Research Institute of Organic Agriculture FiBL
info.suisse@fibl.org | www.fibl.org




Biodiversity, environmental values and LCA: An interdisciplinary perspective

Dr. Michael Curran

Dept. of Socio-Economic Sciences, FiBL

79th LCA Discussion Forum

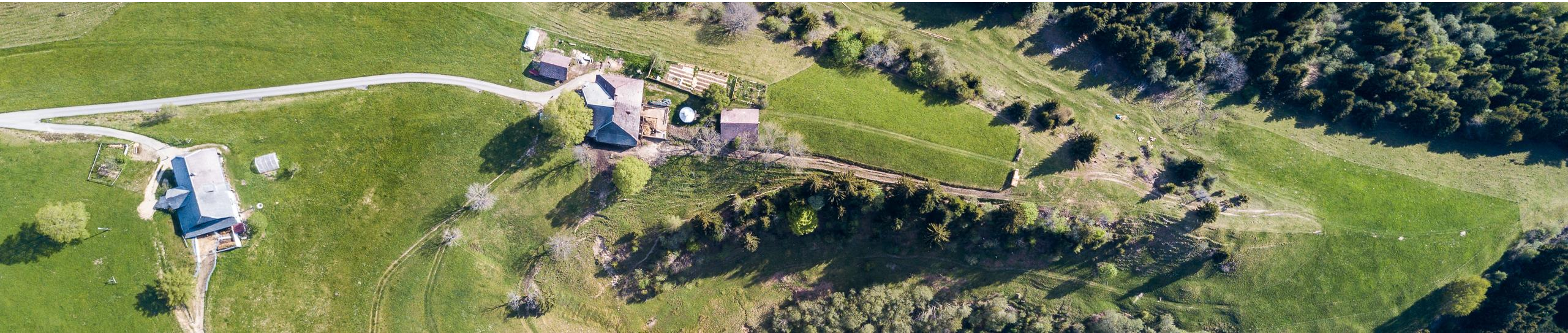
18th November 2021, Zurich

FiBL Switzerland at a glance

- Founded in 1973, private foundation
- 190 staff members
- 70 interns, B.A./Master/PhD students, apprentice
- Research on over 200 Swiss organic farms

Presentation overview

1. Agriculture, biodiversity, ecosystem services and values
2. Agriculture as co-production process of material/non-material outputs
3. Allocation in LCA and non-material outputs
4. Need for new value-led approaches for allocation



Agricultural systems are multifunctional and co-produce many outputs

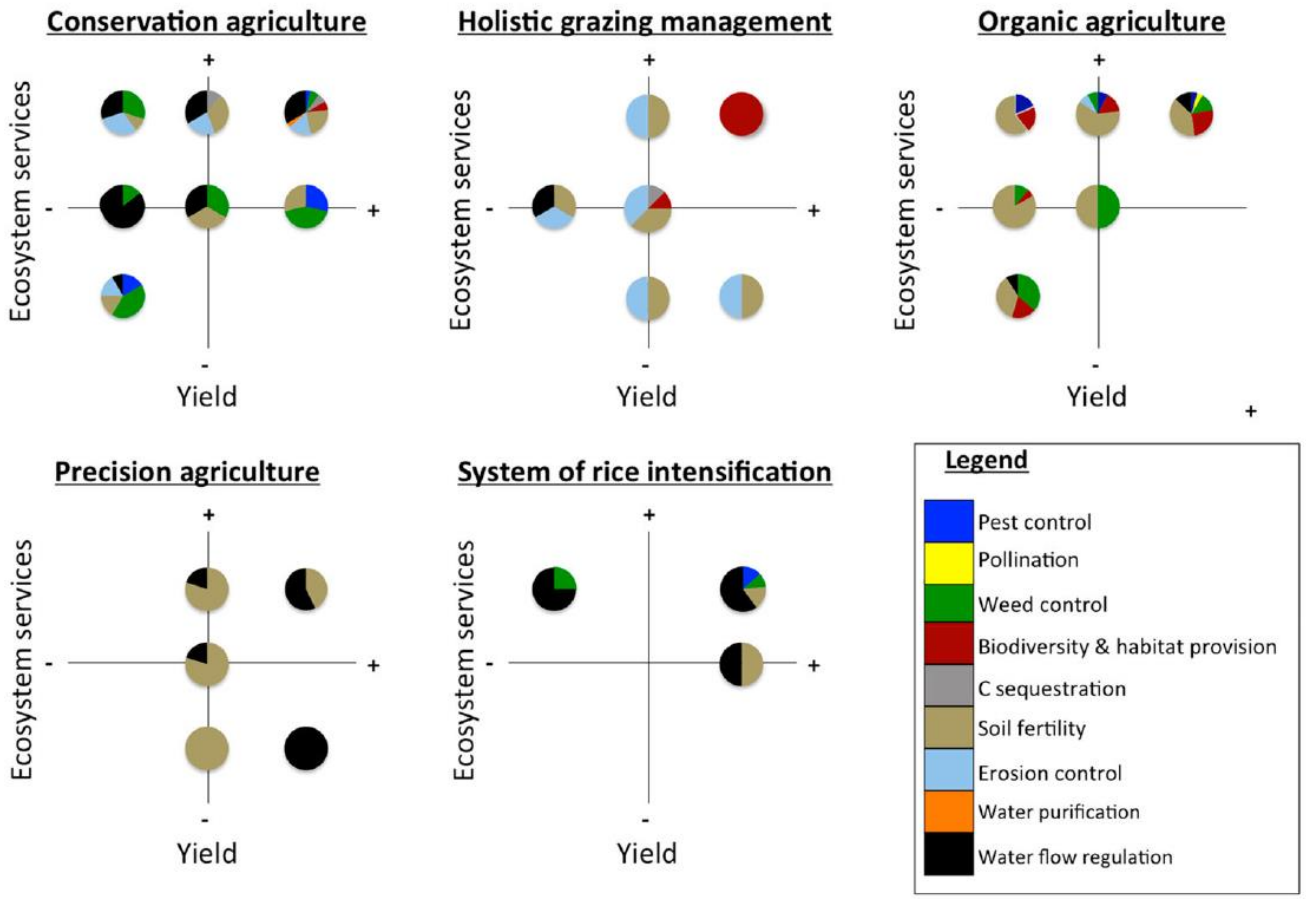
Agroecology, biodiversity and ecosystem services

