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Agroscope Reckenholz-Tänikon Research Station ART



Ökobilanzierungsstelle ÖBS
*TSM Treuhand GmbH, Bern
& ArGe Natur und Landschaft, Hergiswil*



LCM in agriculture: How can farm LCA contribute to an efficient environmental farm management?

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Thanks to M. Alig, S. Blaser and Th. Nemecek

Life Cycle Management Conference 2007

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Promoting LCM thinking in agriculture (1): Which challenges?

- *Agriculture phase often plays a major role in the environmental impact of the food chain*
 - There is a **need to act**
- *High self-responsibility of farmers unusual*
 - Most measures are based on
 - **prohibition** (e.g. pesticide authorisation procedure)
 - **standards** to be kept (organic farming rules)
 - defined by
 - **Authorities**
 - **Private associations**
 - **Retailers and food industry**



Promoting LCM thinking in agriculture (2): Which challenges?

- *In general insufficient economic structure*
 - **small** to **very small enterprises**
 - **Little manpower**
- *Financial dependence*
 - on **governmental measures**
 - on **retailers** and **food industry**
- *Incomplete feedback*
 - Feedback restricted to the **measures**. No feedback on **individual impact** on the environment
 - Rather **bureaucracy** than **self-motivation**



Promoting LCM thinking in agriculture (3): Which challenges?

- *Agriculture is in general non product specific*
 - Respectively environment-friendly agriculture requires **multi-product systems**
- *Agriculture should be multifunctional*
 - Not only production of **food**, but also
 - Production of **raw materials**, **bioenergy**, etc.
 - **Landscape** function
 - **Environmental** requirement
 - Development of **rural zones**
- *Dependence on variable external factors*
 - Fluctuation of **climate**
 - **Soil** type



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Promoting LCM thinking in agriculture (4): Which challenges?

Summarised: In the food chain

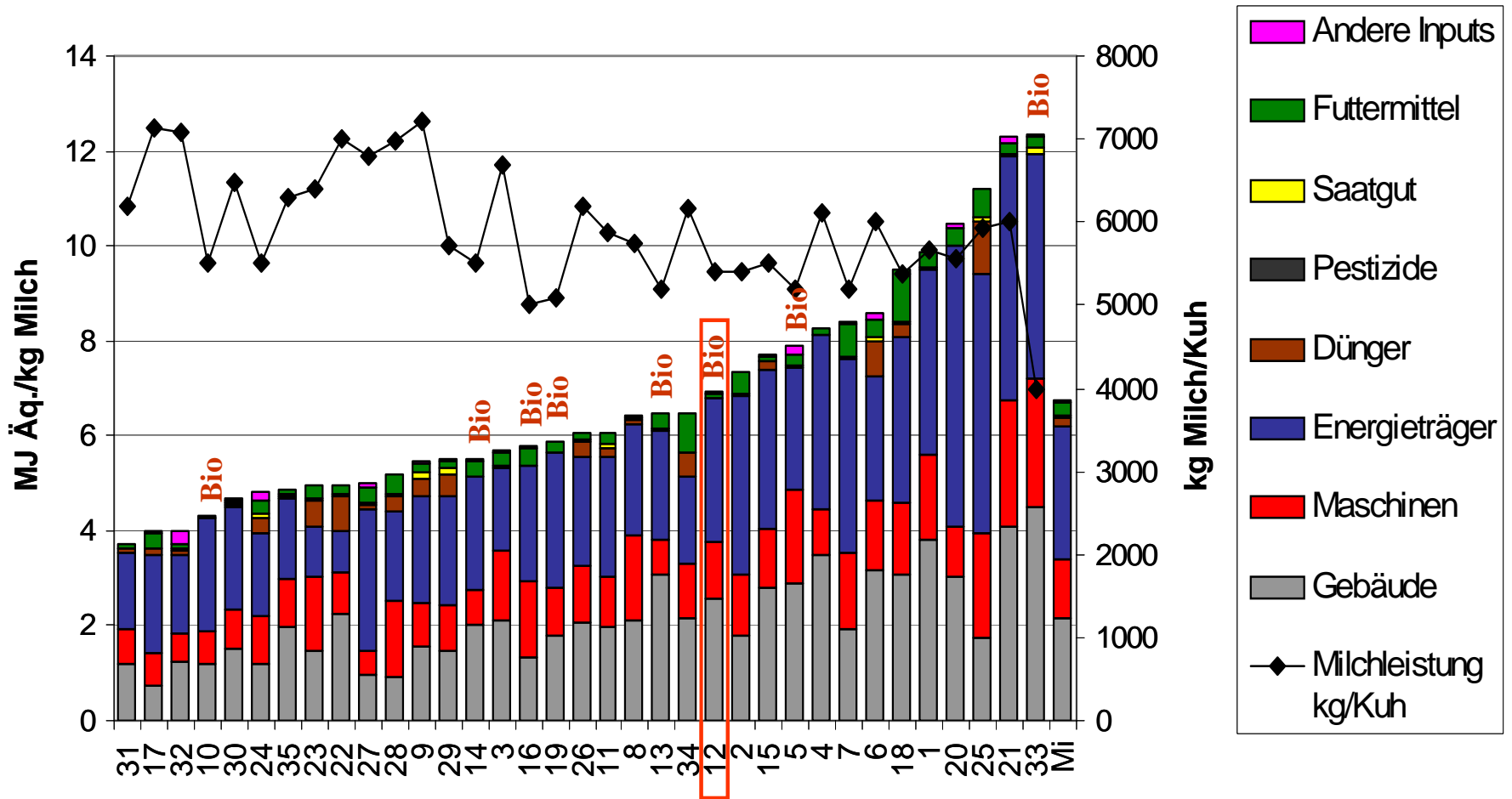
- farming often plays a great role in the **environmental impact**
- the farmer **carries out**, he is not a deciding actor
- risk of **Small efficiency** of measures is present and **occurs!**



