Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Federal Department of Economic Affairs,
Education and Research EAER

Agroscope

Current Research Topics at Agroscope for sustainability in animal nutrition

Joël Bérard

Agroscope, Switzerland

Priorities and Challenges for the livestock sector

European Green Deal: carbon neutrality by 2050

Farm to Fork strategy: specific goals for agriculture up to 2030

*"development of **sustainable and competitive food systems** with **neutral environmental impact**, which help to **mitigate climate change** and **ensure food security, quality and affordability**, and a **sustainable livelihood for primary producers**"*

Priorities

1. **Maximize the resource use efficiency**
2. **Improve animal health and welfare**
3. **Reduce the food/feed competition**
4. **Reduce emissions and losses**
5. **Promote circularity of agro-ecosystems**
6. **Enhance the positive externalities**

Future orientation of agricultural policy

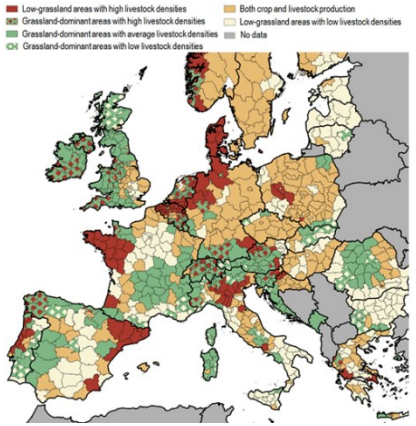
In Switzerland, like in the of the world, we have a large diversity in livestock farming systems **LFS**

This is associated to arable 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**

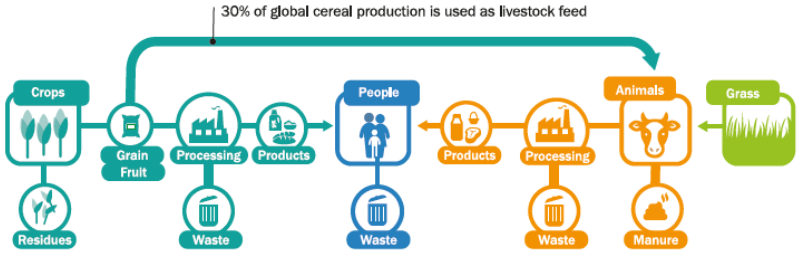


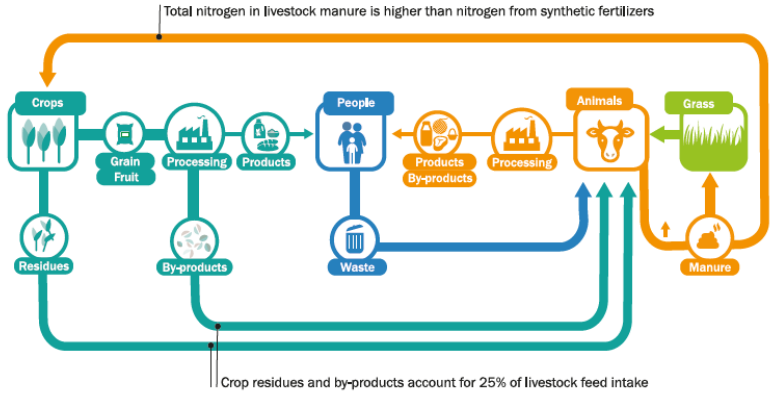
Vision 2050 by Swiss Federal Council

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





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

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]

Site-Adapted arable and livestock productions

1. Maximize the resource use efficiency
3. Reduce the food/feed competition

What does it mean side-adapted productions 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:

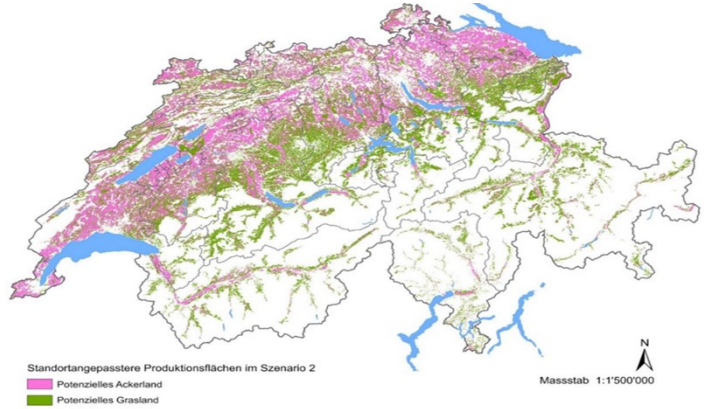
- **Cropland is primarily used for food production**
- **Ruminants feed primarily on grasslands**