- Farming systems are typified by multifunctionality
- Multiple outputs beyond the marketed products
- Valued and non-valued goods and services, material and non-material outputs, public and private goods

FiBL

Agroecology, biodiversity and ecosystem services

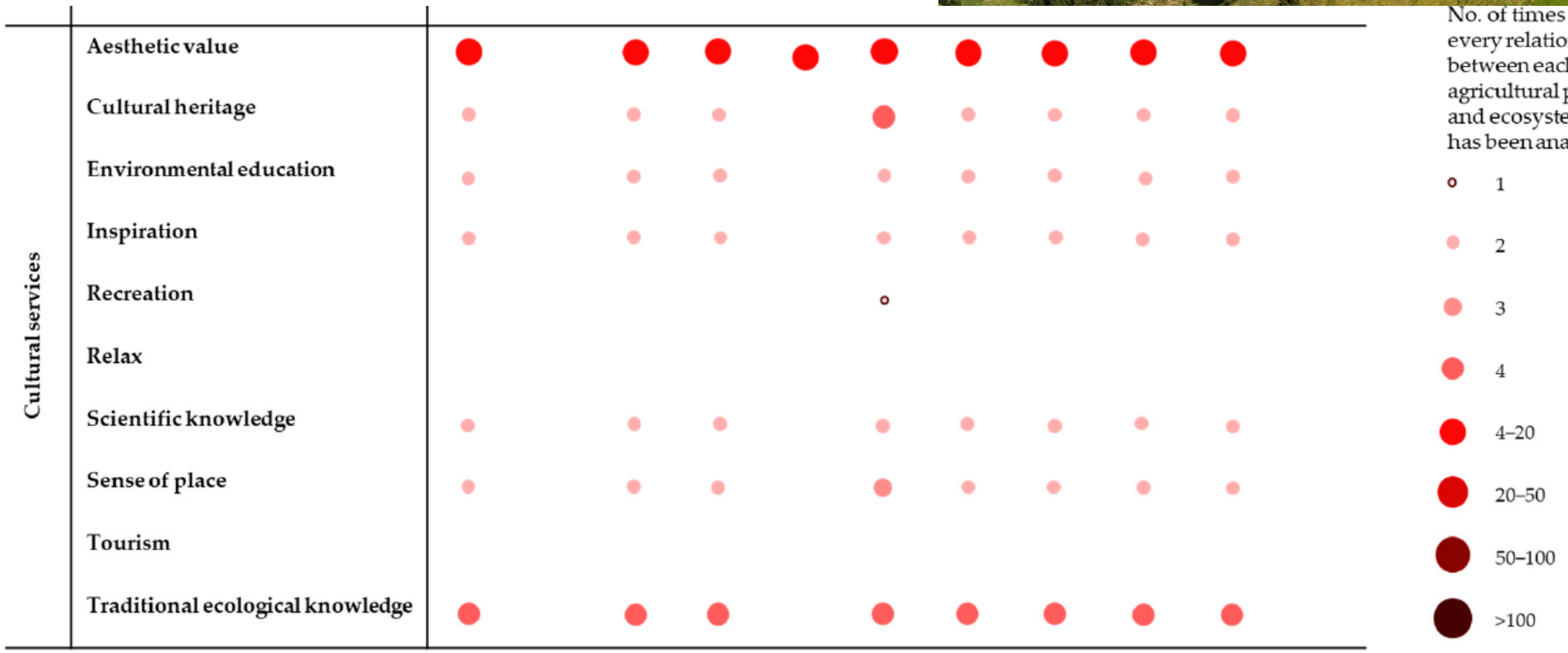
- Farming systems are typified by multifunctionality
- Multiple outputs beyond the marketed products
- Valued and non-valued goods and services, material and non-material outputs, public and private goods



Garbach, K., J. C. Milder, F. A. J. DeClerck, M. Montenegro de Wit, L. Driscoll, and B. Gemmill-Herren. 2017. Examining multi-functionality for crop yield and ecosystem services in five systems of agroecological intensification. International Journal of Agricultural Sustainability 15:11–28.