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Example milk farms Energy demand per kg milk (reference year: 1998)

Source: Rossier & Gaillard (2001 & 2004)



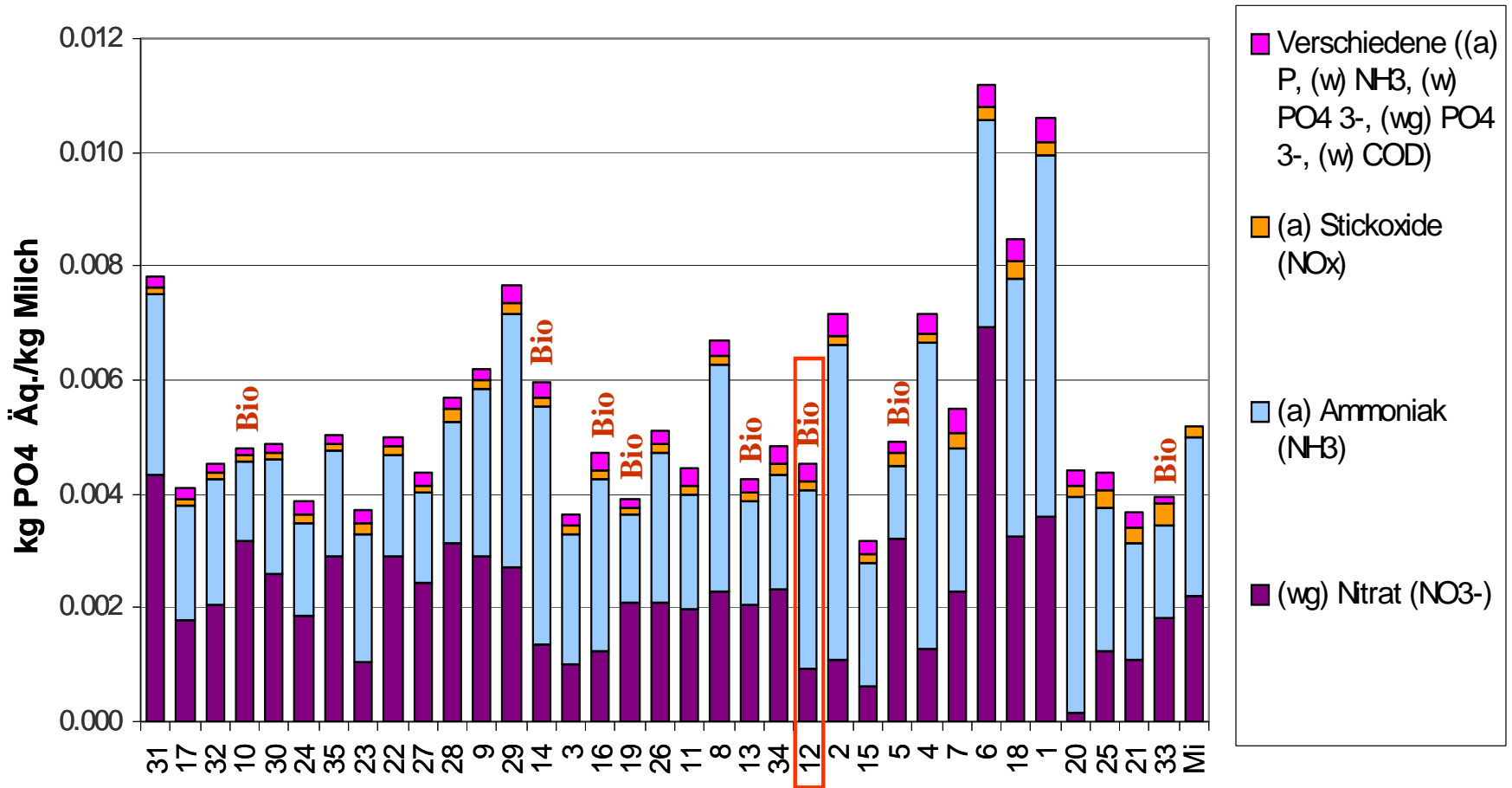


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Example milk farms

Eutrophication potential per kg milk (reference year: 1998)

