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Research Institute of
Organic Agriculture
Switzerland

Joint Bachelor Course on Organic Agriculture 2014

Lecture 2: Organic agriculture as multifunctional model for economic, social and ecological goals

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SNF/SCOPES

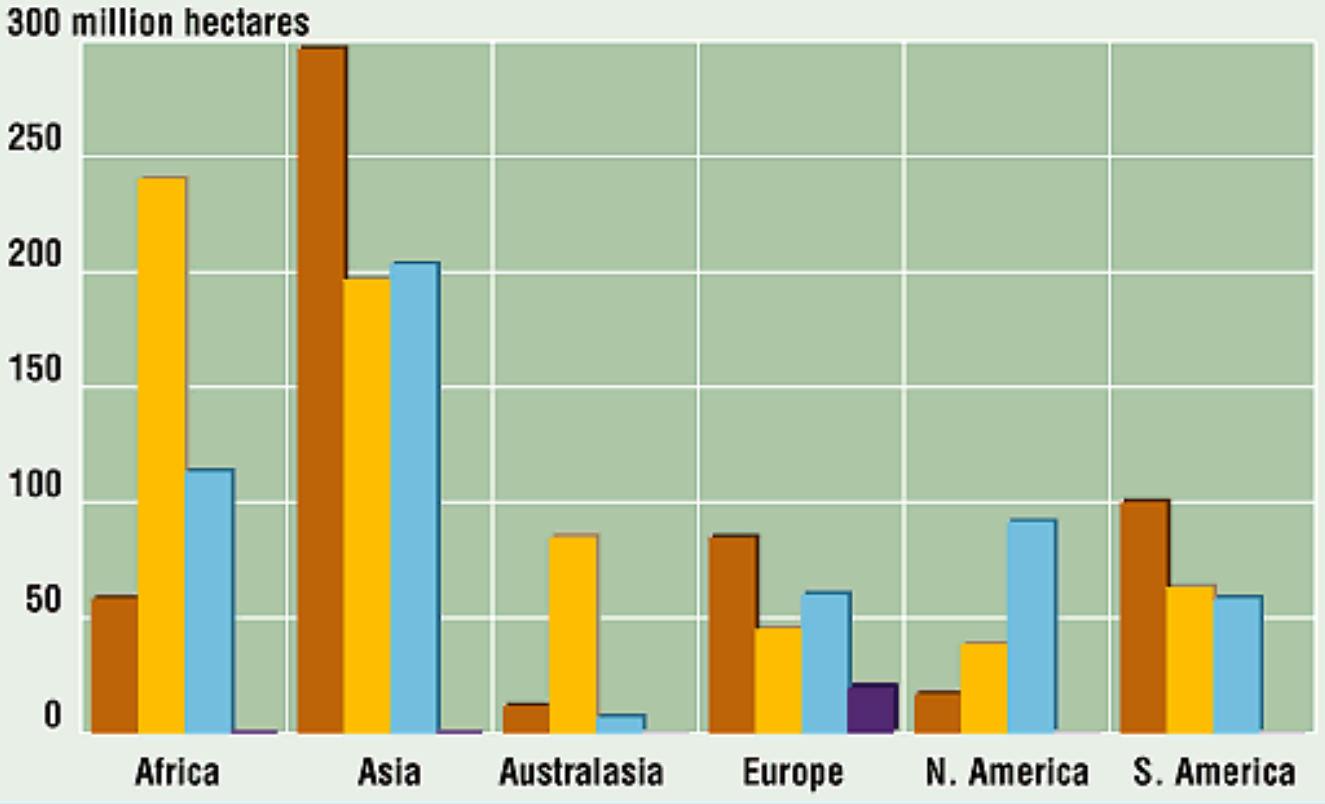
Conventional / industrialised agriculture

- Production/outcome oriented (high yields/turnovers in short time)
- Reducing regional and local landscape characteristics
- Favouring large farms and wide distribution
- Value chain
  - Distorting world market (complex import export structures, added value detached from environmental service and regional development)
  - Questionable burden sharing along value and production chain

Environmental impacts

- Devastating environmental consequences
- Biodiversity (losses of species, varieties, habitats, beneficial interactive services)
- Aquatic ecosystem
- Air (pollution by agricultural emission (e.g. methane), no compensation potential carbon sequestration)
- Surface degradation (destroyed ecosystem functionality, no natural cycles)
- Soil degradation/ salinisation/ contamination (e.g. pesticide residues)
  - Structural degradation (physical and bio-chemical (nutrients) attributes stopped)
  - intensive soil management, inadequate techniques, inadequate crop rotation, monoculture, specialisation