FiBL

Agroecology, biodiversity and ecosystem services

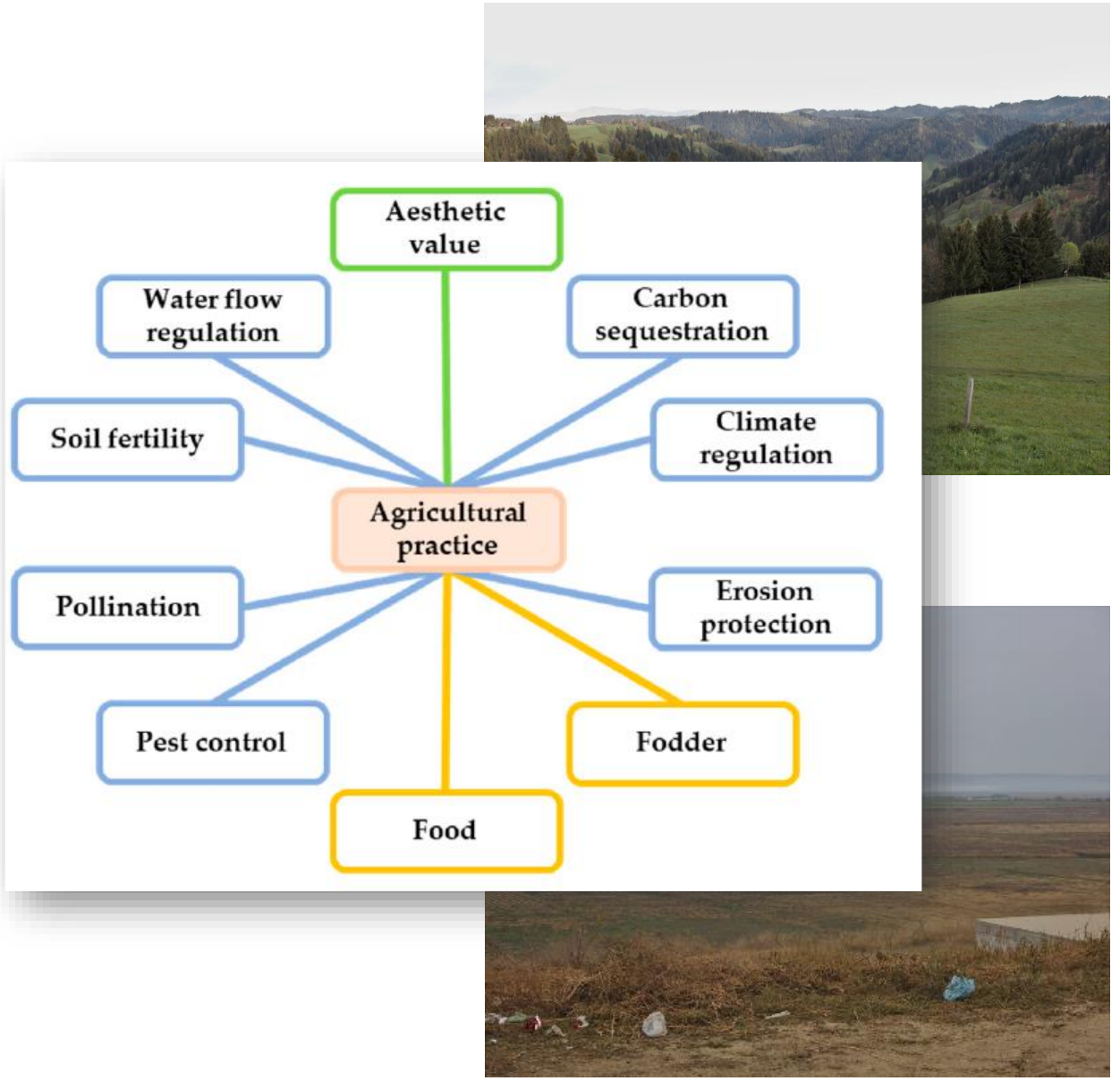


Palomo-Campesino, S., J. A. González, and M. García-Llorente. 2018. Exploring the Connections between Agroecological Practices and Ecosystem Services: A Systematic Literature Review. Sustainability 10:4339.

FiBL

Agroecology, biodiversity and ecosystem services

- LCA deals with co-production via allocation or system expansion
- Allocation is often unavoidable (particularly in agriculture)
- Substantial non-material outputs (cultural values) poses a particular problem



FiBL

Allocation in LCA

- Biophysical allocation is recommended using physical causal relationships
- Criticized as problematic and not better than non-physical, monetary allocation (Mackenzie et al. (2017)
- Cannot deal with non-material outputs (missing causality)

Table 3: Distribution (%) of environmental burden to milk with different ways of handling co-product allocation

Burdens	No allocation = 100	Economic allocation	'Biological' allocation	System expansion
Energy	100	92	85	87
Land use	100	92	85	66
Pesticide use	100	92	85	100
Climate change	100	92	85	63
Acidification	100	92	85	60
Eutrophication	100	92	85	60

Cederberg, C., and M. Stadig. 2003. System expansion and allocation in life cycle assessment of milk and beef production. The International Journal of Life Cycle Assessment 8:350–356.
Mackenzie, S. G., I. Leinonen, and I. Kyriazakis. 2017. The need for co-product allocation in the life cycle assessment of agricultural systems—is "biophysical" allocation progress? The International Journal of Life Cycle Assessment 22:128–137.

