Food and Agriculture Organization of the United Nations

FAO Global Forum for
Animal Feed and Feed Regulators
14–15 November 2023

Environmental sustainability and use of natural resources in feed production

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Agroscope

Good food, healthy environment

Future orientation of agricultural policy

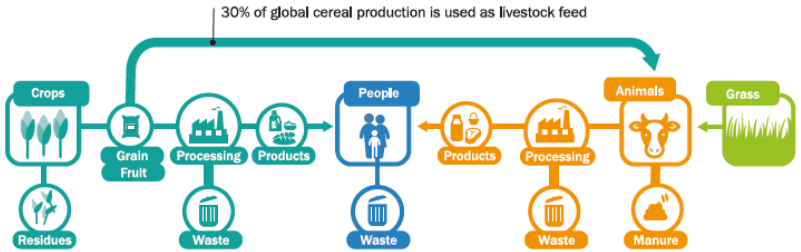
In Switzerland like in Europe we have a large diversity in livestock farming systems **LFS**

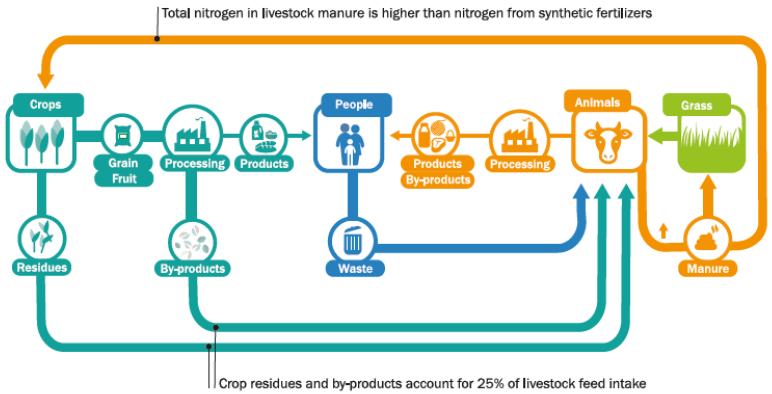
This is associated to agricultural area and permanent grasslands:

≠ livestock species, farm management and products

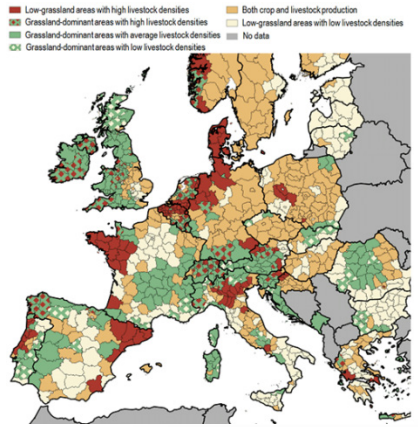
≠ impacts of and services and production provided by **LFS**

In any scenarios, we need move from a **linear production model** to a **circular production model**





Ty Beal et. al 2023 Friend or foe? The role of animal-source foods in healthy and environmentally sustainable diets



Vision 2050 by Swiss Federal Council

Berne, le 22 juin 2022

Orientation future de la politique agricole

Rapport du Conseil fédéral
en réponse aux postulats 20.3931 de la CER-E du 20 août 2020 et 21.3015 de la CER-N du 2 février 2021

Production végétale

1. Les **terres arables** sont réservées en priorité aux cultures destinées à l'alimentation humaine directe. D'autres utilisations sont possibles si elles sont nécessaires pour la santé des plantes et la fertilité des sols dans le cadre de la rotation des cultures, ou pour promouvoir la biodiversité.

Production animale

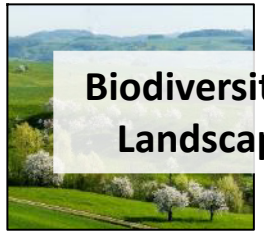
1. L'**élevage de ruminants** est basé en principe sur l'exploitation de pâturages permanents et sur la valorisation de sous-produits de la production alimentaire.
2. La **production de perfectionnement** se fait avec des fourrages issus d'une production durable et sur la base de sous-produits issus de la production de denrées alimentaires.