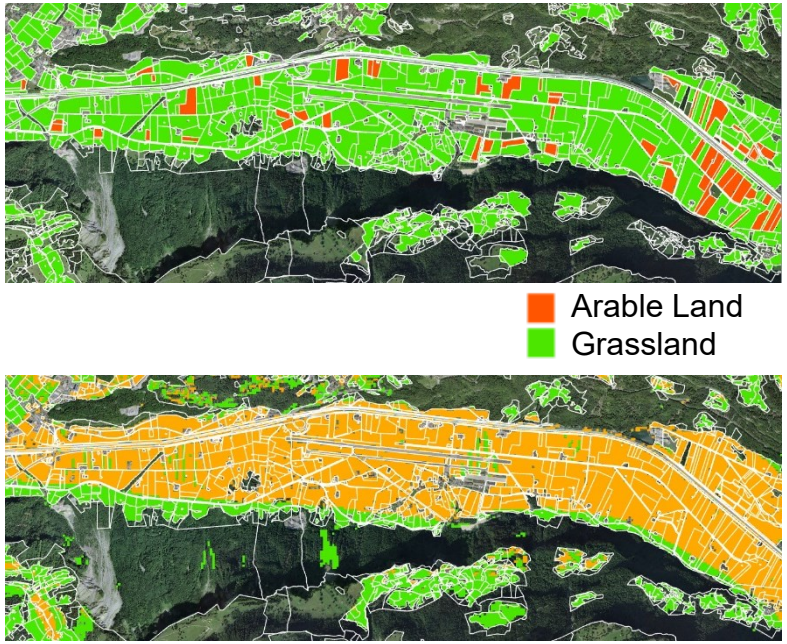
What are the benefits?

- 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?

- Unawareness of **environmental 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 contributions of Kay Sonja (Agroscope)

On arable land: the value of grass/legume leys in crops rotations

Current Research Topics on temporary grasslands

- Testing over 30 Cultivar of different species for recommended list (legal task)
- Developing and maintaining mixtures for the catalogue of Swiss Standard Mixtures
- Optimizing grass/legume/herb proportion for forage production and increasing resilience of grasslands to drought
- Investigating effect of ley proportion in the crop rotation on soil-C, earthworms, soil water holding capacity, weed populations, etc.

Arable systems

- Flowers for pollinators
- Yield follow-on crop
- Biogas

All cropping systems

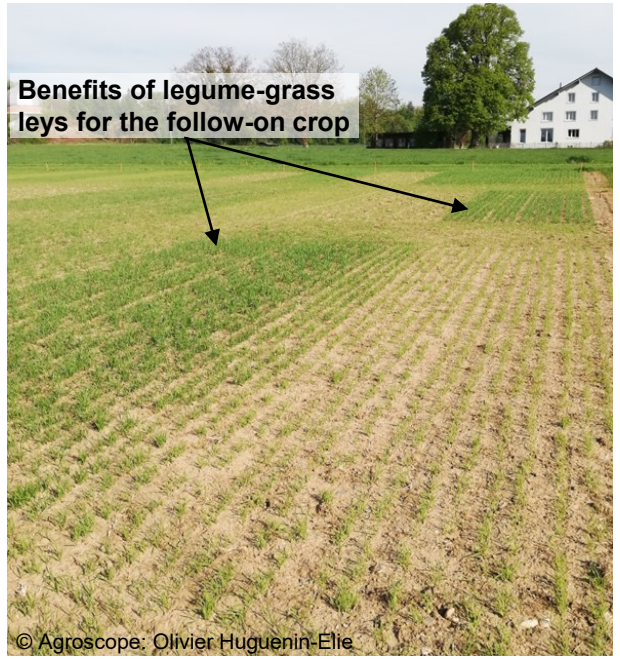
- Soil carbon stocks
- Soil structure
- N input substitution
- Weed suppression

Livestock / Mixed sys.