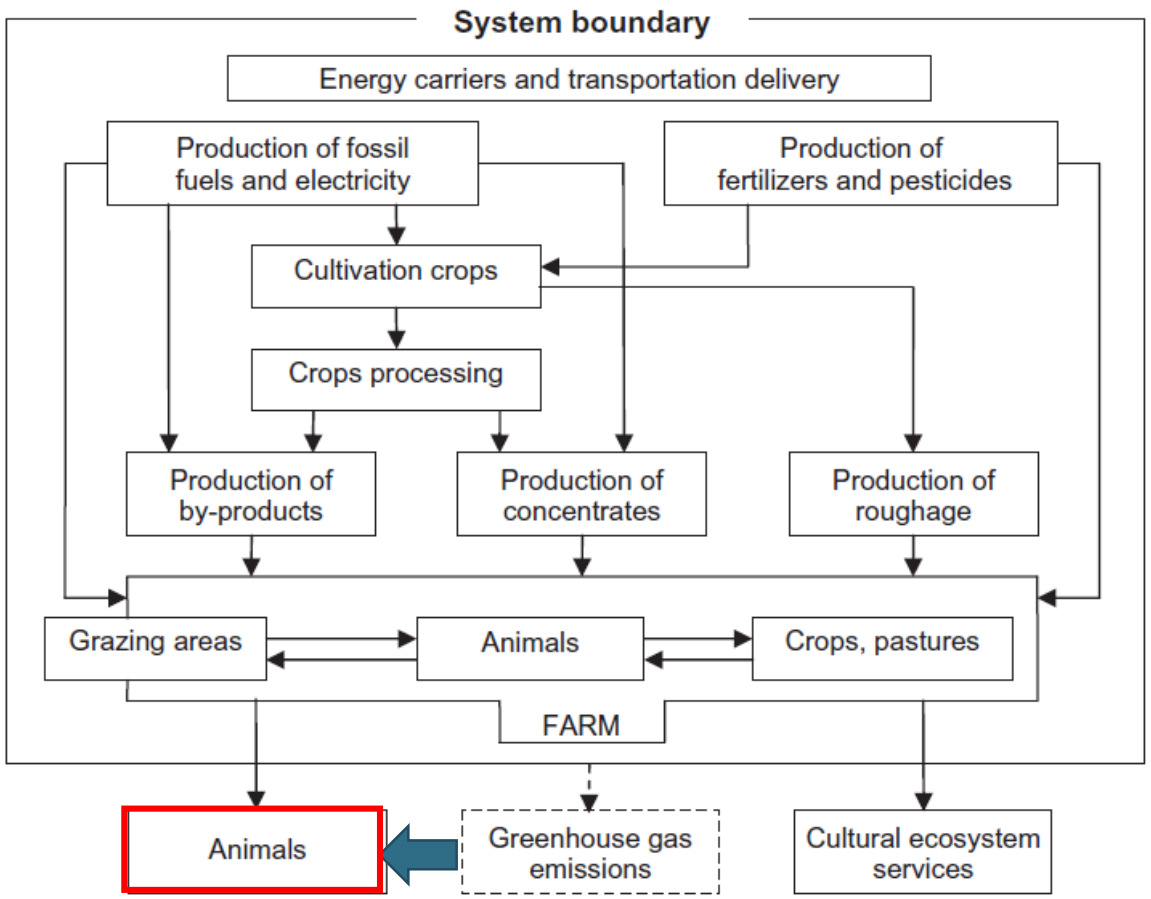
FiBL

Allocation in LCA

- Non-physical outputs, if adequately valued, can invert the direction of product comparisons
- Intensive versus extensive grazing systems

Intensive

Extensive



Allocation of emissions

Ripoll-Bosch, R., I. J. M. de Boer, A. Bernués, and T. V. Vellinga. 2013. Accounting for multi-functionality of sheep farming in the carbon footprint of lamb: A comparison of three contrasting Mediterranean systems. Agricultural Systems 116:60–68.

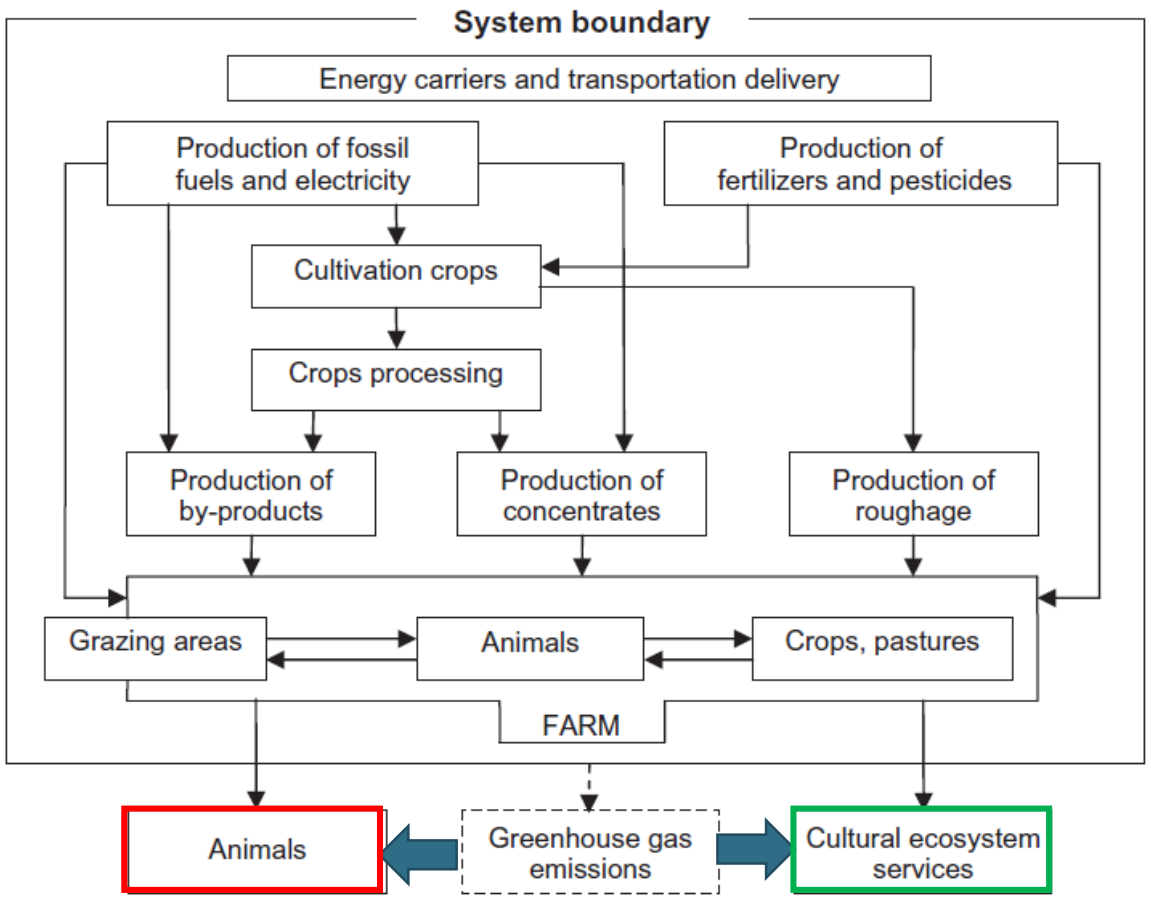
FiBL

Allocation in LCA

- Non-physical outputs, if adequately valued, can invert the direction of product comparisons
- Intensive versus extensive grazing systems