Prestations d'intérêt général et écologie

1. Les **sols agricoles** de la Suisse sont préservés dans leur étendue actuelle et exploités avec une intensité adaptée aux conditions locales.[135] Il n'y a pas de recul net des surfaces d'assolement par rapport à 2020.[136]
2. Près d'un sixième de la surface agricole utile est exploité comme **surfaces de promotion de la biodiversité** de haute qualité biologique et reliées entre elles.[137]

Environmental Targets for Swiss Agriculture

Indicators



(BAFU und BLW, 2008, 2016)

Targets 2008

Preserve and promote
- biodiversity (species, habitats, functions)
- regional typical landscape scenery
- adequate watercourse corridors

Reduce
- GHG emissions *(-0.6% yr^{-1})*
- nitrogenous pollutants (*max. 25 000 t N yr^{-1})*
- diesel soot *(max. 20 t yr^{-1})*

Mitigate
- nitrate in waters for drinking water *(max. 25 mg N l^{-1})*
- nitrate losses from agriculture *(-50% against 1985)*
- phosphorous losses *(> 4 mg O_2 l^{-1} lake water)*
- impairments by pesticides
- Impairments by medications

Prevent
- contaminants in soils *(problem Zn & Cu accumulation)*
- erosion *(max. 2 or 4 t ha^{-1})*
- soil compaction

Status 2016

- First positive results visible (*agricultural biodiversity priority areas*), but ongoing negative impacts on species and habitats
- Reduction of air pollution in progress – targets not yet reached
- Reduction of water pollution in progress – targets not yet reached
- Reduction of soil preservation in progress – targets not yet reached

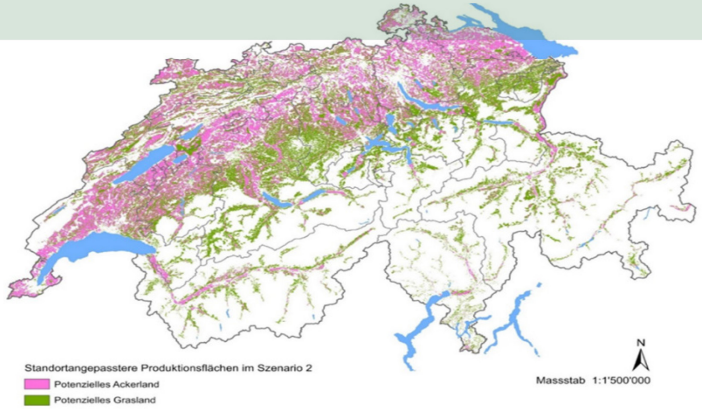
Based on the presentation of Kay Sonja (Agroscope)

Side-adapted arable and livestock production

What does it mean side-adapted production in Switzerland?

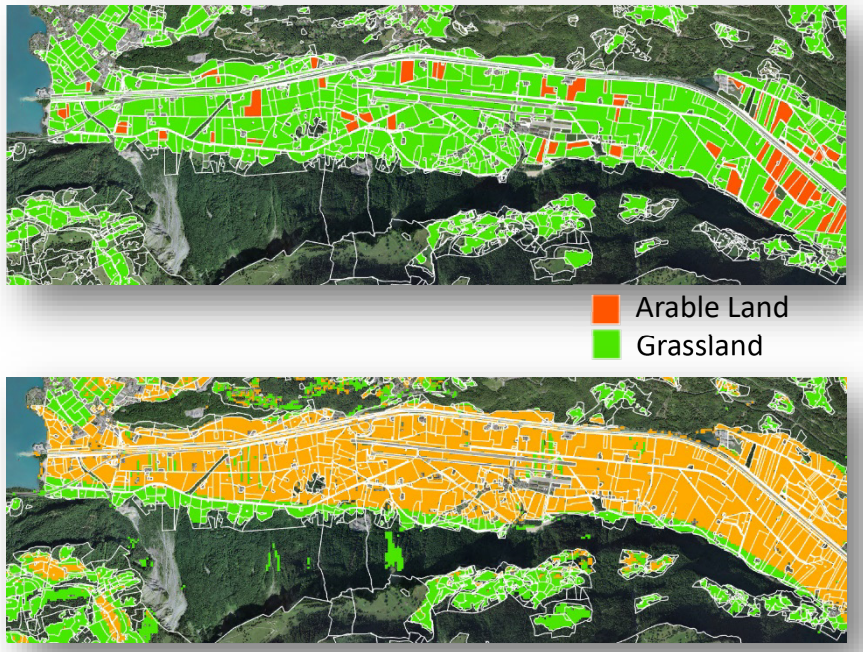
Site-adapted and resource-efficient agriculture uses the **site-specific agronomic, economic and ecological potentials** for food production **within the carrying capacity of ecosystems.** The Swiss environmental targets aim to ensure the preservation of ecosystems following the two main paths:

- **Cropland is primarily used for food production (food no feed)**
- **Ruminants feed primarily on grasslands**



What are the benefits?