- Quality forage
- Protein self-sufficiency
- Benefits of species mixtures

in order

- to produce high forage yield and quality for healthy feed with high protein quality
- to increase protein self-sufficiency
- to increase or maintain soil fertility (humus content, aggregate stability, water retention, erosion prevention, activity of microorganisms)
- to gain N from renewable energy (N from symbiosis) and for circular production (bring back manure to arable land)
- To reduce pesticide use (suppression of fungal diseases and weeds through healthy crop rotations)
- To enhance yields of the follow-on crops
- To increase the amount of flowers for pollinators

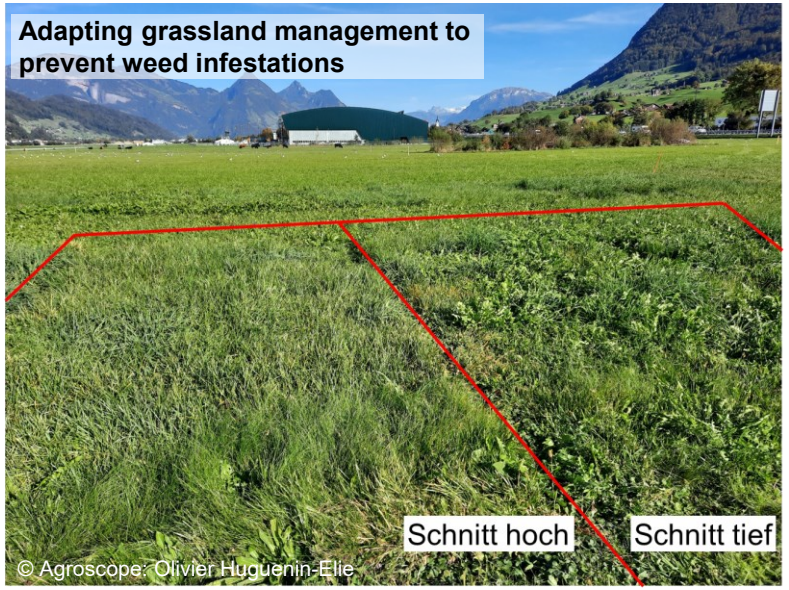


Based on the contributions of Andreas Lüscher (Agroscope)

On non-arable land: the importance of permanent grasslands

Current Research Topics on permanent grasslands

- To better quantify the multiple services delivered by permanent grasslands (productivity, forage quality, ecosystem services)
- To developing indicators to evaluate grassland ecosystem services
- To adapt grassland management to prevent weed infestations
- To optimize utilisation of slurry N by permanent grasslands under different site conditions (soil & climate)



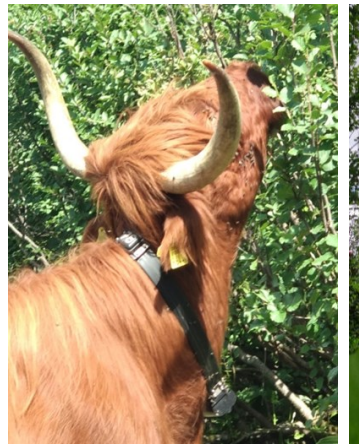
in order

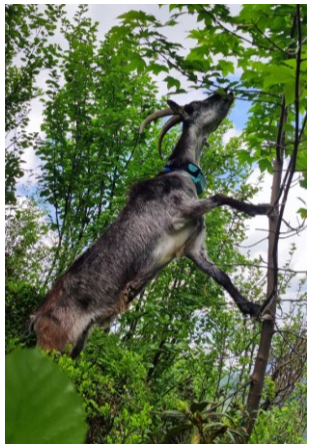
- to ensure food security
- to enhance animal health and input reduction
- to improve farmers livelihood (Living countryside in less favourable regions)
- to protect and enhance Biodiversity
- to valorise landscape aesthetic and recreation (cultural values)
- to prevent soil erosion prevention, carbon storage and provide ecosystem services

Based on the contributions of Olivier Huguenin-Elie (Agroscope)

Grazing systems and Agroforestry in animal production

Current Research Topics of Grazing Systems





Developing site adapted grazing systems

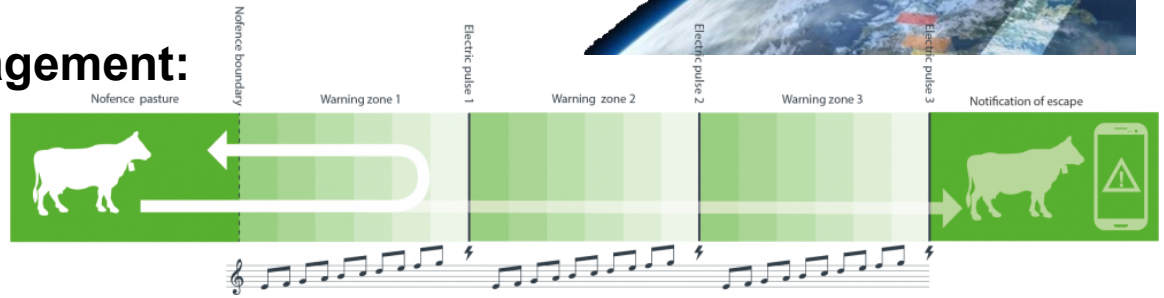
- to promoting ecological and economic sustainability and animal welfare
- to counteract woody species encroachment on mountain pastures, using robust livestock, combination with mechanical clearing and use of attractive points