Intensive

Extensive



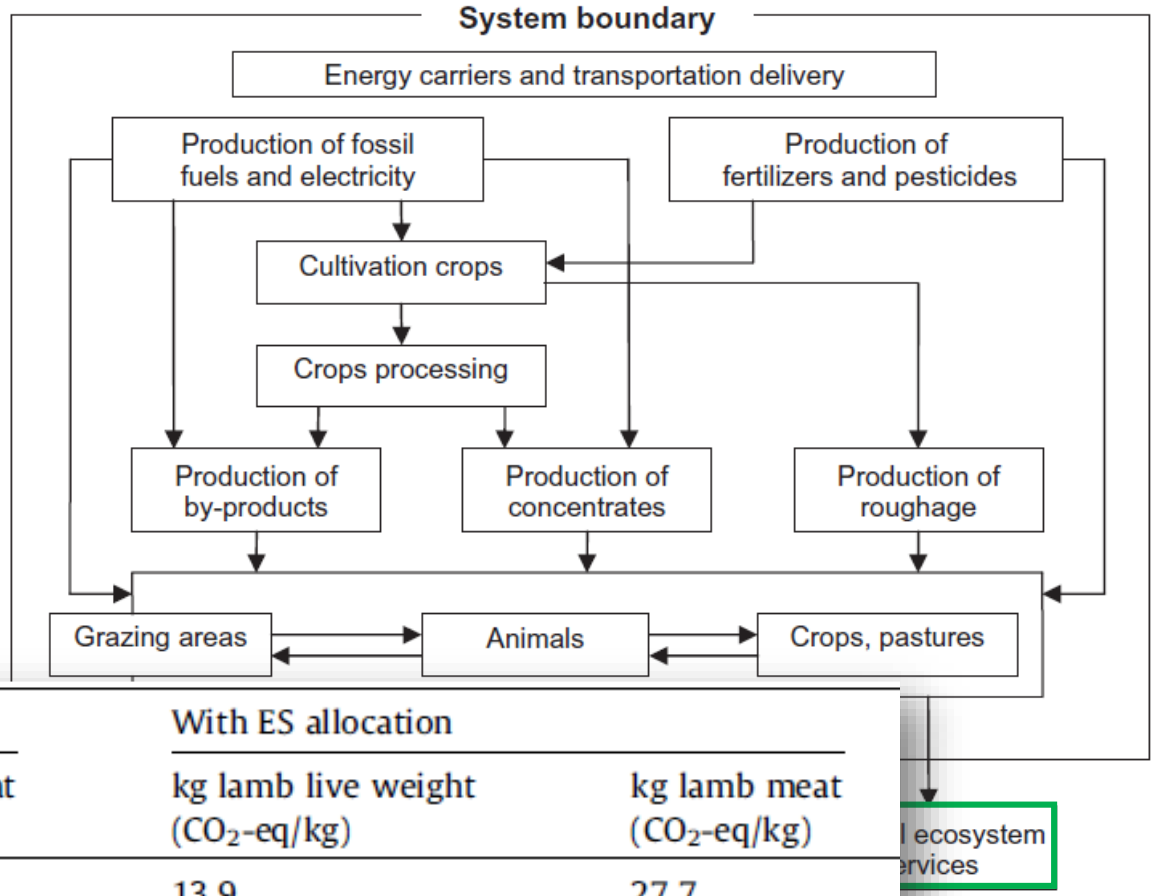
Allocation of emissions

Ripoll-Bosch, R., I. J. M. de Boer, A. Bernués, and T. V. Vellinga. 2013. Accounting for multi-functionality of sheep farming in the carbon footprint of lamb: A comparison of three contrasting Mediterranean systems. Agricultural Systems 116:60–68.

FiBL

Allocation in LCA

- Non-physical outputs, if adequately valued, can invert the direction of product comparisons
- Intensive versus extensive grazing systems



	Without ES allocation		With ES allocation	
	kg lamb live weight (CO_2-eq/kg)	kg lamb meat (CO_2-eq/kg)	kg lamb live weight (CO_2-eq/kg)	kg lamb meat (CO_2-eq/kg)
Pasture-based	25.9	51.7	13.9	27.7
Mixed	24.0	47.9	17.7	35.4
Zero-grazing	19.5	38.9	19.5	39.0

