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Agroscope

Life cycle thinking leads farmers towards a more eco-efficient agriculture

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Background

- Agroscope's Life Cycle Assessment group has been investigating the environmental impacts of farms for many years.
- Two recent and ongoing collaborations are transferring life cycle thinking into agricultural practice, helping farmers to lower their impact on the environment:

FarmLife
Für eine ökoeffiziente Landwirtschaft

FarmLife: Showcasing an example for a working tool

IP-SUISSE

Point system climate protection: Showcasing the process of developing a tool

- We present our research that went into these two projects and how it was transferred into tools that are used by farmers.

→ This illustrates how life cycle thinking makes its way from research into agricultural practice.

1. FarmLife: Showcasing an example for a farm management tool

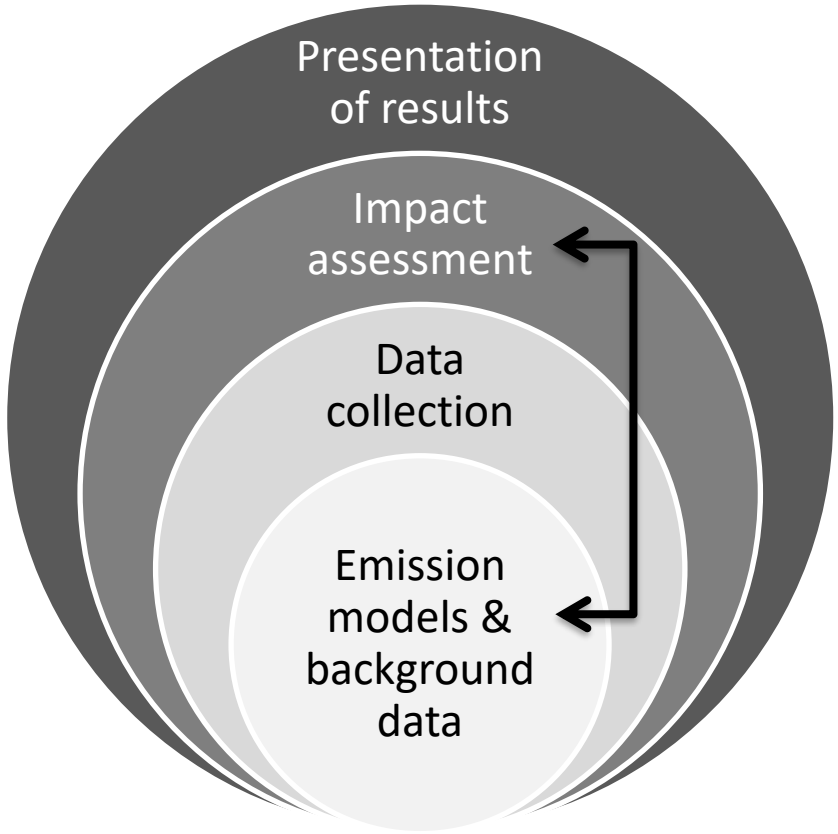
FarmLife: A tool for eco-efficient agriculture
Idea and expected impacts

External impact:
Transparent information on environmental impacts leads to higher appreciation of agricultural products

Internal impact:
Assessment of all management areas enables a SWOT analysis and identification of goals and measures

Educational impact:
Agricultural schools can establish practical link to subject areas. Goal: Capacity building of farmers