MAIN CAUSES OF DRYLAND SOIL DEGRADATION BY REGION



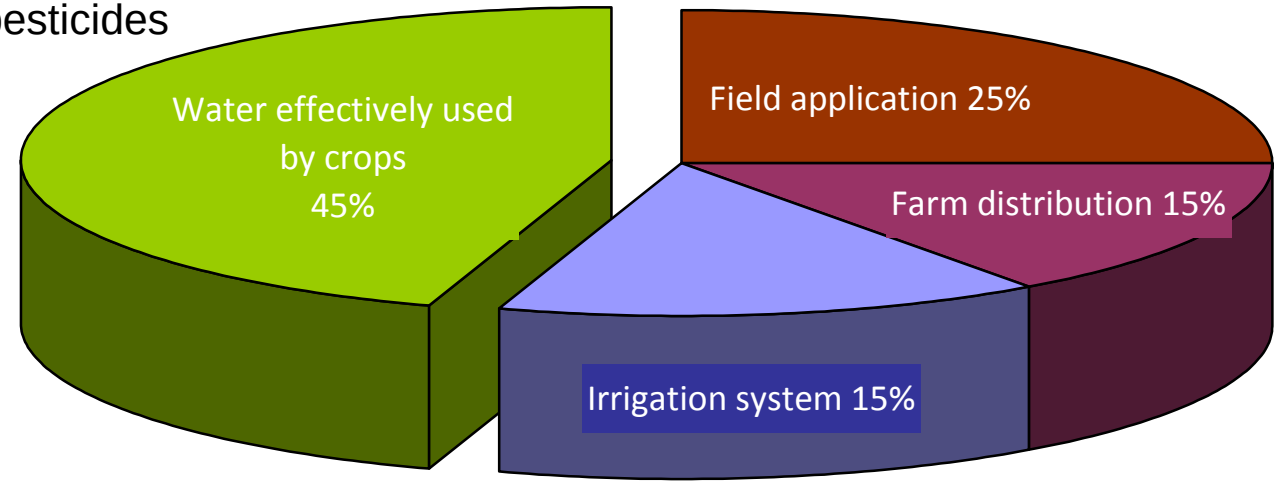
Desertification does not refer to the moving forward of existing deserts but to the formation, expansion or intensification of degraded patches of soil and vegetation cover.