Assessing forage yield and quality of alpine pastures

- to update of Swiss references
- to compare pasture use, energetic balance and green house gas emissions by different cattle breeds on alpine pastures

Developing the use of new technologies for pasture management:

- virtual fencing systems and remote sensing technologies



Adapting forage production to climate change:

- agroforestry
- drought-resistant forage crops and grassland mixtures,
- optimization of irrigation regimes

Based on the contributions of Massimiliano Probo (Agroscope)

Grazing systems and Agroforestry in animal production

Our competences on Agroforestry

Fodder tree hedgerows in Swiss permanent grasslands

Experimental design

- **6 tree species:** *Morus alba, Salix caprea, Fraxinus ornus, Tilia cordata, Tilia platyphyllos, Alnus cordata.*
- **7 on-farm sites:** wide altitudinal and climatic gradient.
- **Hedgerows:** 3 lines of trees with all trees spaced by 1 m (1 tree/m^2)

Main measurements

- **Tree:** mortality, growth, forage yield, quality, palatability, digestibility.
- **Livestock:** methane emissions and protein assimilation.
- **Ecosystem services:** biodiversity, carbon storage, soil moisture.
- **Economy:** profitability at paddock and farm scale (monetization).

Forage production

- Tree-based forage resource (yield)
- Higher forage quality than grasses/legumes
- Partially compensate drought-induced forage losses in Summer

Animal production

- Provide a more balanced diet
- Increase milk quality (omega 3 and 6)
- Reduce methane emissions (effects of tannins)

Animal's health

- Reduce heat stress (shading)
- Increase protein assimilation (tannins)
- Reduce intestinal parasites / bloating (tannins)

Ecosystem services

- Promote biodiversity (insects, birds, bats)
- Increase soil moisture (benefit forage species)
- Enhance carbon storage (soil, wood biomass)

Based on the contributions of Pierre Mariotte (Agroscope)

Current Research Topics on dairy systems

Dairy Cow

Efficient, sustainable use of grassland growth with dairy cows

- Improvement of the use of nutrients, energy, and minerals by dairy cows by minimizing the negative impacts on the environment and reducing the food/feed competition
- Enhancing the health and welfare of dairy cows in site-specific, herbage-based feeding systems

Emissions and Losses

Future dairy farming towards efficient nutrient management and lower emissions taking into account animal health and welfare

- Investigating housing systems structural-technical, organizational and feeding strategies to reduce emissions and losses
- Revising of nutrient and excretion norms (legal task)

Ruminant Nutrition: Grass-based milk production systems and beyond

Our competences on Former Food in Dairy Cow

Animals

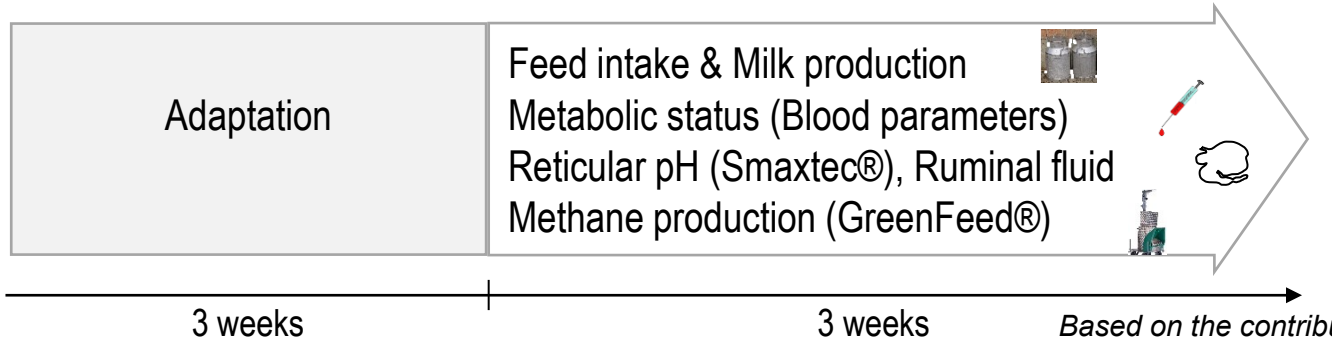
34 early-lactating (Red) Holstein cows (~ 33 DIM; ~ 38 kg Milk)