FarmLife:
Collaboration between Agroscope and HBLFA



FarmLife-Report

FarmLife Calculate

FarmLife-Capture

SALCA

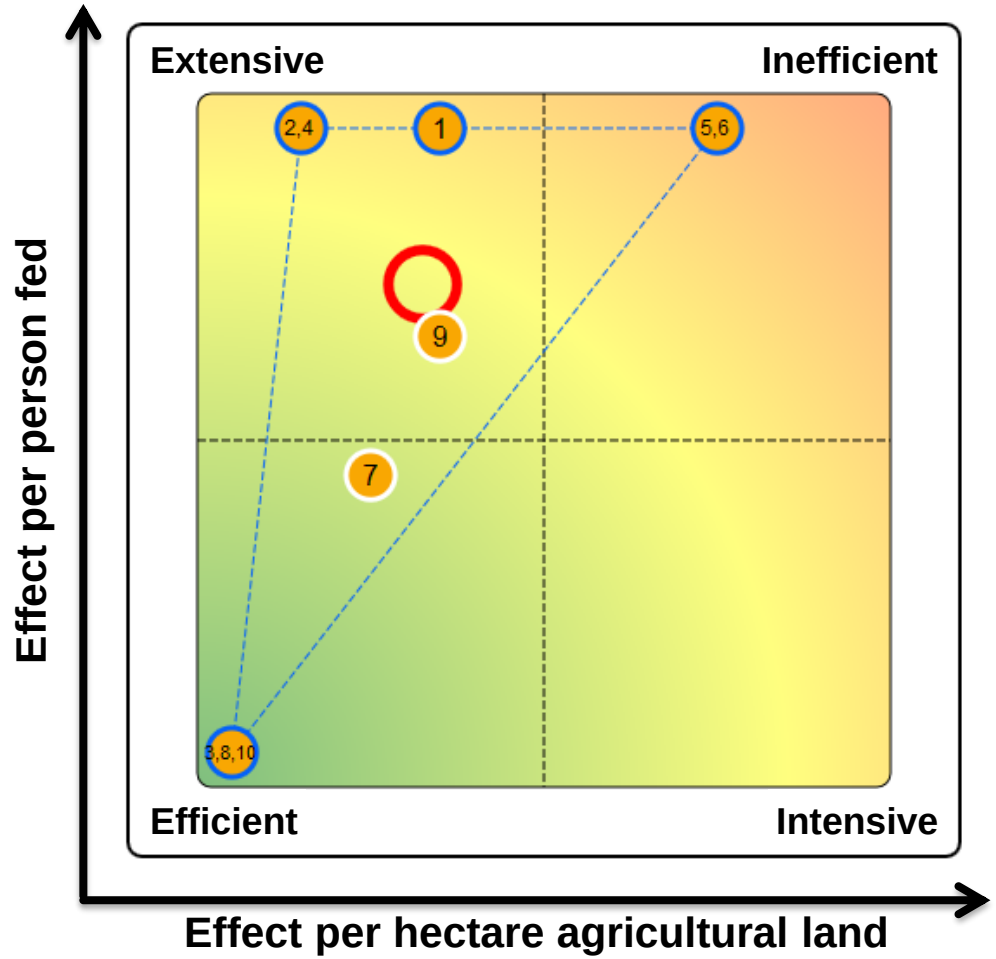
Swiss Agricultural Life Cycle Assessment