Source: FAO

Negative environmental effects of intensive agriculture

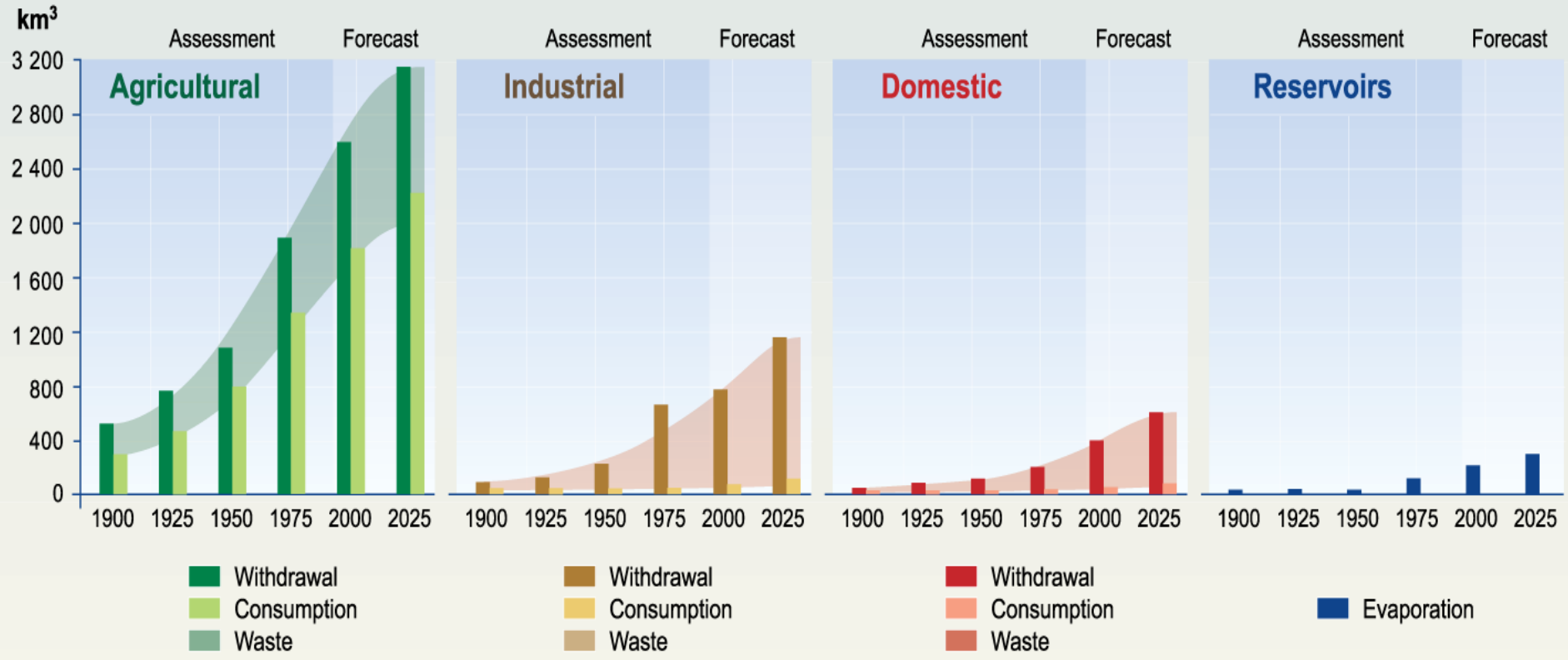
Ground and surface water

- Mismanaged agricultural water use damages yield quality
  - crop specific permanent welting point
  - appropriate amount of water at needed time
    - E.g. avoid mouldering and deformed development
- Losses
  - inappropriate irrigation methods increasing evapotranspiration, surface run-off, lacking water holding capacity (strong infiltration, fertile soil lacks water)
  - Need of balanced irrigation-drainage farm system via adequate soil management (e.g. avoiding soil covering)
- Contamination
  - chemical fertilisers, pesticides



Evolution of Global Water Use

Withdrawal and Consumption by Sector



UNEP

Note: Domestic water consumption in developed countries (500-800 litres per person per day) is about six times greater than in developing countries (60-150 litres per person per day).

PHILIPPE REKACEWICZ
FEBRUARY 2002

Source: Igor A. Shiklomanov, State Hydrological Institute (SHI, St. Petersburg) and United Nations Educational,Scientific and Cultural Organisation (UNESCO, Paris), 1999.

Aral sea

- Wrong irrigation methods of cotton fields
  - Over exploitation
    - Water amount decreased -90%
    - Surface decreased -75%
- No proper soil management
- Too intensive use of chemicals
  - Reduced fish population
  - Health problems (respiratory diseases because of the polluted sediment)
  - Social problems by population (no fish – no job)

Environmental pollution is not only an ecological but as well a socio-economic problem

The annual total external costs of UK agriculture, 1996 (range values for 1990–1996)[a]

Cost category	UK (£ million)	Range[b] (£ million)
1. Damage to natural capital — water		
1a. Pesticides in sources of drinking water	120	84–129
1b. Nitrate in sources of drinking water	16	8–33
1c. Phosphate and soil in sources of drinking water	55	22–90
1d. Zoonoses (esp. *Cryptosporidium*) in sources of drinking water	23	15–30
1e. Eutrophication and pollution incidents (fertilisers, animal wastes, sheep dips)	6	4–7
1f. Monitoring and advice on pesticides and nutrients	11	8–11
2. Damage to natural capital — air		
2a. Emissions of methane	280	248–376
2b. Emissions of ammonia	48	23–72
2c. Emissions of nitrous oxide	738	418–1700
2d. Emissions of carbon dioxide	47	35–85
3. Damage to natural capital — soil		
3a. Off-site damage caused by erosion[c]	14	8–30
3b. Organic matter and carbon dioxide losses from soils	82	59–140
4. Damage to natural capital — biodiversity and landscape		
4a. Biodiversity/wildlife losses (habitats and species)	25	10–35
4b. Hedgerows and drystone walls	99	73–122
4c. Bee colony losses	2	1–2
4d. Agricultural biodiversity	+[d]	+
5. Damage to human health — pesticides		
5a. Acute effects	1	0.4–1.6
5b. Chronic effects	+	+
6. Damage to human health — nitrate	0	0
7. Damage to human health: microorganisms and other disease agents		
7a. Bacterial and viral outbreaks in food	169	100–243
7b. Antibiotic resistance	+	+
7c. BSE[e] and nvCJD	607	33–800
Total	2343	1149–3907

Pretty et al. 2000

Organic agriculture as a multifunctional model

Solution on the problems of conventional agriculture is a new multifunctional agricultural model

- In addition to food security, it is possible to organise the contributions of agriculture and related land-use into three main sets of functions
  - Environmental, economic, social

The three functions are strongly inter-related. Their relative importance depends on strategic choices at the local and national levels. Similarly, their impacts should be evaluated over time.