Diets

Freshly cut grass (zero grazing) *ad libitum* +

- Cereal-based control concentrate
- Bakery by-products (55%) without cocoa bean shells
- Bakery by-products (55%) with cocoa bean shells (5%)

Measurements



55% bakery by-products in concentrate (~17% of the whole diet) over six weeks

- → **No negative effects** on feed intake and milk production
- → **Similar** metabolic status
- → Season-dependent effects on ruminal pH need further investigation
- → **No effects** on methane production

Based on the contributions of Anna Reiche (Agroscope)

Ruminant Nutrition: Efficiency of beef-on-dairy cattle production system adapted to the site

1. Maximize the resource use efficiency
3. Reduce the food/feed competition
5. Promote circularity of agro-ecosystems

Diverse pedoclimatic conditions accross Switzerland

- **Availability of specific feed resources depends on the site of production**

⇒ **Crops** *(e.g., maize and grains intended for animal production)* **may be produced on arable lands of lowlands**

⇒ **Only grasslands are available in high-mountain areas** *(harsh topographical, altitude, and pedologic conditions)*

Challenge: Increase feed autonomy at the farm level requires to select feeding systems based on the feed resources available locally

Integration of dairy and beef production systems

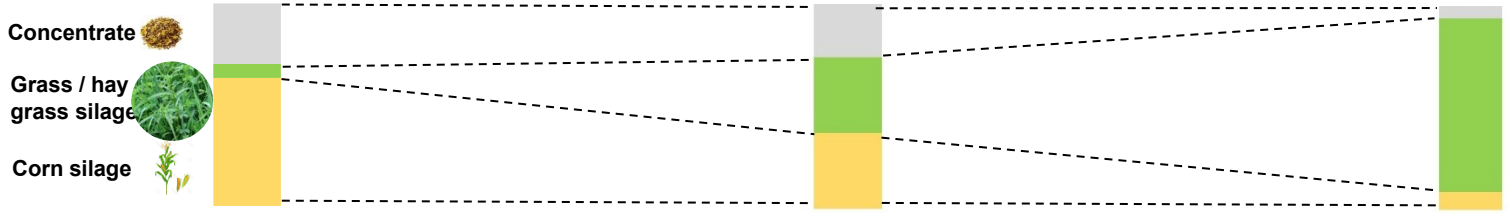
- **Offspring of beef bull crossbred with a dairy cow female: "beef-on-dairy" cattle**
- **May improve economic performances**
- **Lower environmental footprint** *part of the environmental foot-print is share between the two systems*

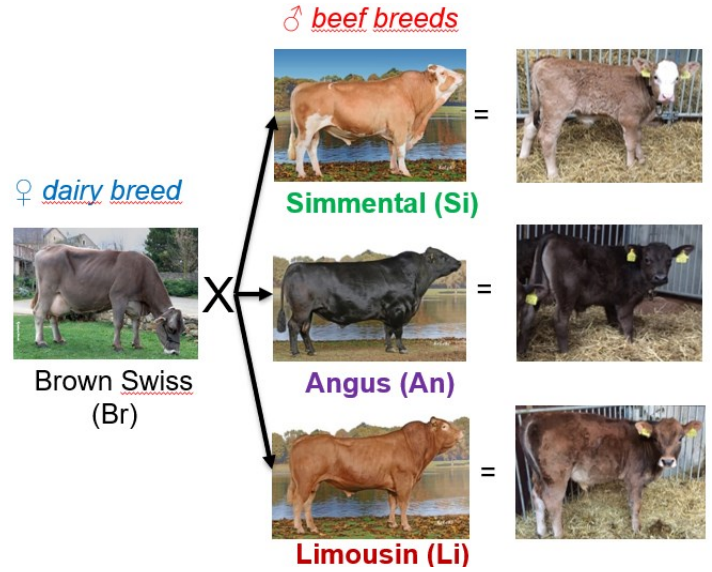
Challenge: Wide diversity of genetic resources *(dam and sire breeds)*

Based on the contributions of Sylvain Lerch (Agroscope)