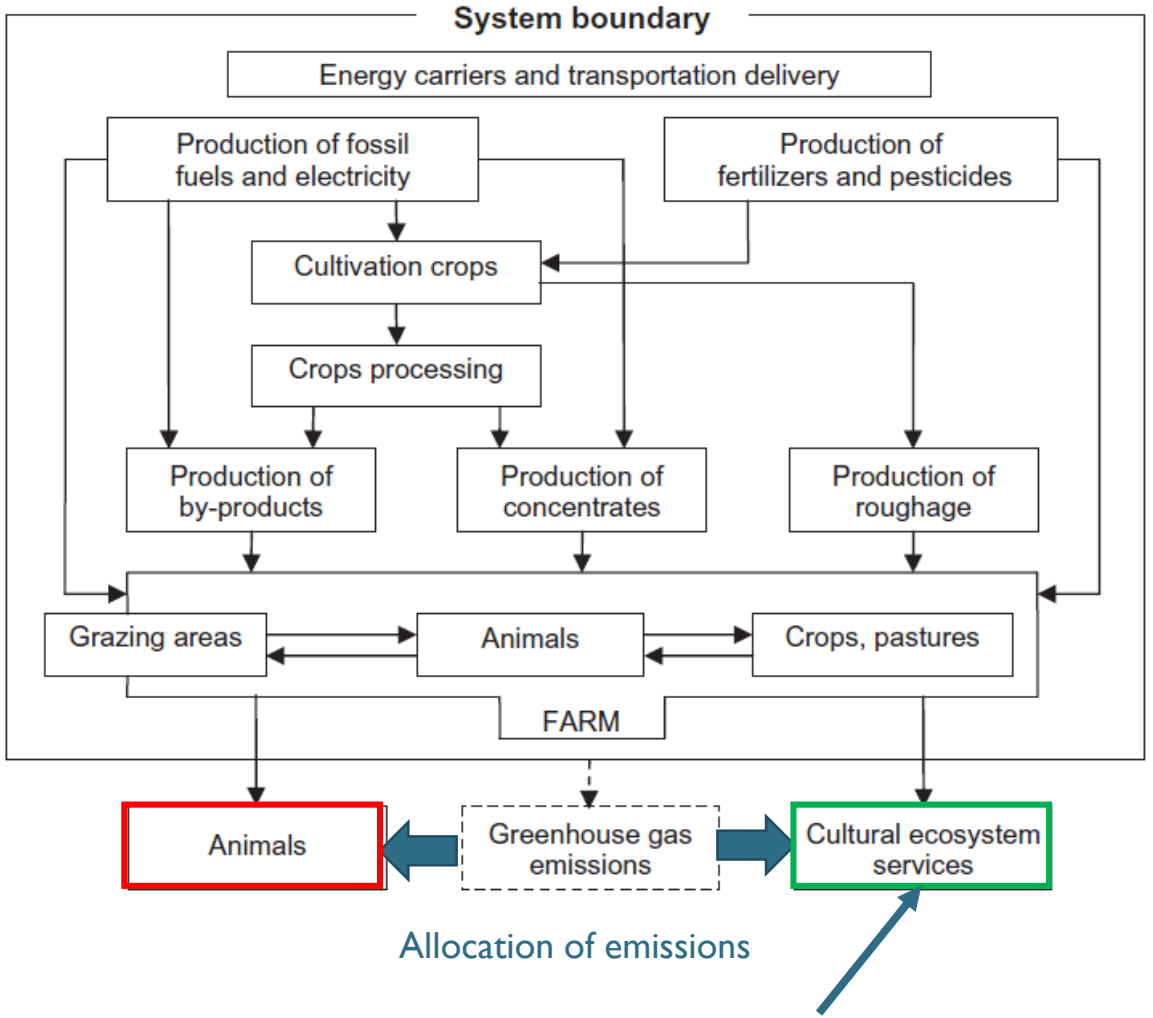
ES: ecosystem services.

Ripoll-Bosch, R., I. J. M. de Boer, A. Bernués, and T. V. Vellinga. 2013. Accounting for multi-functionality of sheep farming in the carbon footprint of lamb: A comparison of three contrasting Mediterranean systems. Agricultural Systems 116:60–68.

FiBL

Environmental valuation

- Valuation plays a key role in non-physical allocation
- Monetary allocation the only common value-led approach
  - Prices reflect complex properties of products that influence consumer choice
  - Captures "societal cause" of emissions
- Prices limited to markets, no use for public goods and services (e.g. many Ecosystem Services)



Ripoll-Bosch, R., I. J. M. de Boer, A. Bernués, and T. V. Vellinga. 2013. Accounting for multi-functionality of sheep farming in the carbon footprint of lamb: A comparison of three contrasting Mediterranean systems. Agricultural Systems 116:60–68.

FiBL

Environmental valuation

- Prices need to be supplemented with valuation approaches
- Monetary valuation alone is very problematic
- Plurality of valuation methods have emerged in recent years
- Need for interdisciplinary research to explore "value-led approaches"