Organic agriculture is a working model for multifunctional agriculture

Definition of organic agriculture

"Organic Agriculture is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic Agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved."

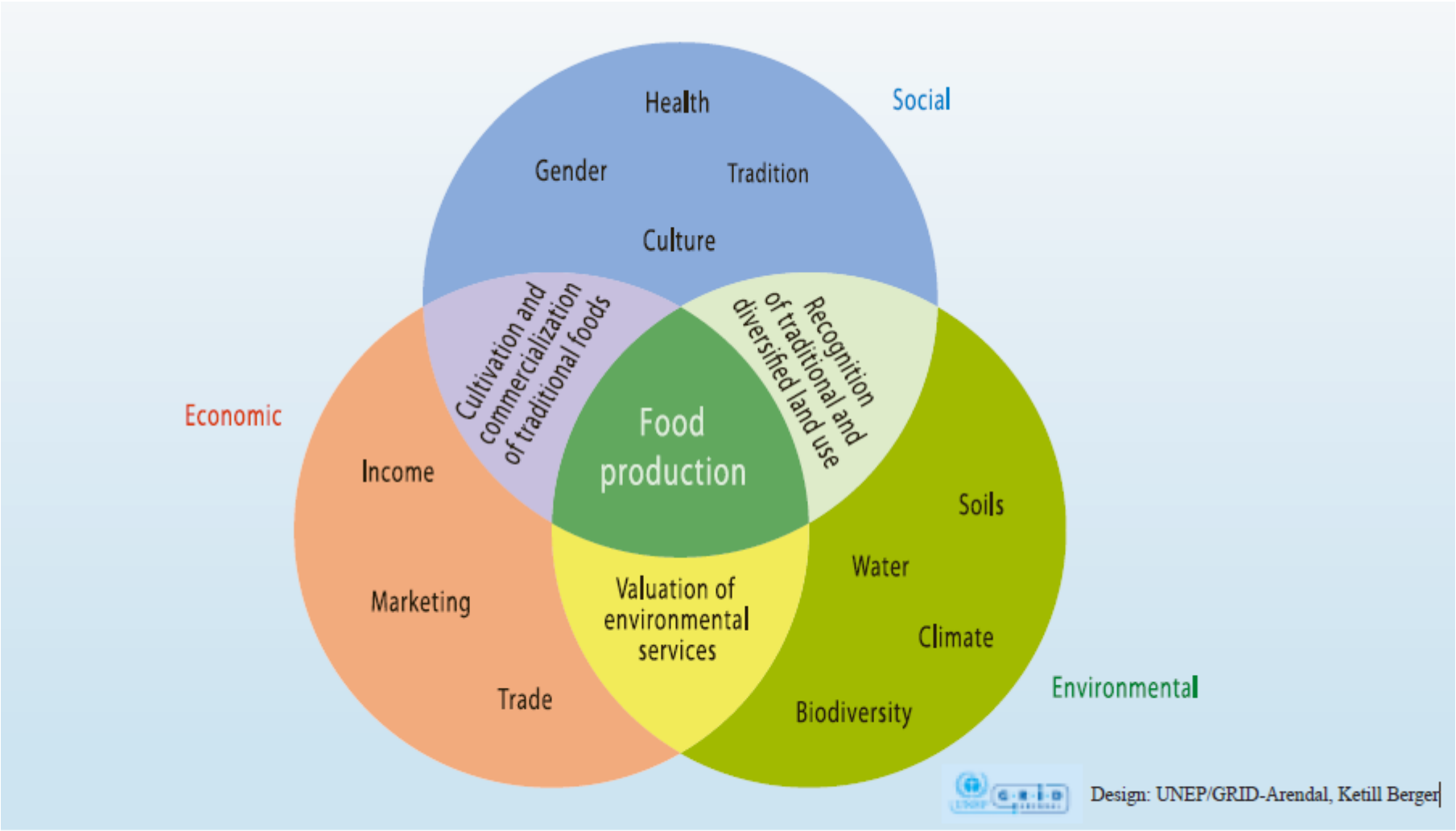
http://www.ifoam.org/en/organic-landmarks/definition-organic-agriculture

Organic versus Conventional: Approach

Paradigms	Organic farms	Non-organic
Ontology	Farm is part of broader eco- and socio-cultural system, natural conditions are accepted and adjusted	Short term profit oriented, maximization of labour and technology efficiency
Methodology	Balancing between the different parts of farming system, avoiding losses	Technology and output oriented
Epistemology	Observation, diagnosis, therapy, prevention and risk avoidance	Observation, analysis, policy decision, technological framework