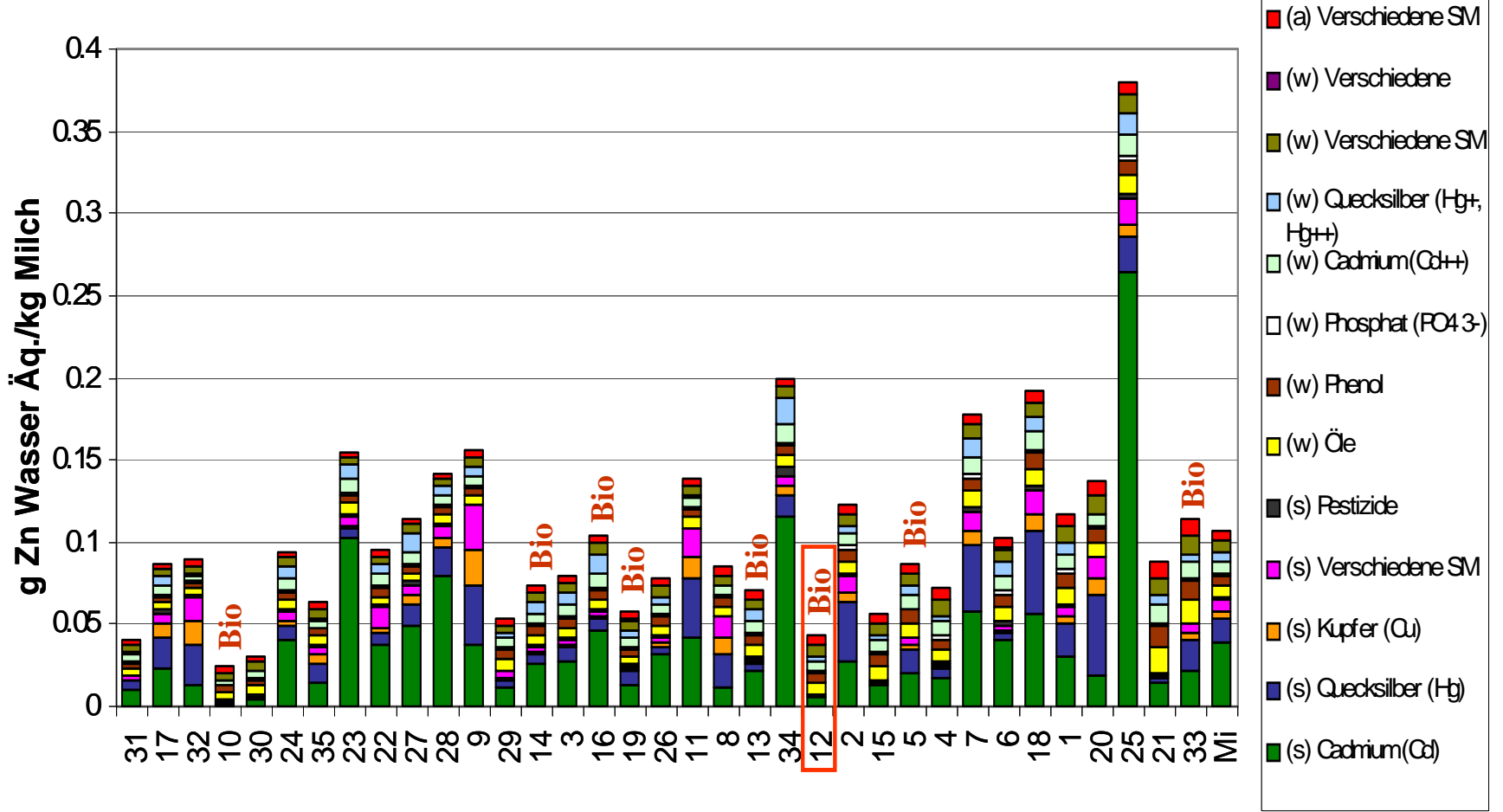
Source: Rossier & Gaillard (2001 & 2004)





Example milk farms Aquatic ecotoxicity potential per kg milk (reference year: 1998)

Source: Rossier & Gaillard (2001 & 2004)





Promoting LCM thinking in agriculture (5): Which challenges?

- *Factors like production region, farming system, play a role, but, **comparatively**, are of minor importance*

→ The **farmer** is the key factor!

→ There is a need to act at the **personal level!**

→ We are convinced of the need of introducing **life cycle thinking** by the farmers