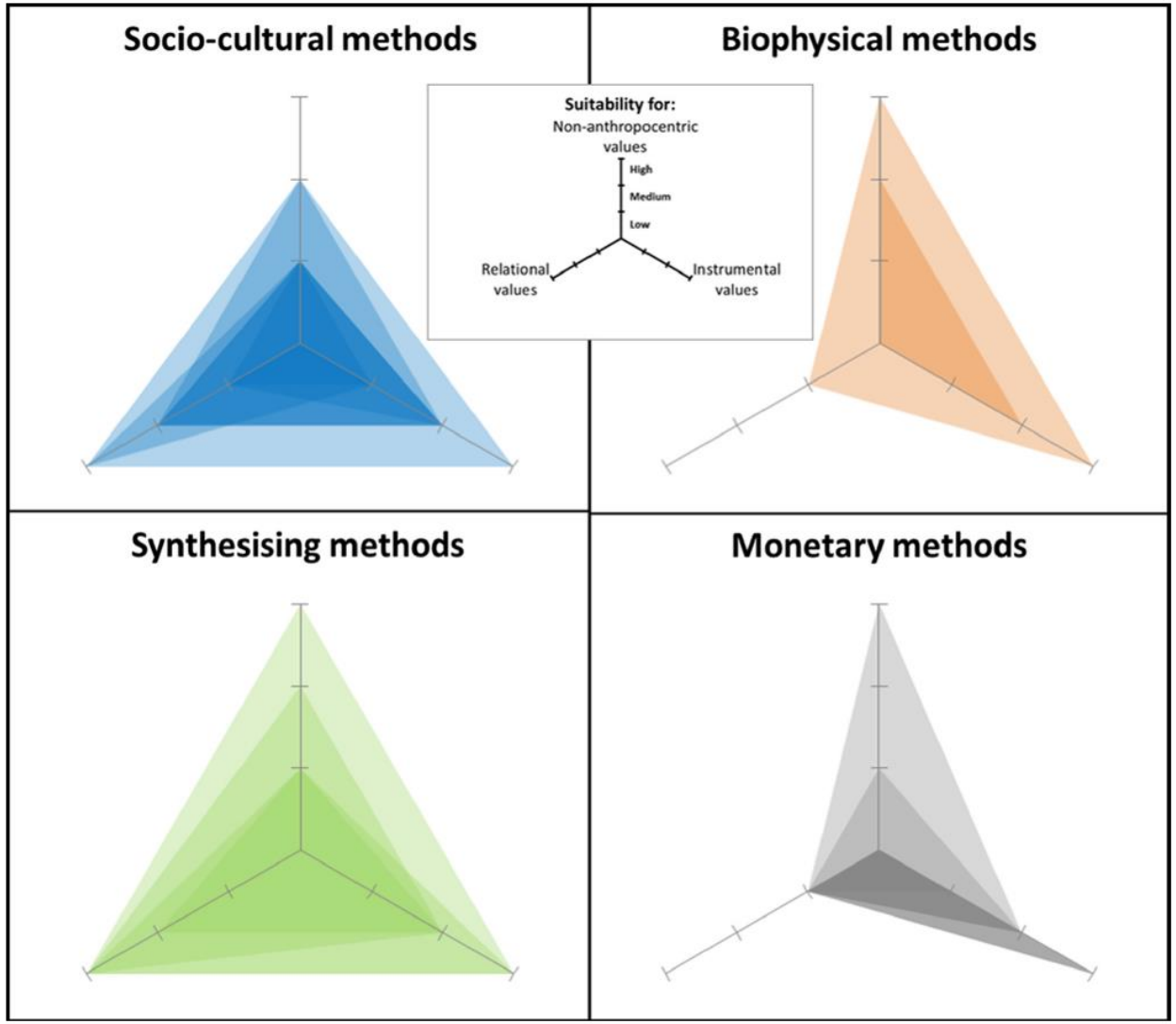
Framework	Category of value
Total Economic Value (TEV)	Direct use values (e.g. provisioning services) Indirect use values (e.g. regulation of air pollution) Option values (e.g. preservation of forests for future use and other values) Bequest values (non-use, e.g. natural heritage and cultural heritage for future generations,...) Existence values (non-use, e.g. existence of diverse species and ecosystems)
The Economics of Ecosystems and Biodiversity (TEEB)	Ecological values (e.g. resilience, biodiversity or functioning ecosystem,...) Sociocultural values (e.g. heritage, sense of place or spirituality) Monetary values (e.g. jobs, profits, costs or investments)
Intergovernmental Platform of Biodiversity and Ecosystem Services (IPBES)	Non-anthropocentric value dimension[a] Instrumental value dimension Relational value dimension

Jacobs, S., B. Martín-López, D. N. Barton, R. Dunford, P. A. Harrison, E. Kelemen, H. Saarikoski, M. Termansen, M. García-Llorente, E. Gómez-Baggethun, L. Kopperoinen, S. Luque, I. Palomo, J. A. Priess, G. M. Rusch, P. Tenerelli, F. Turkelboom, R. Demeyer, J. Hauck, H. Keune, and R. Smith. 2018. The means determine the end – Pursuing integrated valuation in practice. Ecosystem Services 29:515–528.

FiBL

Environmental valuation

- Prices need to be supplemented with valuation approaches
- Monetary valuation alone is very problematic
- Plurality of valuation methods have emerged in recent years
- Need for interdisciplinary research to explore "value-led approaches"



Jacobs, S., B. Martín-López, D. N. Barton, R. Dunford, P. A. Harrison, E. Kelemen, H. Saarikoski, M. Termansen, M. García-Llorente, E. Gómez-Baggethun, L. Kopperoinen, S. Luque, I. Palomo, J. A. Priess, G. M. Rusch, P. Tenerelli, F. Turkelboom, R. Demeyer, J. Hauck, H. Keune, and R. Smith. 2018. The means determine the end – Pursuing integrated valuation in practice. Ecosystem Services 29:515–528.

FiBL

Conclusions

- Co-production in agriculture presents a major challenge to LCA
- Existing allocation methods cannot capture non-material, non-marketed ecosystem services
- Public goods and services fall within the remit of LCA, and thus should not be ignored
- The "production" of public goods and services also has an "environmental cost" that should be reflected in LCA
- Inclusion of plural values and other non-marketed ESs can profoundly impact the results of comparative LCAs
- Extensive (agroecological, organic) systems are the likely losers of this oversight
- New interdisciplinary research is required to explore the potential of a "value-led" approach to sustainability assessment and LCA