↓ Adaptation to Austria

FarmLife-LCA

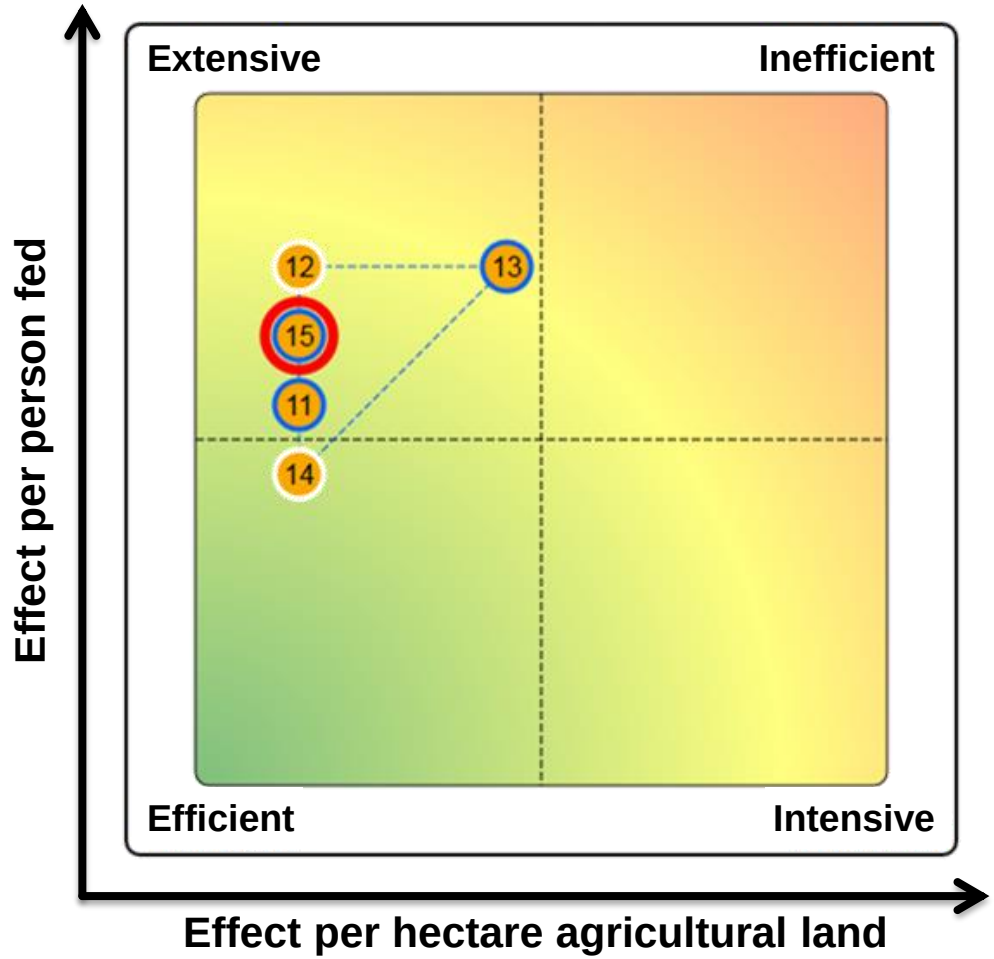
Emission models (nutrients, heavy metals, pesticides, animal emissions), LCI data

FarmLife report:
Which are the environmental impacts of my farm?



1	Nicht erneuerbare Energie, fossil und nuklear	Non-renewable energy
2	Treibhauspotenzial (100 Jahre)	GWP
3	Phosphorverbrauch	Use of P resources
4	Landverbrauch	Land use
5	Stickstoffeintrag in das Wasser, Österreich	N emissions to water
6	Phosphoreintrag in das Wasser, Österreich	P emissions to water
7	Wirkung von Schwermetallen auf den Boden (CML)	Terr. ecotoxicity of heavy metals
8	Wirkung von Pestizide auf den Boden (CML)	Terr. ecotoxicity of pesticides
9	Wirkung von Schwermetalle auf das Wasser (CML)	Aq. ecotoxicity of heavy metals
10	Wirkung von Pestizide auf das Wasser (CML)	Aq. ecotoxicity of pesticides
	Einfluß auf Bewirtschaftungsklasse	Influence on efficiency/intensity class
	Gesamtbewertung im Untersuchungsjahr	Overall score

FarmLife report: How profitable is my farm?