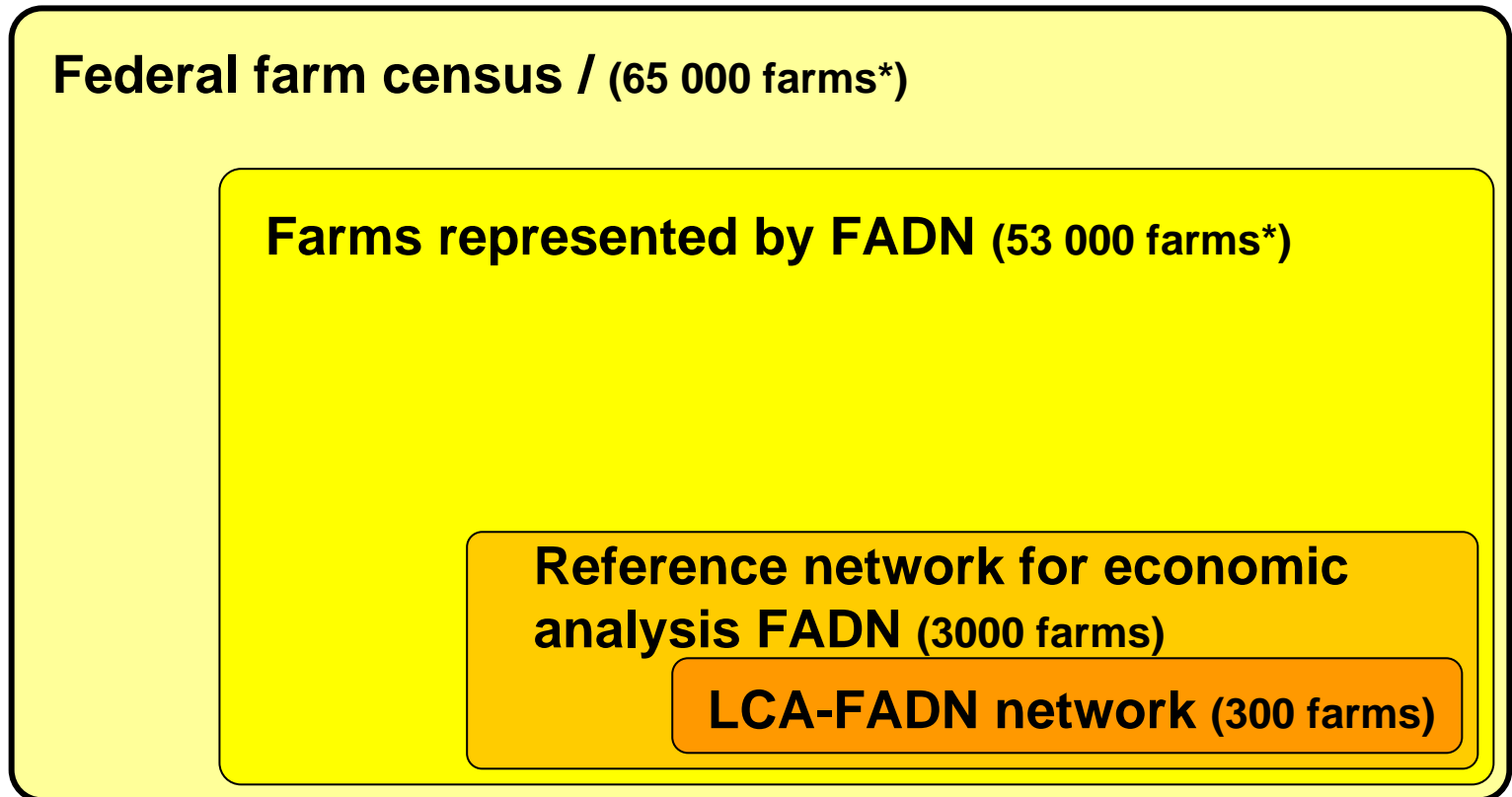
- Project supported by the **Swiss Federal Office for Agriculture**
- Establish an operating system with **300 farms** (during 3 years with 100 in the first year)
- Establish an **information technology infrastructure**
- **Training LCM principles** in the practice
- Develop concepts for **evaluation** and **communication** (at farm, production type and regional level) and practice them with **farmers** and **extension services**



Project LCA-FADN (2)

Life Cycle Assessment – Farm Accountancy Data Network

Farm recruiting



* Stand 2004



Project LCA-FADN (3)

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Sampling plan

- **300 farms**
- **Stratified sampling**, according to
 - **Farm type**
 - **Production region** (lowlands, hills, mountains)
 - **Farming system:** integrated production, organic farming

Farm type		Lowlands		Hills		Mountains		All regions		
No.	Type	IP	Organic	IP	Organic	IP	Organic	IP	Organic	Total
11	Arable crops	12						12	0	12
13	Horticulture	3						3	0	3
14	Fruit growing	3		1				4	0	4
15	Viticulture	1						1	0	1
16	Other special crops	3						3	0	3
21	Dairying	19	6	29	6	15	19	63	31	94
22	Suckling cows	2		2	1	6	5	10	6	16
23	Other cattle	1		2		9	3	12	3	15
31	Horses/sheep/goats		1	1			1	1	2	3
42	Pigs	1		1				2	0	2
43	Poultry			1			1	1	1	2
44	Other pigs/poultry							0	0	0
51	Combined dairying/arable crops	20	2	3				23	2	25
52	Combined suckling cows	2	1	3				5	1	6
53	Combined pigs/poultry	24	6	22	2	3	1	49	9	58
55	Combined others/dairying	10	1	6				16	1	17
56	Combined others/cattle	4			1			4	1	5
57	Combined not attributable	1	1		1	1		2	2	4
		106	18	71	11	34	30	211	59	270



Project LCA-FADN (5)

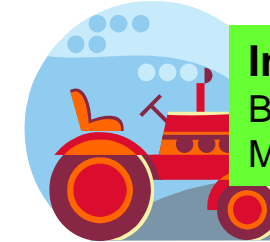
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Limits of the system: What belongs to the farm?