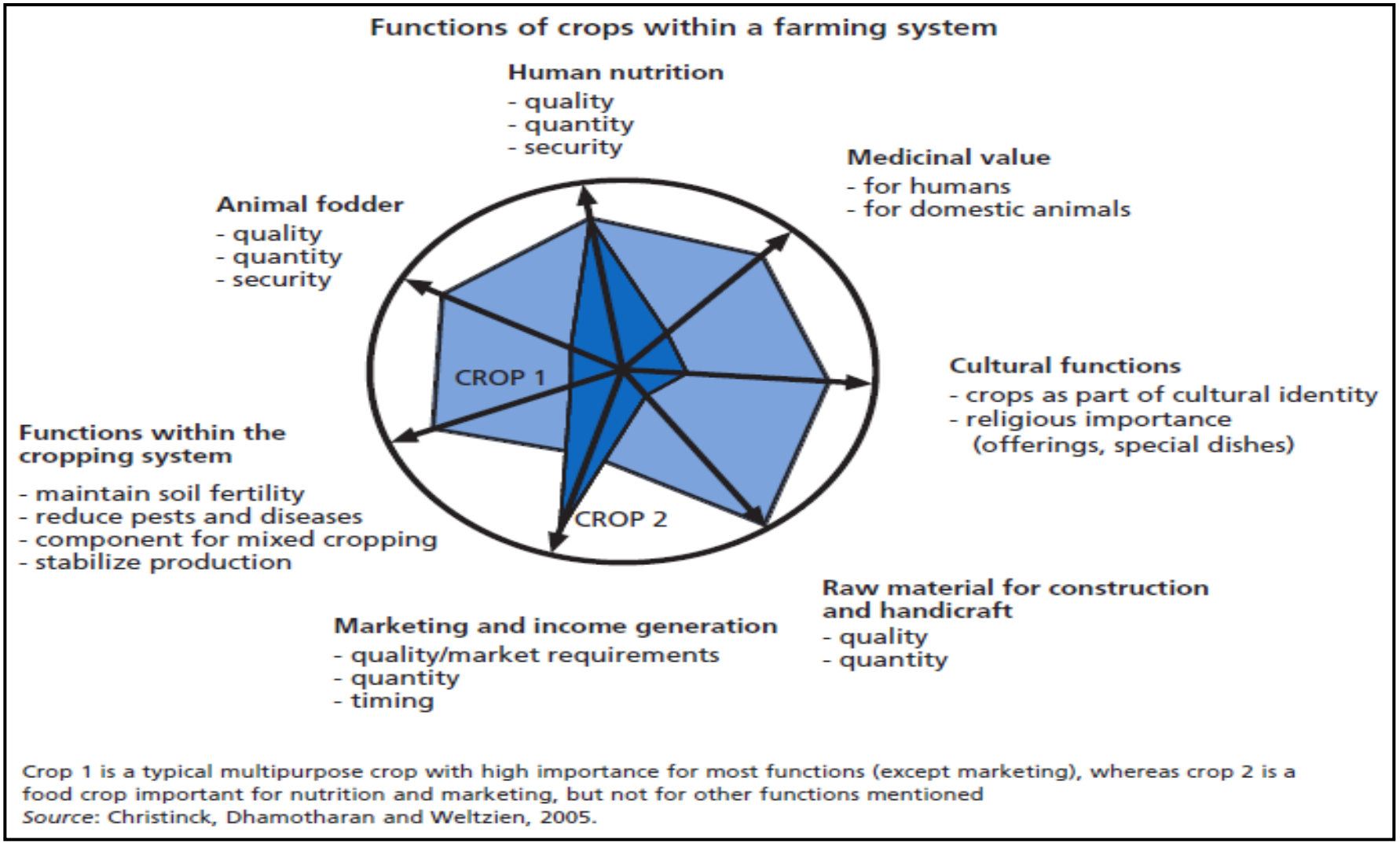
Source: Adapted from Fryer and Bingen 2012

Agriculture's different roles and functions



The inescapable interconnectedness of agriculture's different roles and functions.

Multifunktional Model- Resource Sufficiency



Crop 1 is a typical multipurpose crop with high importance for most functions (except marketing), whereas crop 2 is a food crop important for nutrition and marketing, but not for other functions mentioned

Source: Christinck, Dhamotharan and Weltzien, 2005.