11	Direktkosten	Direct costs
12	Direktleistungen	Direct proceeds
13	Übrige Vorleistungskosten	Other input costs
14	Gemeinleistungen	General proceeds
15	Faktorentlohnung	Factor payments
	Einfluß auf Bewirtschaftungsklasse	Influence on efficiency/intensity class
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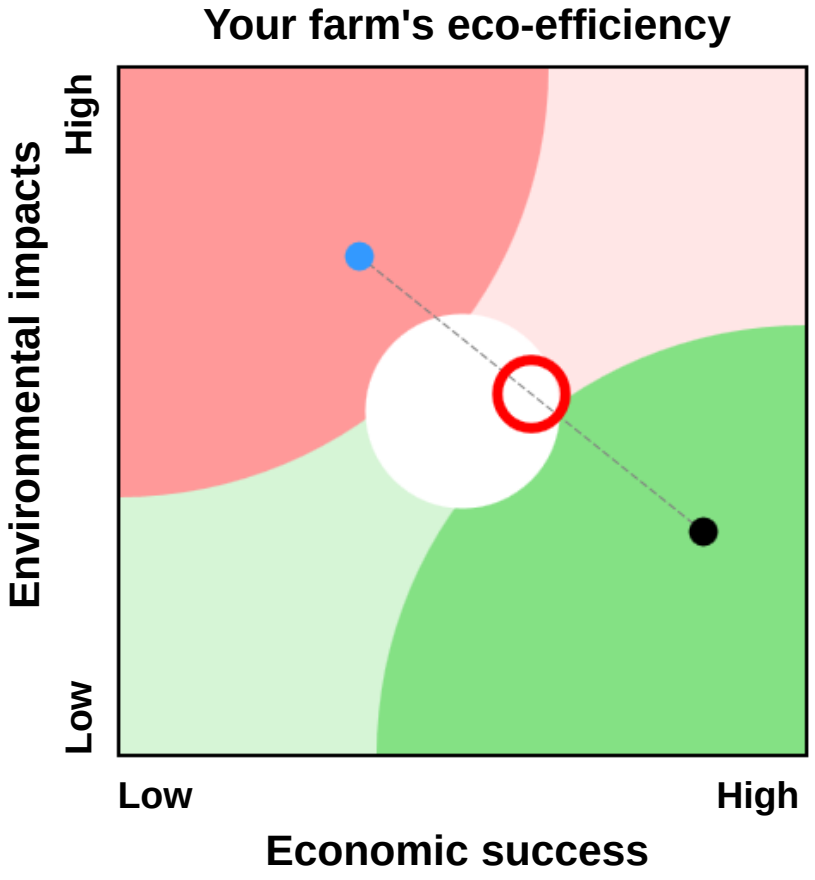
FarmLife report: How are environmental and economic effects connected?



In total, your farm is balanced.

Land management is eco-efficient

Food production is not eco-efficient

Land management and food production are contrary

Eco-efficient

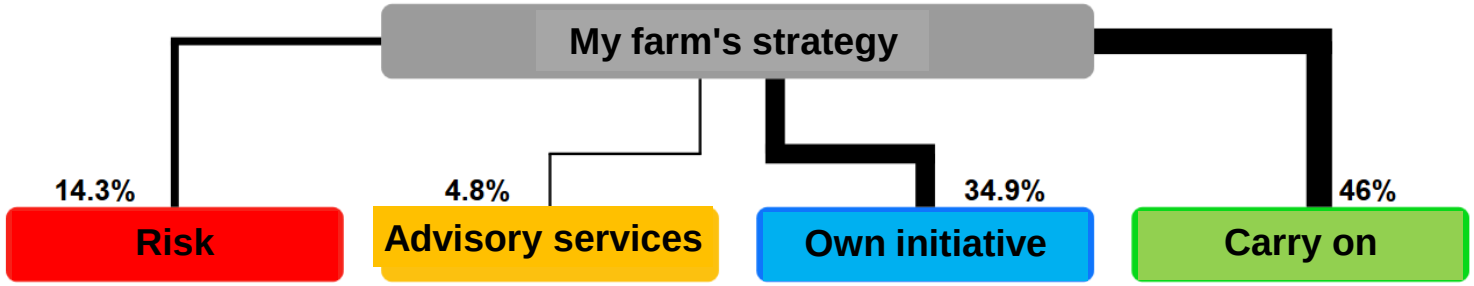
Oriented towards ecology

Oriented towards economy

Not eco-efficient

Neutral

FarmLife: How can I improve my farm?



Risk	Advisory services	Own initiative	Carry on
Resource use: • Land use Nutrient management: • N emissions to water • P emissions to water	Economic evaluation: • Direct proceeds: We need a higher price for our product • General proceeds: direct payments have to be better adapted to my situation	Resource use: • Non-renewable energy use: use buildings and machinery long-term; purchase of roughage has to be an exception; low efficiency has to do with low milk yield	Resource use: GWP • Use of P resources • Water use Management of pollutants: • Terr. ecotoxicity of heavy metals • Terr. ecotoxicity of pesticides