Animal breeding

Energy carriers

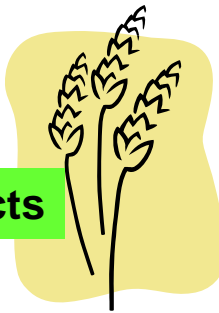


Infrastructure:
Buildings
Machines

Feedstuffs



Products



Production means:

Fertilisers
Pesticides
Plastics



Seeds

Work from third-parties on the farm



Whole agricultural area

Plant cropping

Measures:

- Soil tillage
- Fertilising
- Seeding
- Harvesting





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Project LCA-FADN (6):

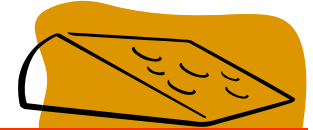
Limits of the system: What does **NOT** belong to the farm?



Forest



Household



Farm shop



Product Transformation

Work for third parties



Agro-Tourism



Non agricultural activities



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Project LCA-FADN (6): Major features of farm LCA

- Subdivision of the farm in max. **14 product groups**
 - For example: **cereals, vegetables, milk, pork** etc.
- Interpretation according to **4 types of functional units** representing the whole multifunctionality
 - **Product unit, digestible energy, area, gross profit**
- Interpretation concepts according to
 - **Impact categories** (energy demand, eutrophication, ...)
 - **Selected emissions** (nitrate, methane, ...)
 - **Input groups** (infrastructure, fertilisers, seeds, ...)
 - **Product groups**



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Project LCA-FADN (4) LCA of a farm according to SALCA

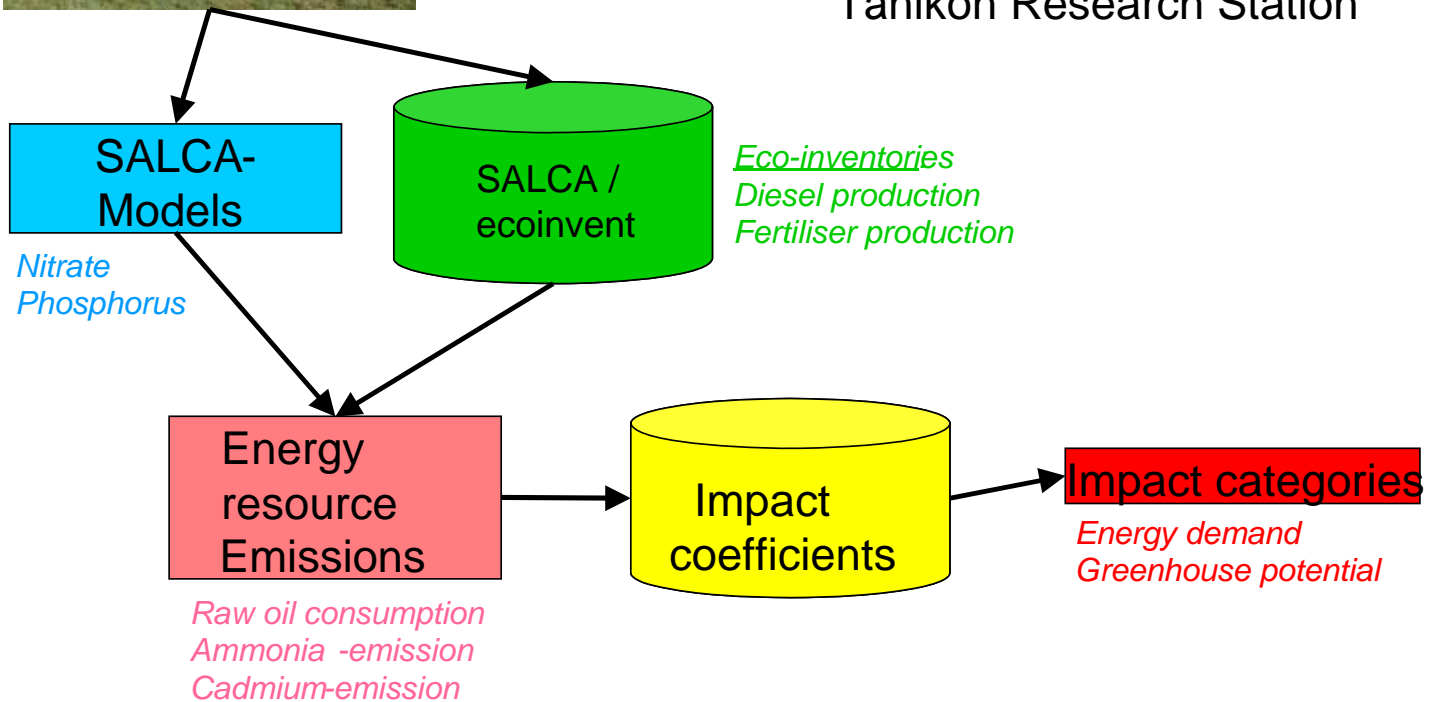


Farm Technical
Production
Data
(AGRO-TECH)