- Ensure long-term, resilient, and sustainable production (→ agronomic)
- Preserve ecosystems and their services (→ environmental)
- Stabilize cross-sectoral economic (society) and business (farm) benefits (→ economic)



Which are the major challenges for the implementation?

- Knowledge gaps on site-specific impacts and their natural interrelationships
- Unawareness of environmental costs (→ Internalization of external costs)

- Existing structures and dependencies, i.e. machinery, barn sizes, loans,…
- Fixed market structures and one-sided argumentation in favor of higher production

Based on the presentation of Kay Sonja (Agroscope)

Grass-based milk and meat production (GMM)

Benefits of grass-based diets in ruminant production through ruminal fermentations **:**

Contributes to human food security

70% grassland of the agricultural land + 0.5 mio ha alpine grassland
Ruminants utilize herbage efficiently in contrast to humans or monogastric animals
Reduction of the competition of resources (feed/food – and land)
Production of high-quality food – milk AND meat.

Herbage as a natural total mixed-ration (energy, protein, minerals – except sodium)

Reduces the dependency on imported high-protein feeds

Milk and meat with potential nutritional benefits (e.g. high quality protein and fatty acid profile)

The cheapest feed especially when grazed

GMM (CH-subsidies) program introduced 1st January 2014 in Switzerland:

The aim of the program

- Maintain ruminant production adapted to local conditions, herbage-based and with reduced concentrate use
- Adapted to local conditions means: production site adapted forage/feed production and adapted animals to these feeds

GMM requirements regarding the annual ration:

Maximum 10 % concentrates
Lowland: 75 % herbage (fresh, ensiled or dried)
Mountain area: 85 % herbage

Key figures

2021: 112 million Fr./€ were used (200.- Fr./€ per ha grassland, 80 % grassland area)

Grass-based milk and meat production (GMM+)

Reorientation of the GMM → GMM+

GMM program evaluation (Mack et al., 2017)

- No significant effect on closing the **nitrogen** and the **phosphorus** cycles on farms
- "Deadweight" losses
- Difficulties to control compliance with the program requirements

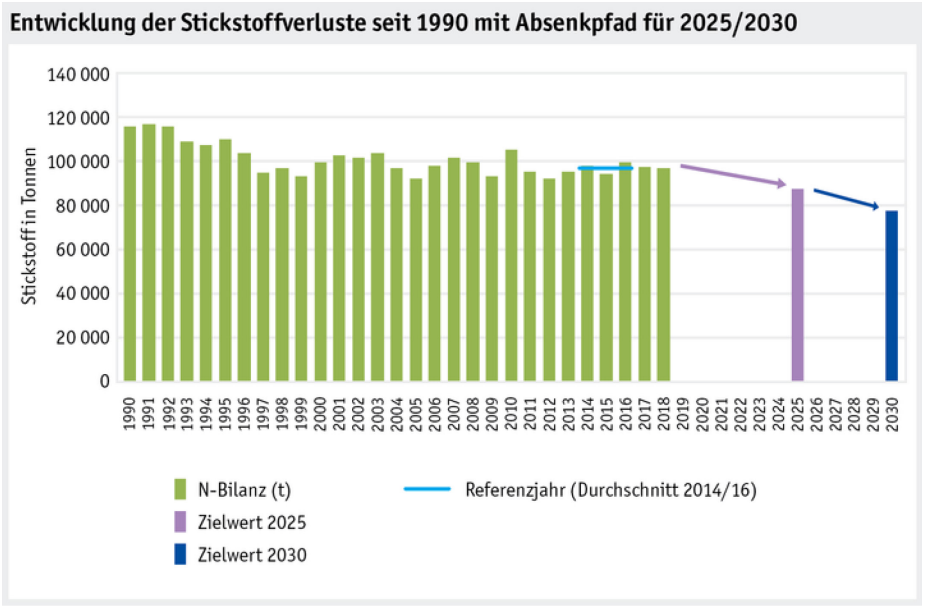
Additional goal for GMM+

Contribution to the reduction of nitrogen surpluses (nitrogen lowering path)

Studied approaches from the Federal Office of Agriculture for GMM+:

1. Maximum crude protein content of concentrates for ruminants
   (Schori, 2020; Schori, 2022; Bystricky et al., 2023)
   Opposition from the dairy sector
2. Limiting the amount of crude protein from purchased concentrates per marketed milk (g/kg)

- Range 0 to 74 g crude protein per kg milk
  (median 17.8 g/kg, estimation based on 240 farm records)
- Estimated average saving potential around 10 %
  (Ineichen et al., unpublished data)



Quelle: Agroscope/BLW

The importance of permanent grasslands

- Use of non arable land for food production (food security)[1) 2)]
- Grassland-based ruminant production (recycling, animal health, input reduction) [3)]
- Living countryside in less favourable regions (social values) [4)]
- Biodiversity [5) 6)]
- Landscape aesthetic and recreation (cultural values) [7) 8)]
- Erosion prevention, carbon stocks and other regulating ecosystem services (synergies) [6)]


Foto: Valentin Klaus, Agroscope

1) Van Zanten et al., 2016, Int J Life Cycle Assess

2) Bengtsson et al., 2019, Ecosphere

3) Van den Pol et al., 2018, Grassland Sci Europe

4) Dumont et al., 2016, INRA

5) Huguenin-Elie et al., 2018, Burleigh Dodds

6) Schils et al, 2022, Agric Ecosyst Environ

7) Pellaton et al., 2022, Ambio

8) Tindale et al., 2023, Land Use Policy

The value of grass/legume leys in crops rotations

Livestock / Mixed sys.

- Quality forage[5)]
- Protein self-sufficiency[5)]
- Benefits of species mixtures[6)]

All cropping systems

- Soil carbon stocks[1)]
- Soil structure[2)]
- N input substitution[3)]
- Weed suppression[4)]

Arable systems

- Flowers for pollinators[7)]
- Yield follow-on crop[3)]
- Biogas[8)]

[1)] Guillaume et al., 2022. Geoderma
[2)] Guest et al., 2022. Science of the Total Environment
[3)] Fox et al., 2020. Plant and Soil
[4)] Dominschek et al., 2021. Journal of Cleaner Production
[5)] Lüscher et al., 2014. Grass and Forage Science
[6)] Suter et al., 2021. Scientific Reports
[7)] Cong et al., 2020. Agriculture, Ecosystems & Environment
[8)] Cong et al., 2018. Biomass and Bioenergy

The value of grass/legume leys in crops rotations

Agroecological principle Wezel et al. (2020)	Benefit of grass/legume leys	Reference
Input reduction	Symbiotic N_2 fixation ⇨ less fertiliser, higher yield Symbiotic N_2 fixation ⇨ less N_2O emissions Weed suppression ⇨ less herbicides High forage quality ⇨ less concentrates	Nyfeler *et al.* (2009; 2011) Fuchs *et al.* (2018) Connolly *et al.* (2018) Sturlodottir *et al.* (2014)
Soil health	Soil structure, microbial diversity Soil organic matter, carbon sequestration Soil fertility ⇨ higher yield of follow-on crop	Hoeffner *et al.* (2021) Guillaume *et al.* (2022) Fox *et al.* (2020)
Animal health	Reduced gastro-intestinal parasite load Mixed diet, high quality forage	Malisch *et al.* (2015; 2017) Mueller-Harvey *et al*. (2019) Lüscher *et al*. (2014)
Biodiversity	Multispecies mixtures ⇨ ecotypes, genetic diversity Functional diversity Incread multifunctionality	Suter *et al.* (2015) Finn *et al.* (2013) Suter *et al*. (2021)
Synergies	Symbiotic N_2 fixation ⇨ less fertiliser Resource use efficiency ⇨ less energy, fertiliser Complementarity ⇨ increased resistance, resilience (e.g. to drought stress, climate change)	Nyfeler *et al.* (2011) Suter *et al.* (2021) Haughey *et al.* (2018) Lüscher *et al.* (2022)

Integrated productions in Switzerland (Agroforestry)

Agroforestry can enhance **ecosystem services** and be a promising solution for **Climate change <u>adaptation</u>** and **<u>mitigation</u>**. Indeed, in agricultural systems trees can:

- provide additional **fodder** resources of high nutritional value[1]
- diversity production: **fruits, wood, mushrooms**, etc.
- be more resistant and resilient to increasing **drought periods**[2]
- reduce wind and provide shade for livestock to **reduce** their **thermic stress**[3]
- improve **soil carbon storage**[4]
- increase **resource-use efficiency** (nutrient –N, P, K- and water retention)
- increase ecological niches and thus **plant and animal diversity**[5]