2. Point system climate protection: Showcasing the process of developing a tool

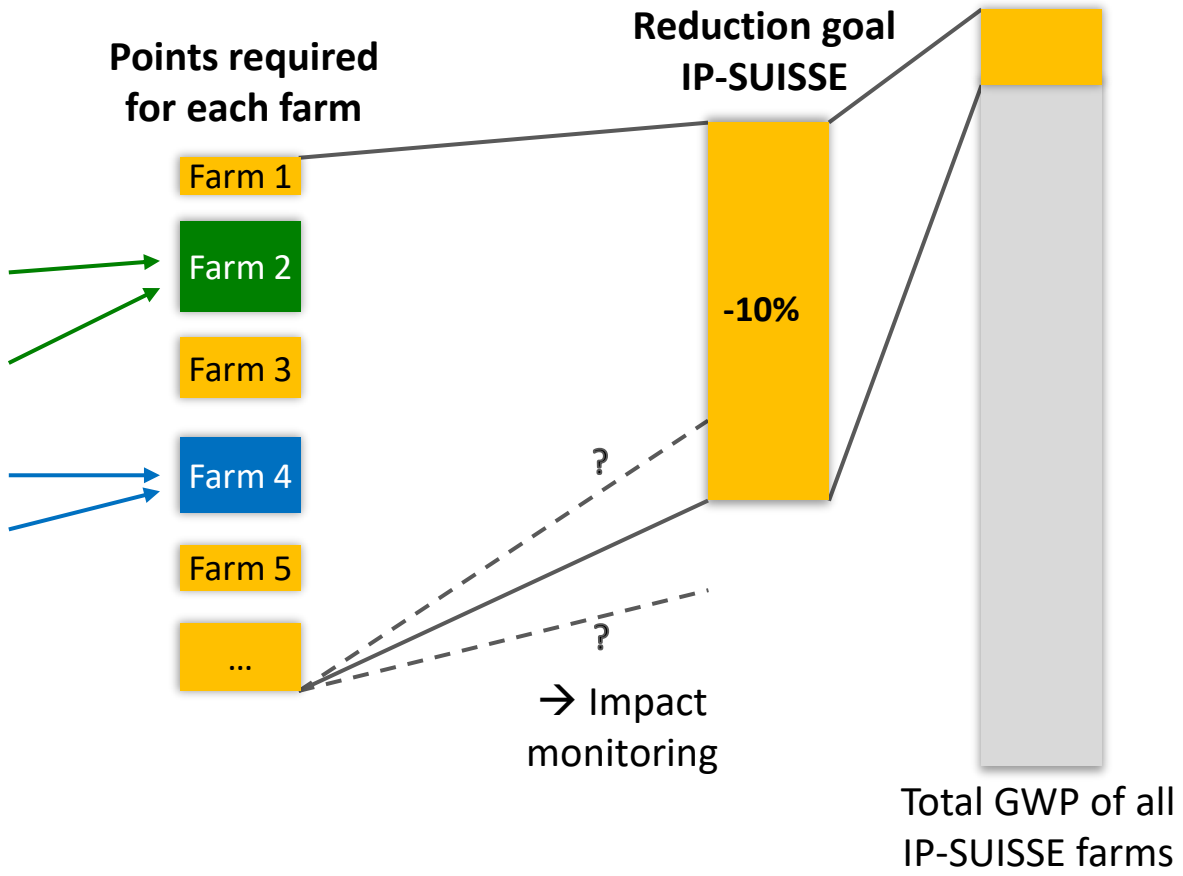
Point system climate protection

- IP-SUISSE:
  - Large agricultural producer and distribution organization in Switzerland
  - More than 18000 member farms
- Launched climate protection program in 2021
- Goal: Reduce greenhouse gas emissions of the organization by 10%.
- Agroscope:
  - Developed a system to calculate the greenhouse gas reduction required from each member farm
  - Developed a catalogue of greenhouse gas reduction measures, from which the farmers can choose

Concept of the point system

Catalog of measures

- Covering liquid manure store
- Phase feeding of pigs
- Increasing the number of lactations of dairy cows
- Photovoltaic
- Biochar
- Plot-specific fertilization
- Heating with wood
- …