Examples
Energy carriers
Machines
Feedstuffs

SALCA =
Swiss Agricultural
Life Cycle Assessment

Developed at ART Reckenholz-
Tänikon Research Station



080307 2. Begleitgruppentreffen ZA-ÖB

2006

- Allgemeine Betriebsdaten
- Maschinen
- Gebäude / Einrichtungen
- Fruchtfolgen
- Parzellen
- Massnahmen
 - Bodenbearbeitung
 - Saat/Pflanzung
 - Düngung
 - Pflanzenschutz / Pflege
 - Ernte Futterbau
 - Ernte übrige Kulturen
 - Diverses
- Tierbestand
- Hofdünger
- Zu-/ Wegfuhr Düngemittel
- Futtermittel / Stroh
 - Verfütterung AF/ Stroh
 - Künstliche Trocknung
 - Zu-/ Wegfuhr GF/ Stroh
 - Zufuhr Ergänzungsfutter
- Energieträger und Hilfsstoffe
- Produkteverwertung
 - Pflanzliche Produkte
 - Milch / übrige tier. Produkte
 - Tiere

Allgemeine Betriebsdaten 20

Betriebsname (*)	2. Begleitgruppentreffen ZA-ÖB	Höhe (m über Meer) (*)	441
Gemeinde	Zürich	Anzahl Hochstamm bäume	3
Kanton	Zürich	Anzahl Einzelbäume	1
Sprache Betrieb	Deutsch	Ges. Betriebsfläche (ha)	26.85
Prod.-katasterzone	Ackerbauzone	Landw. Nutzfläche (ha) (*)	26
Klimazone	Ackerbau und Futterbau begünstigt	Grossvieheinheiten (GVE)	14
Rechtsform	Natürliche Person	Wird Heu belüftet ?	Ja
Betriebsform	Landwirtschaftsbetrieb (ohne Sömmerung)	Milch silofrei hergestellt	Ja
Betriebsleitung	Einzelbetrieb	Stalleinrichtung für Milchkuhe	vorwiegend in
Produktionsform	Mit Ökonachweis	Umstellungsjahr BIO	
Eigentumsform	Betrieb im Eigentum	In Pacht seit Jahr	
Zusammenarbeitsform	Einzelbetrieb	Anz. Betriebe in Gemeinschaft	
Betriebszweiggemeinschaft 1		Anz. Betriebe Betriebszweiggemeinschaft 1	
Betriebszweiggemeinschaft 2		Anz. Betriebe Betriebszweiggemeinschaft 2	
Betriebsnummer BUR		TVD berücksichtigen / TVD-Nr	<input type="checkbox"/> <input type="text"/>
Betriebsnummer Kanton		Betriebsnummer BIO	<input type="text"/>
Buchstellen-Nr. aktuell (*)	77777777		
Buchstellen-Nr. vorgängig			
Buchhaltungs-Nr. aktuell	80307		
Buchhaltungs-Nr. vor BU			
Buchhaltungs-Nr. vor Bst-W			

Allgemeine Betriebsdaten

Geben Sie hier Ihre **Allgemeinen Betriebsdaten** ein.

Folgende Angaben sind **obligatorisch**:

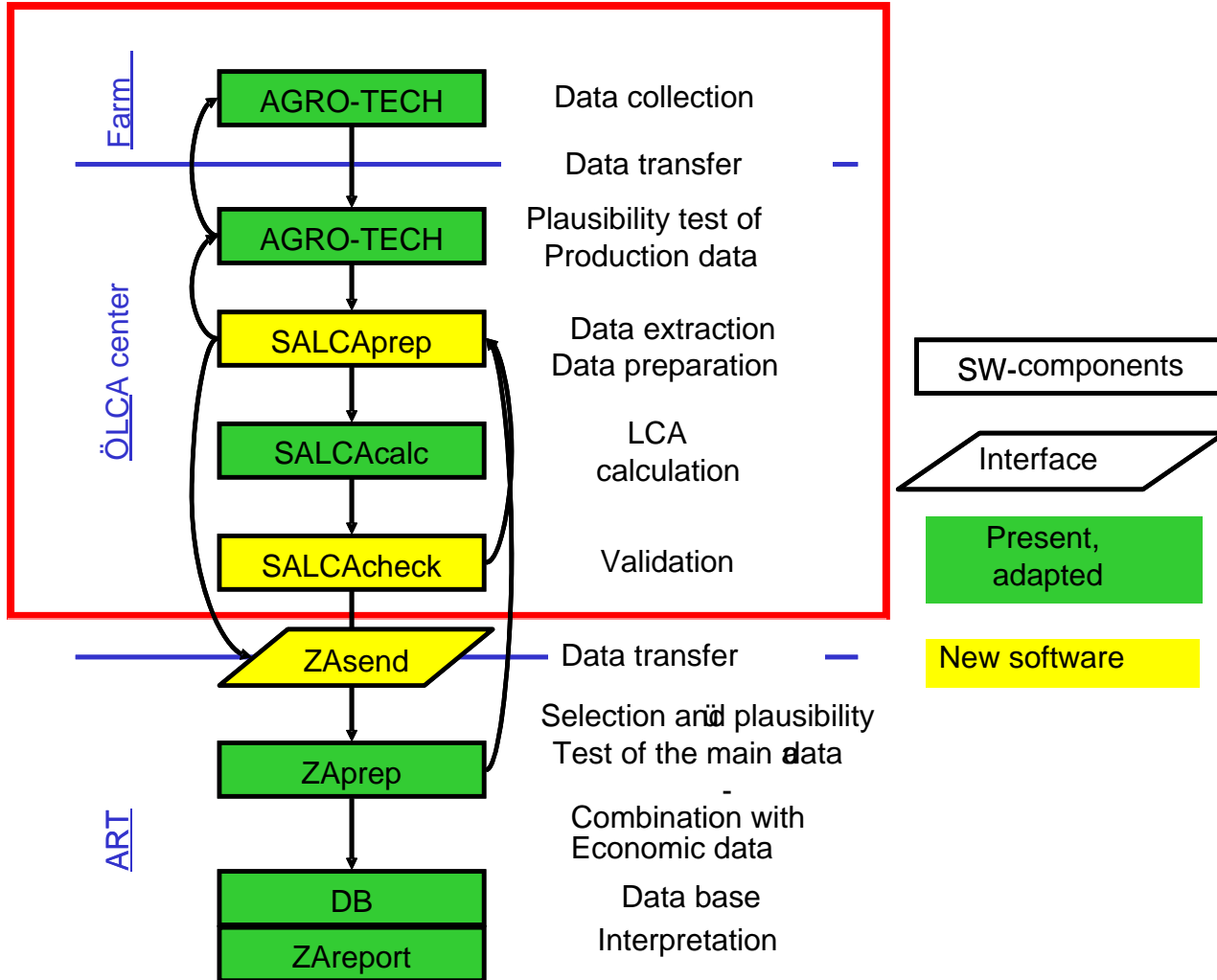
- **Betriebsname**
- **Kanton**
- **Prod.-Katasterzone**
- **Produktionsform**
- **Buchstellen Nummer aktuell**
- **Höhe (m über dem Meer)**
- **Landw. Nutzfläche**