Ruminant Nutrition: Efficiency of beef-on-dairy cattle production system adapted to the site

Research Topic: beef-on-dairy cattle production system



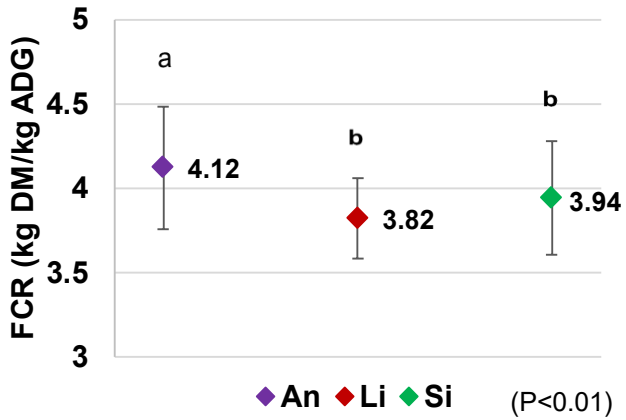


The best combination between site and the crossbred can be chosen based on the prioritized criteria

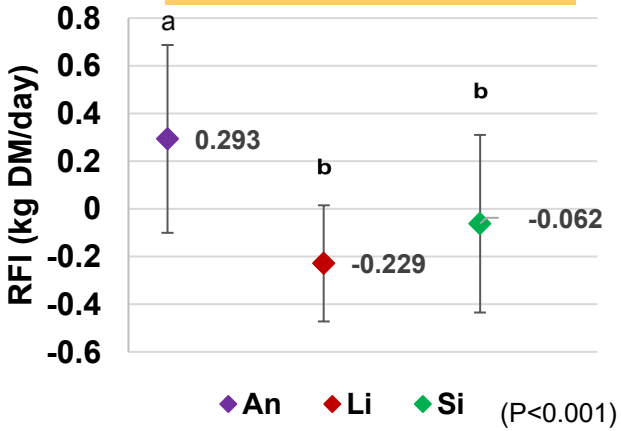
Cattle's performance in intensive diets

Higher feed efficiency for ×Limousin and ×Simmental than ×Angus crossbreeds

Feed Conversion Ratio



Residual Feed Intake



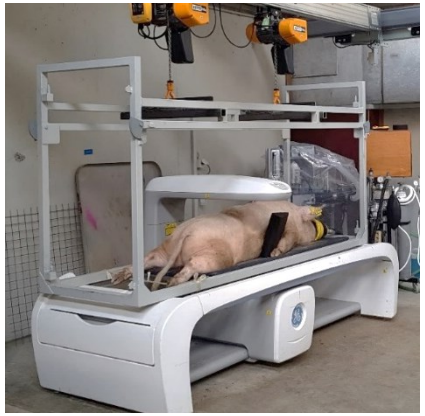
Based on the contributions of Sylvain Lerch (Agroscope)

Sustainable pig nutrition

Current Research Topics on Pig nutrition

Pig Efficiency:

- Improving N and P efficiency by increasing digestibility, amino acid profile, management or by mobilizing body reserves.
- Maximizing the use of alternative feed as grass silages, former food products or other by-products



Pig Health

- Developing diagnostic tool to objectively assess intrauterine growth restriction (IUGR) in piglets
- 3R principles to non-invasively collect intestinal content and blood
- Assessing nutritional strategies to limit the incidence of post-weaning diseases

MaternitySow

- Determining the effect of dietary fibers, Ca and P mobilization in gestating and lactating sow to:
  - ✓ reduce farrowing duration,
  - ✓ improve colostrum production

Sustainable pig nutrition

Our competences on Body reserves as P resource for the fine tuning of dietary P requirement for sows

- 6 dietary treatments during lactation were tested: (50%, 75%, 100% of P requirement) with/without phytase supplementation
- Repeated body composition scans (min. 4 per production cycle) on each sow

Our Results:

- **Body composition of sows and piglets determined: useful for GRUD/PRIF norms**
- **During lactation, body Ca and P reserves were mobilized and quantified**
- **During following gestation, sows replenished their body Ca and P reserves P excretion was reduced (up to -45% of P) in lactating sows with reduced dietary P.**
- **No effect on growth performance, nor bone mineralization of piglets**