Catalog of measures and points for each measure: Examples for dairy farms

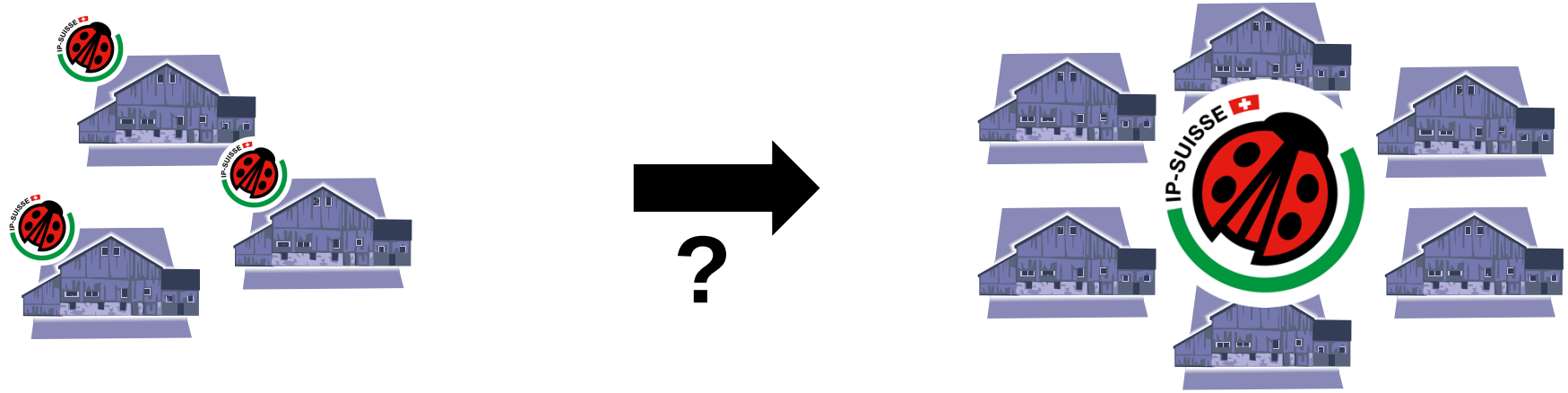
Installing a frequency converter in the milking system	Heat recovery from milk cooling	Increasing the number of lactations of dairy cows	Linseed as feed for dairy cows
350'000 kg of milk → 1 point	130'000 kg of milk → 1 point	1 lactation more for 1.8 cows → 1 point	Feeding 2'236 kg of linseed → 1 point

Covering of liquid manure stores	Spreading of liquid manure with trailed hoses	Recycling silage films
23m^3 capacity of the manure store → 1 point	Spreading 770m^3 liquid manure → 1 point	Recycling 320 kg of LLDPE or 299 kg of LDPE film → 1 point

1 point =
1 t CO_2-eq. saved

Source: Bystricky (2021), IDF Dairy Sustainability Outlook

Estimating the reduction goal of IP-SUISSE and of each farm via data from pilot farms



Detailed data available from 33 pilot farms from 2016 and 2018

→ Fed into SALCA

→ Specific GWP of each farm estimated

General metrics available for all IP-SUISSE farms:

- Agricultural land
- Livestock units
- Open arable land
- Crops cultivated
- Animal categories kept
- ...

Estimating the reduction goal of IP-SUISSE and of each farm using general metrics