Principles of organic farming

Principle of Health

›To produce food of high nutritional quality in sufficient quantity

›To give all livestock conditions of life that allow them to perform all aspects of their innate behaviour

Principle of Ecology

›To work as much as possible within a closed systems with regard to organic matter and nutrient elements

›To encourage and enhance biological cycles within the farming system, involving microorganisms, soil flora and fauna, plants and animals

›To maintain and increase the long-term fertility of soils

Principle of Care

›To avoid all performs of pollution that may result from agricultural techniques

›To maintain the genetic diversity of the agricultural system and its surroundings, including the protection of plant and wildlife habitats

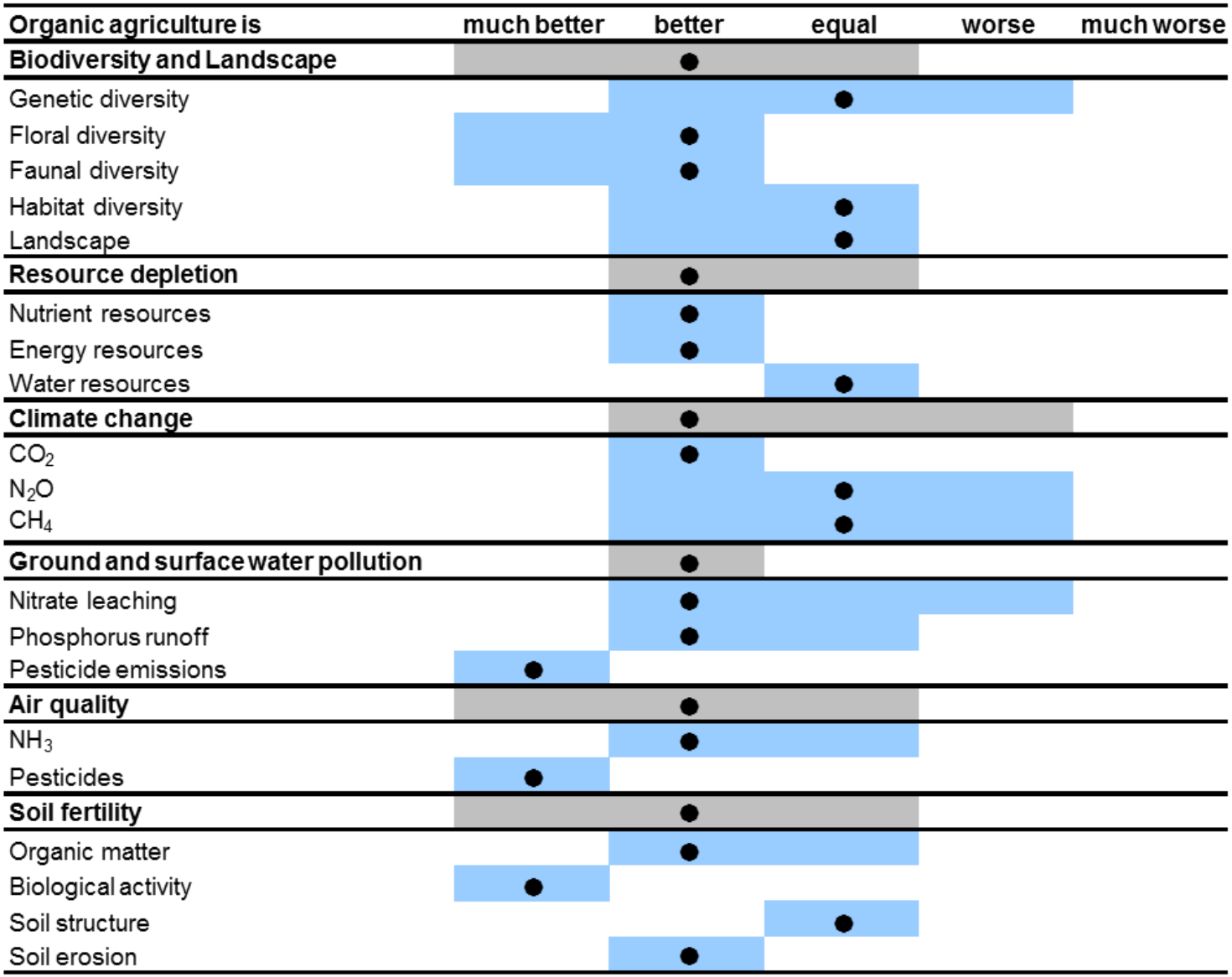
To use as far as possible renewable resources in locally organised agricultural systems

Principle of Fairness

›To allow agricultural producers an adequate return and satisfaction from their work including a safe working environment

Source: Lampkin 1992

Environmental effects of organic vs conventional



based on Stolze et al. (2000), adapted

Principle of Health

High nutritional quality food of sufficient quantity

›Nutritional quality (flavonoids, polyphenols, vitamins)