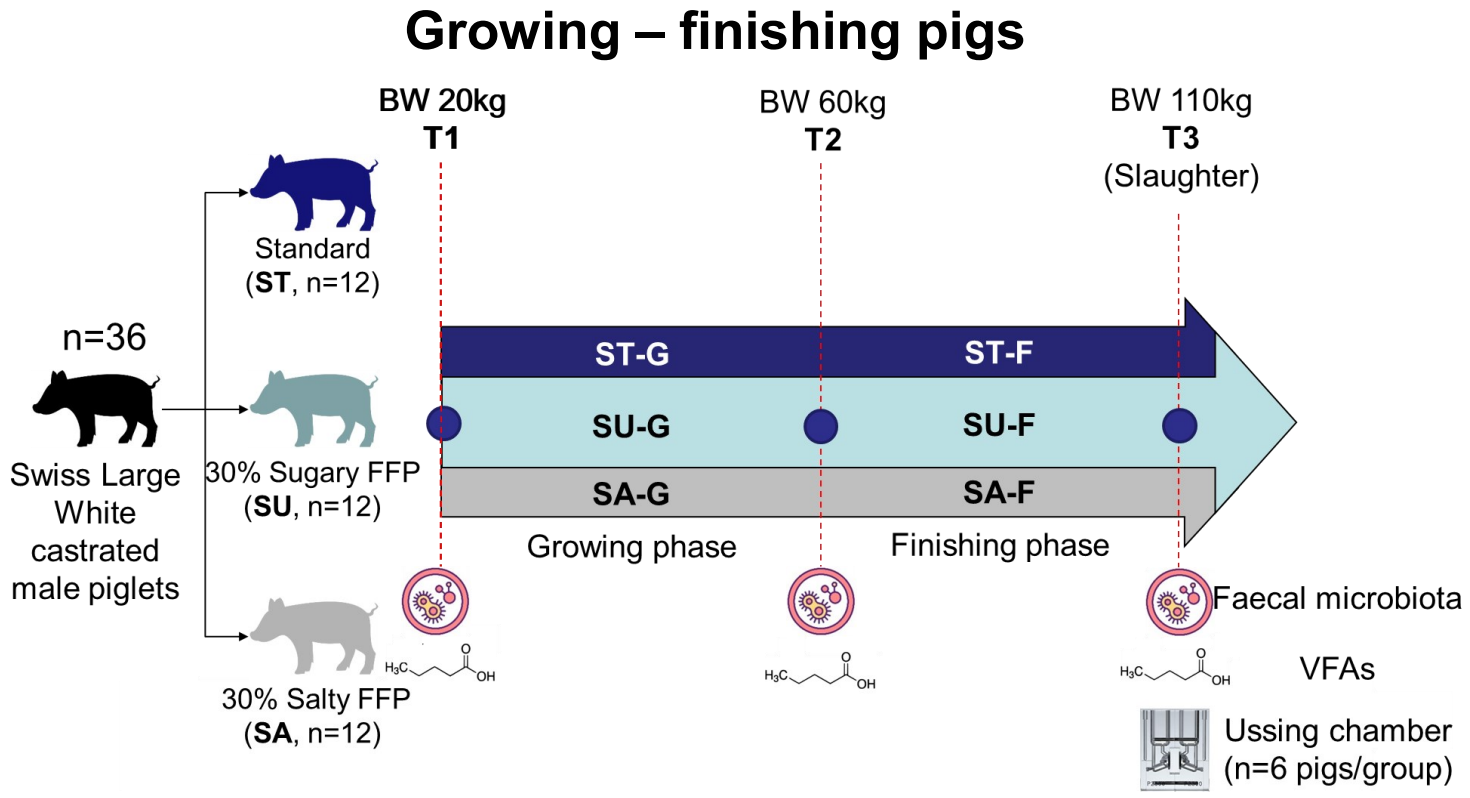
Sow's have 2 P-ressources in lactation: diet + body
There is a potential to reduce dietary mineral phosphates

Based on the contributions of Patrick Schlegel (Agroscope)

Sustainable pig nutrition

Our competences on Revalorizing Former Food Products (FFPs)

FFPs can replace up to 30% of cereals in pig's ratio without detrimental effects on pork production and pig gut health.



Pig's Performance

- Similar growth performance
- Similar live body and carcass composition.

Product's quality

- Sligh effects on fatty acid profile of pork.
- Improved sensory quality of loins (sweetness and tenderness).

Pig's health

- Similar gut microbiota, intestinal integrity and blood mineral homeostasis.