1) Novak et al., 2022, Fourrages

2) Brunner et al., 2015, Frontiers in Plant Science

3) Veissier et al. 2018, International Journal of biometereology

4) Pardon et al., 2017, Agriculture, Ecosystems and Environment

5) Torralba et al. 2016, Agriculture, Ecosystems and Environment

Alternative sources of animal feed (by products and Former Foods)

The Paradox

In the European Union

- **32.6 million** people suffer from food insecurity
- **59 million tons** of food are wasted yearly
- **15% of food** produced is lost before being sold

Circular Food Production

The Potential

Replace cereal with former food products in livestock production

Reduce losses of nutrient resources and lower food-feed competition

The Challenges

- Make it **cost effective**
- Clarify the **highest inclusion level** possible.
- **Lyfe Cycle Assessment** needed
- **Safety** needs to be further investigated

The Science

Former food products **replace**

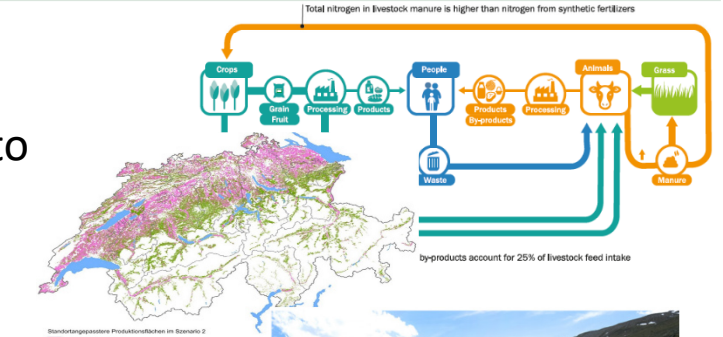
- 30% of cereals in pigs' feed
- 50% of cereals in concentrates for dairy cows.

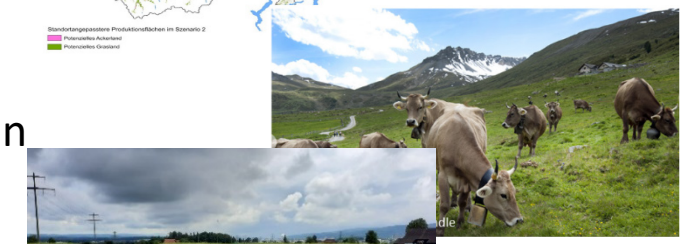
had

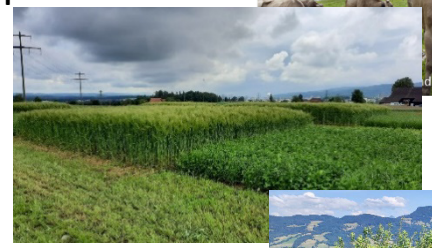
- no negative effect on **performance**
- no negative on **animal health**

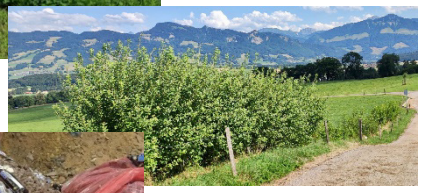
Conclusions and outlooked

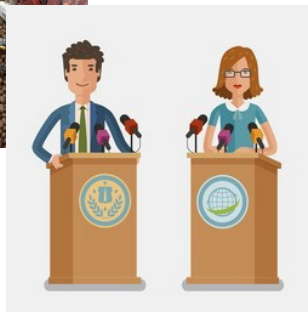
- In Switzerland as in the rest of the world, we need move from a **linear production model** to a **circular production model**
- We must be able to adapt the livestock farming system to **Side-adapted arable and livestock** production
  (Switzerland is a pioneer in this and can be a European and Global model)
- **Animal productions** play and will play an essential role in food supply by closing production cycles
- **Permanent grasslands** will continue to be an essential source of protein and energy that only ruminants will be able to exploit
- **Temporary grasslands** productions will be an essential element in arable lands though crops rotations, promoting biodiversity, ecosystem services, limiting erosion, promoting C sequestration
- **Agroforestry** can enhance **ecosystem services** and be a promising solution for **Climate change** adaptation and mitigation
- **Alternative sources** of feed, such as by-products and former foods, will reduce and revalorizing food waste
- **Policy makers must support and encourage** these integrated and sustainable production models











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Thank you

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