Wenn Sie alle **Allgemeinen Betriebsdaten** erfasst haben, aktivieren Sie **Speichern**.



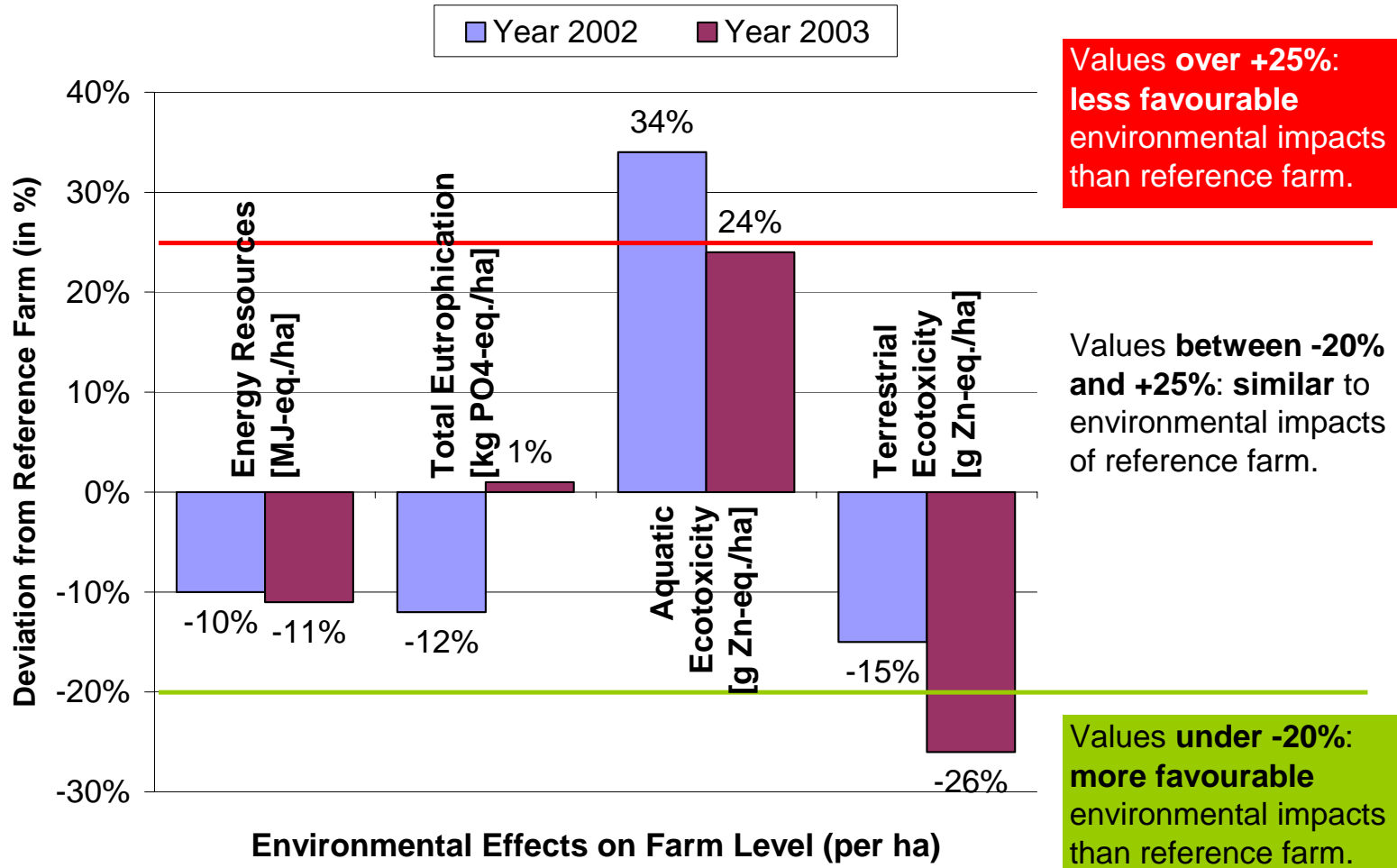
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Project LCA-FADN (7): Information technology infrastructure