Based on the contributions of MarcoTretola (Agroscope)

Algae: using natural biodiversity to produce nutrient rich bio mass

Current Research Topics implementing Algae in Livestock

Goals of the Program

- To obtain an alternative source of protein for animal nutrition

(To reduce / eliminate imports of Soy as Feed)

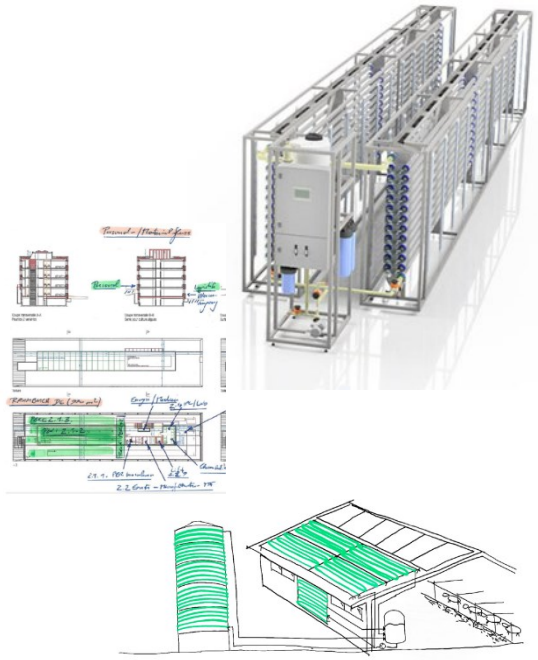
- To evaluate the potential of reducing enteric Methane emission
- To develop a vertical Integration of feed supply to primary producers
- To Optimize a Life Cycle Assessment of animal based food

Isolation of microalgae on farm environment

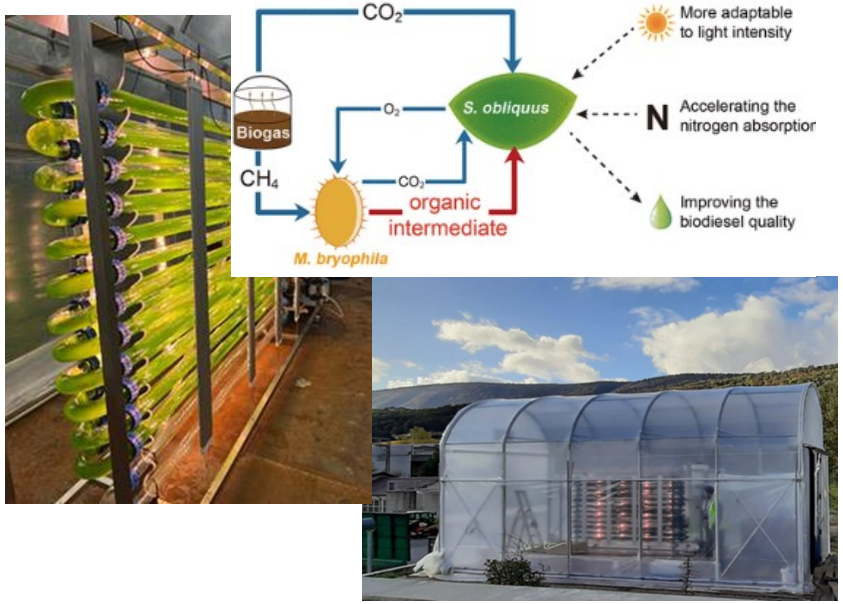
Multistage project plan for realisation

Actual running a Micoralgae Pilot Plan
(2x 170 l pilot plant)
To upscale:

- Mobile 1200 l reactor
- 50m^3 Algae Reactor
- 30 farms active till 2030



Cultivation of Microalgae



Based on the contributions of Fabian Wahl (Agroscope)

Conclusions and outlooked

- We work for a sustainable livestock system, moving from a **line production model** to a **circular production model**
- Adjusting livestock farming system to **Site-adapted arable and livestock production**

In our vision of new livestock farming systems:

- **Animal productions** will play an essential role in food supply by closing production cycles through grass-based diets
- **Permanent grasslands** will be an essential source of protein and energy that ruminants will be able to exploit
- **Temporary grasslands** productions will be an essential element in arable lands though crops rotations also promoting externalities
- will enhance **ecosystem services** and will be a promising solution for **climate change adaptation and mitigation**
- **Alternative sources** of feed, such as algae or by-products and former foods, will reduce and revalorizing food waste

All this work will support Policy makers to encourage transition in sustainable production models

Thank you for your attention

Joël Bérard
joel.berard@agroscope.admin.ch

Agroscope good food, healthy environment
www.agroscope.admin.ch