›Structural quality (e.g. meat structure, ratio of fibers)

›Safety and health effects (pesticide residues, nitrates, artificial additives) (Baker et al. 2002)

Livestock conditions

›Livestock health should be maintained through good preventive husbandry, animal welfare and appropriate housing and feeding systems (Lund & Algers 2003)

- › Animal specific balanced feeding (physiology-adapted)
- › Using food largely produced on the farm
- › Stress reduction

›Operate with highest welfare standards

›No prophylactic drug use in veterinary treatment

›Quality and not quantity in the production (milk, egg production)

›Suitable choice by variety using

Principle of Health

Example Animal Husbandry

Farm System	Organic	Non-Organic
Animal Husbandry	Low input -Own fodder -Long life span -Regulated antibiotics -Excluded hormones -Free range	High performance -Large herds -High fodder input -Short life span -Use of antibiotics, hormones -...

Source: Adapted from Fryer and Bingen 2012

Principle of Ecology

Work within a closed systems

- Connecting plant production and animal husbandry within a farm
  - With regard to organic matter and nutrient elements
  - Harvesting fodder
  - Using own propagation material

Enhance biological cycles within the farming system

- To work with natural systems rather than regulating it
- Involving microorganisms, soil flora and fauna, plants and animals
- Promoting beneficial eco-functions and services among farm components
  - Recycling plant and animal residues (manure/compost)
  - Enhance N fixing
  - In plant protection: natural enemies

Manage long-term soil fertility

- Manage naturally bio-chemical and physical soil condition
  - Varying rooting systems via crop rotation (N fixing legumes, microbial activity, nutrient uptake, aeration, etc.)
- Adequate site and cultivation specific tillage (proper timing/tool)
- Natural input (Animal manure, avoid using pesticides, etc.)

Principles of Ecology

Farm System	Organic	Non-Organic
Plant production and agro-ecology	Low input systems - limited fertilizers, - mechanical weeding - biocontrol - crop rotation (legumes) - green manure - integration of nature protection in farm - …	High input systems - Mineral fertilizers - Herbicides/Pesticides - Mono-cropping - Large fields - Segregation between farming and nature protection - …

DOK trial

- Long term comparison of the different farming methods
- 21-year study of agronomic and ecological performance of biodynamic, bioorganic, and conventional farming systems in Central Europe.
- It was found that crop yields were 20% lower in the organic systems,
- although input of fertilizer and energy was reduced by 34 to 53% and
- pesticide input by 97%.
- Enhanced soil fertility and higher biodiversity found in organic plots (Mäder et al. 2002, Fließbach et al. 2007)

Principle of Care

Use of local renewable resources on farm

›Soil as renewable recourses – protect, enhance biological activity and fertility of soil

›Composting plant residues

›Aim to produce more energy saving

›Base agricultural production on renewable energy resources (sun, wind, water, geothermic, biomass (Gelfand et al. 2010)

Mitigate pollution resulting from agricultural techniques

›Possible pollution sources (Pretty et al. 2000)

›Plant production: soil loss, pesticide and fertilisers residues, decreasing soil structure, erosion of landscape, nitrate leaching (Kramer et al. 2006)

›Animal husbandry: over grazing, antibiotic residues, soil and water contamination