Equation: Calculating the GWP of an individual IP-SUISSE farm

$$y = 10.56 - 2.73*x_1 + 1.48*(x_1)^2 - 23.61*x_2 + 17.91*(x_2)^2$$

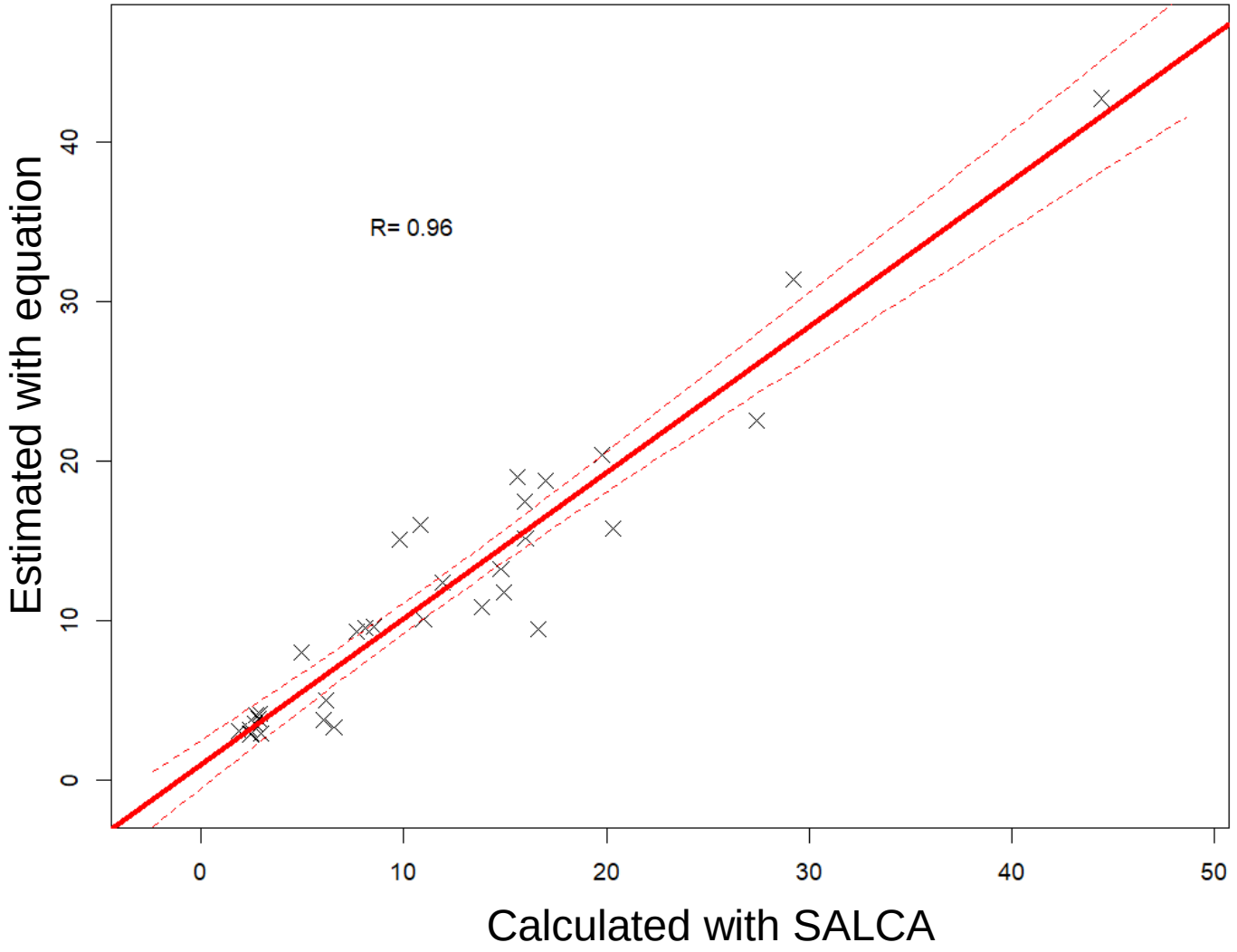
- Target variable **y** = **greenhouse gas emissions** [t CO_2-eq per ha farmland]
- 1. explanatory variable: x_1 = **livestock density** [livestock units per ha farmland]
- 2. explanatory variable: x_2 = **share of open arable land** [ha per ha farmland]

livestock density correlates strongly with methane emissions (CH4)
and open arable land with nitrous oxide emissions (N2O) and energy use.