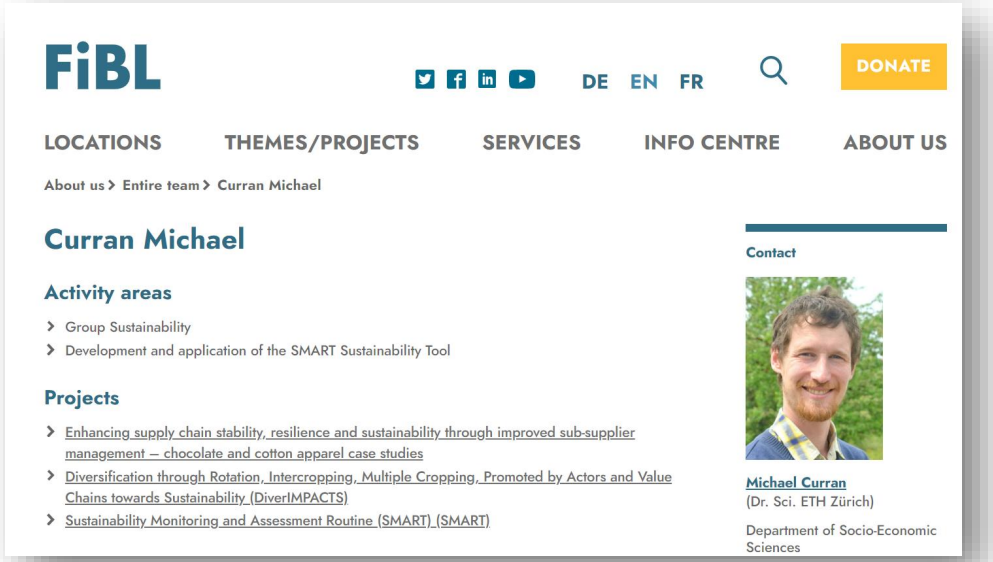
FiBL

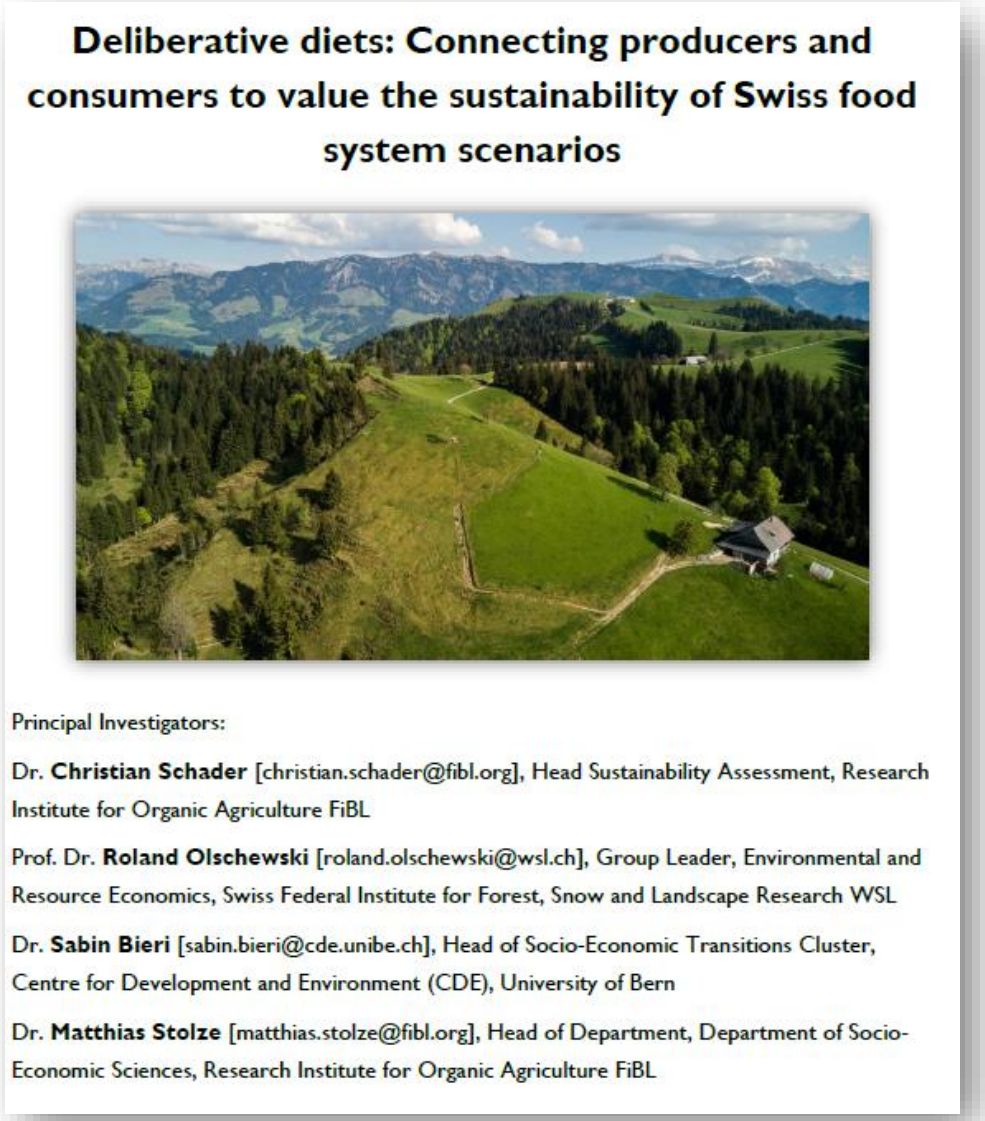
Thank you for your attention

Michael Curran

Research Institute of Organic Agriculture FiBL
Ackerstrasse 113, Box 219
5070 Frick
Switzerland

michael.curran@fibl.org
www.fibl.org





FiBL

About the speaker

Michael Curran

- Agricultural research since 2018
- Indicator-based (multi-criteria) sustainability assessment
- https://www.fibl.org/en/about-us/team/curran-michael-en.html

Background

- PhD in ecology, conservation, sustainability sciences
- Further education in agriculture (3 ha farm in Emmental, 1000 m a.s.l, mixed vegetables, breeding ewes, direct sale)