Maintain genetic diversity of agricultural system/ surroundings

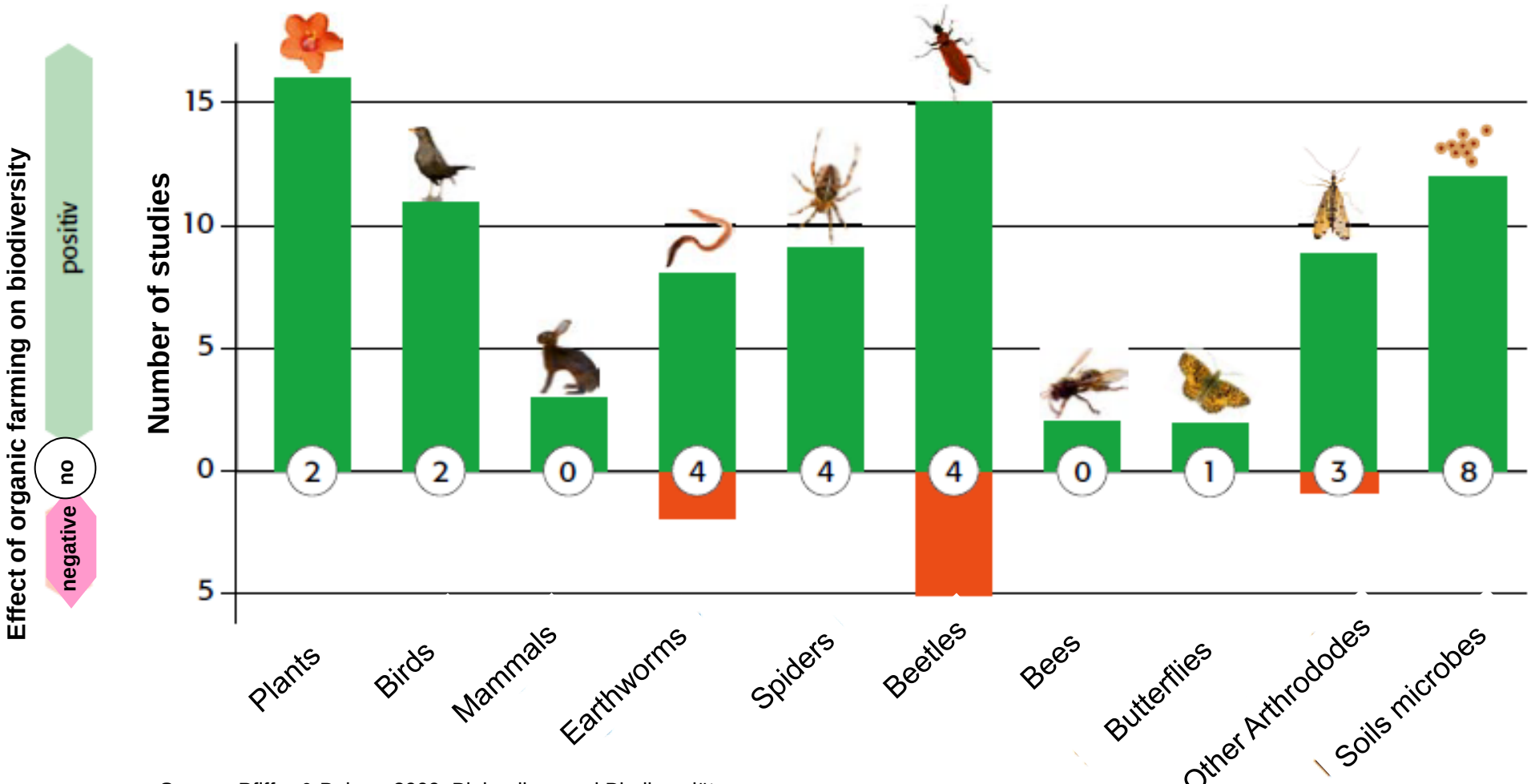
›Higher biodiversity – better safety in production

›Tools of organic agriculture enhancing/operating on biodiversity:

- › Crop rotation, intercropping, green channels, agroforestry (hedges, trees), beneficial insect strips, reduced tillage, participatory plant breeding

Effect of organic farming on biodiversity

Analysis of 95 scientific studies



Source: Pfiffer & Balmer 2009: Biolandbau und Biodiversiät

Principle of Fairness

Socio-economic wellbeing of agricultural producer

- Adequate return (long-term reliability and safety)
  - Ensure income
- Satisfaction from their work
  - Safe working environment
  - Working place without stress
  - Number of working hours
  - Rural and local development
  - Shared benefit/added value
  - Active value chain participation

Related environment	Organic farms	Non-organic
Agro and food industry	Local and regional players, diverse, partly international	Global players, uniformed commodities
Consumer and markets, certification	Diverse relations towards consumers and different markets, certification following specific guidelines, linked to subsidies	Impersonal consumer - retailer relation, big retailers, voluntary certification systems
Farm Economy and market orientation	Diversified production, investment into soils and biodiversity, several markets	Industry oriented, controlled by industry, one market, economy of scale
Information policy, research	State and farmer organisations, private small scale research, environmentally friendly oriented subsidies, farmer driven research	Industry, compatible with official agricultural policy, sector oriented subsidies

Source: Adapted from Fryer and Bingen 2012

Advantages of organic farming

- Certified production method, defined and regulated set of standards
- Internationally acknowledged organic label
  - Sound competition and fair trade on global scale
- No synthetic fertilizers and pesticides
- Guaranteed GMO-free chain
- Strengthening biodiversity
- Production of rich and fertile soil
- High overall outcome on environmental indicators/services
- Shared burden
  - Farmers' higher production costs are compensated along supply chain
  - Farmer-consumer relation, strong responsibility
- Global contribution to food safety and security, bio diversity, soil and environment in the production countries

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