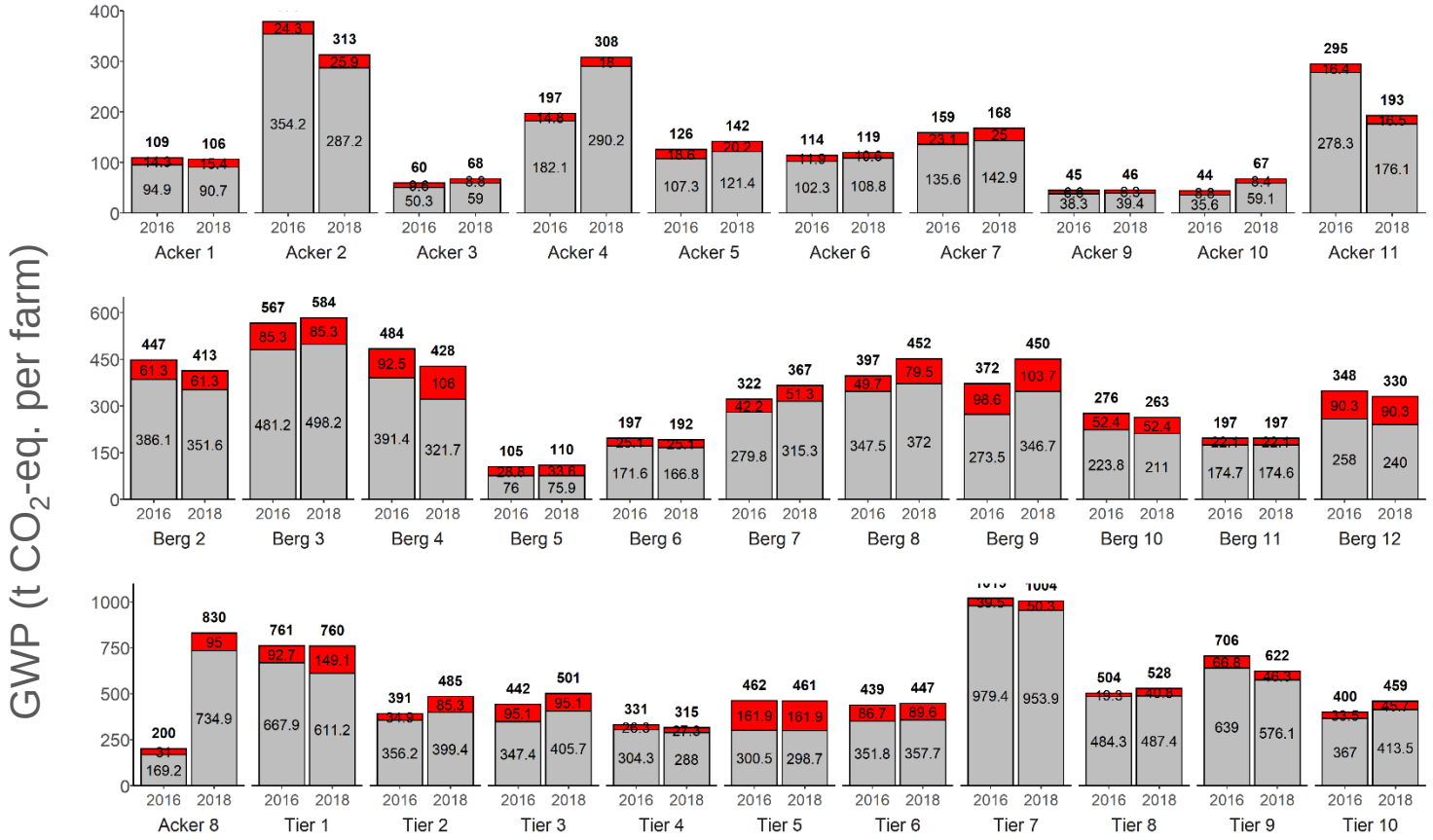
This modeling represents a rough estimate of individual farm GWP. It is not a detailed calculation.

GWP: Estimation vs. detailed calculation

Global warming potential of pilot farms



GWP of pilot farms and climate protection measures in 2016 and 2018



Additional GWP without climate protection measures

GWP calculated with SALCA

- GWP reduction from 2016 to 2018: 2.8%
- ~85% of the climate points were achieved by 5 measures (particularly covering of liquid manure stores)
- Monitoring in 2022 and 2023 will confirm current system or reveal need for adjustments

Conclusions

Where are we and what comes next?

- **FarmLife:**
  - Has been taken up on dairy farms in Austria
  - Is integrated in agricultural education and training schemes in Austria
  - Will be extended to include animal welfare
- **Point system climate protection:**
  Will become mandatory on a large proportion of Swiss farms

Life Cycle Thinking:

→ Grows in importance especially among buyers and marketing organizations of agricultural products. It can really change the agricultural sector

→ Need for practical tools that can be used by farmers – need for integration of sustainability topics into education and training of farmers

→ From a practical point of view, LCA people have to adapt themselves to small enterprises rather than to expect from them to be specialist of LCA

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Thank you for your attention

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