Project LCA-FADN (7): Interpretation - Principle

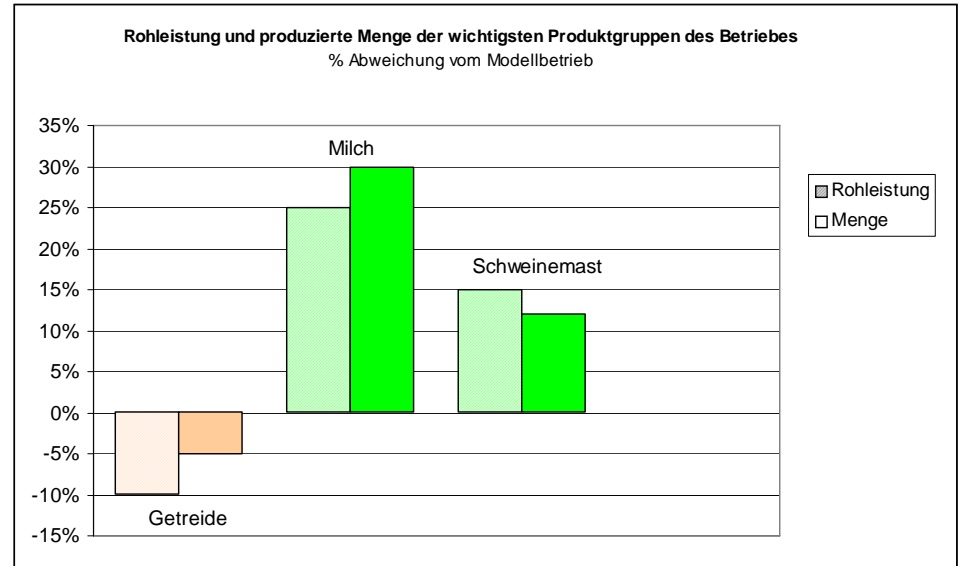
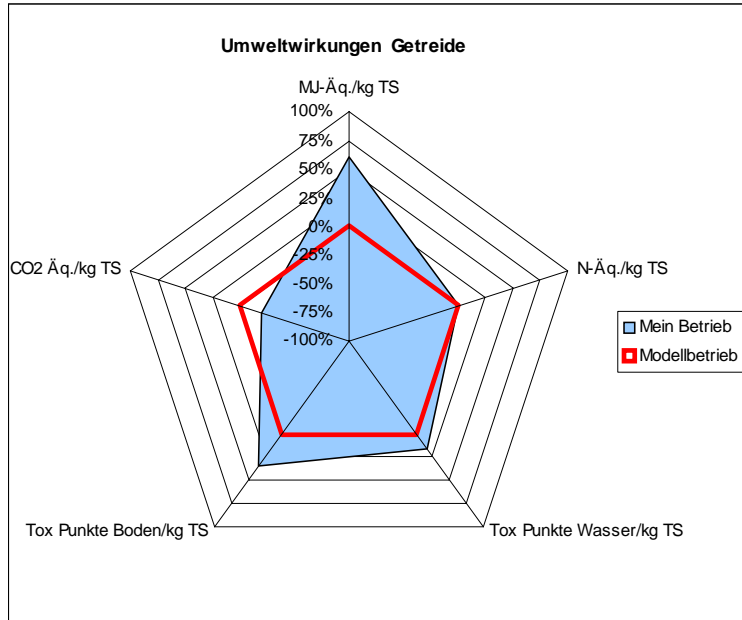


Source: COMETE (Bockstaller *et al.* 2006)



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Project LCA-FADN (8): Interpretation – Communication (Examples)



	Energiebedarf (MJ)		Treibhauspotenzial (CO ₂ -Äq.)		Nährstoffanreicherung (N-Äq.)		Schadstoffwirkung Boden (Tox-Punkte)		Schadstoffwirkung Wasser (Tox-Punkte)		Verdauliche Energie (MJ)		Rohleistung (CHF)	
	B	M	B	M	B	M	B	M	B	M	B	M	B	M
Getreide	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Schw.mast	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Milch	X	X	X	X	X	X	X	X	X	X	X	X	X	X



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Conclusion

- Efficient reduction of the environmental impact requires the *implementation of Life Cycle Thinking by farmers*
- It is a *very challenging task!*
- *Required* are:
 - Training of **Farmers** and **extension services** in LCM principles
 - **Information technology infrastructure**
 - Interpretation and **communication concepts** of LCA results
- *Test on 300 farms* under way
 - **Data** for 100 farms collected; 200 additional farms recruited
 - **Software programmes** in implementation
 - **Interpretation and communication concepts** in test