!