Landwirtschaft und Umwelt

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Univ Vienna
update 10/2022

Entwicklungen, Zuechtung, Ziele
Konventionelle Methoden Biotech
GVO, Klonieren, Crisp
Green Revolution
Öko Ziele, Values, Trade
Organic farming principles
Organic farming forms
Healthy soil, yields, sustainability
Local or organic, trading

1

1

Webs

2

Why farm?

- Increase yields
- To decrease the risk of loss, weeds, pests, environmental hazards
- Eventually, people transported some wild plants (such as wild cereals) from their natural habitats to more productive habitats and began intentional cultivation.

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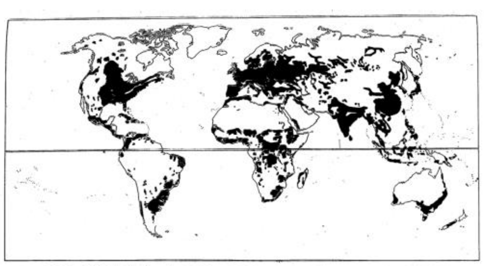
Arable Land: Where is it?



The world distribution of arable land *Source: The Times Atlas of the World*, London, 1968, pp. XXVI–XXVII

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12,000 BC

- People of the Natufian culture, living in the Southwest Asia (Middle East) begin to cultivate cereals; grasses grown for their edible seeds.
- (Ceres - the Roman goddess of grain.)

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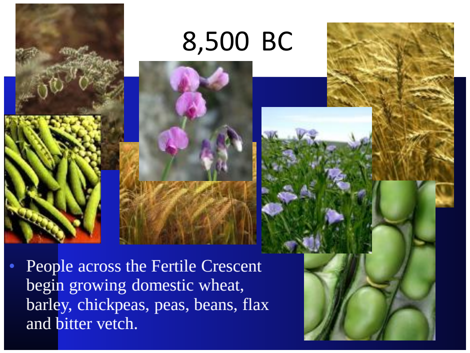
9,800 BC

- Earliest evidence for domesticated wheat is found at sites in the Middle East.

6

8,500 BC



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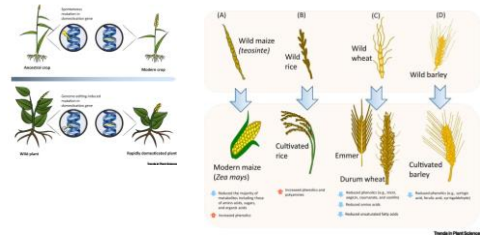

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Coevolution: crops Society
Spread, centers of origin

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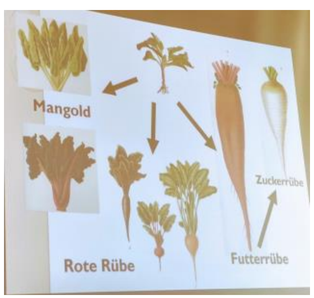

stammen von derselben Wildart und Familie (Gänsefuß-gewächse) ab

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8500 BC

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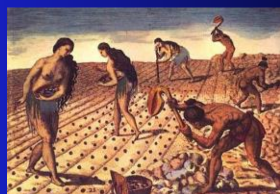
12

7,000 BC

- Native Americans - Indians, Hawaiians and Eskimos - begin simple farming.



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6,800 BC

- Rice is domesticated in Southeast Asia.

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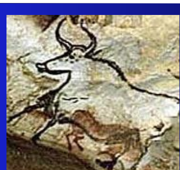
6,500 BC



- Evidence that cattle are domesticated in Turkey.

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4,000 BC, Cont'd

- Evidence that rice is domesticated in northwestern Thailand.

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Plowing the Fields

18

4,000 BC


- Egyptians discover how to make bread using yeast.

19

3,500 BC

- First agriculture in the Americas, around Ecuador.

20

2,000 BC


- Evidence of the domestication of chickens around India. (Some sources state that this may have happened earlier in other parts of the world.)

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600

- The moldboard plough is invented in eastern Europe.

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850

- Use of coffee is known in Arabia.


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1,000

- Corn is being raised by Native Americans in large plots.

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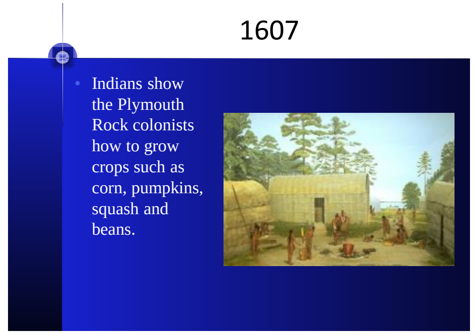

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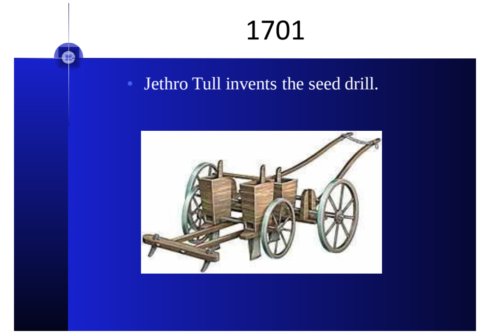

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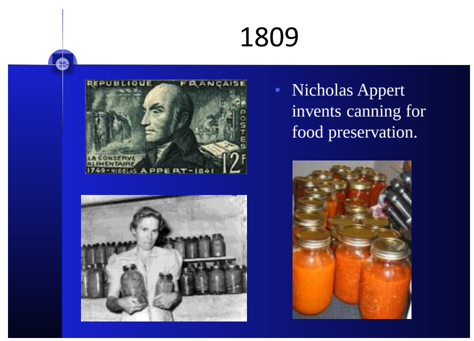

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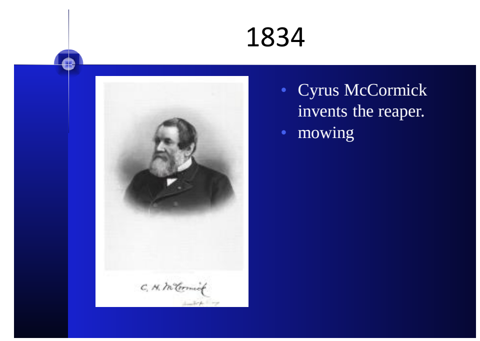

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1855

- Gregor Mendel publishes his paper describing Mendelian Inheritance.

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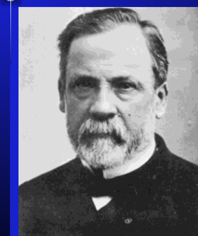
1871



- Louis Pasteur invents pasteurization.

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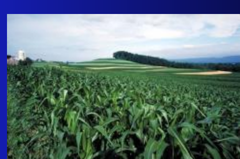
2000s

- Improved varieties of corn are developed. These varieties exhibit additional resistance to pests and diseases.



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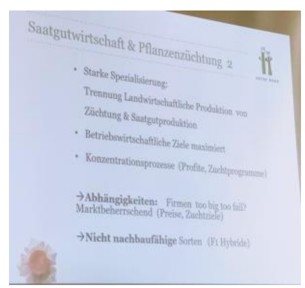

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2000s

- Development of new pesticides.

36

2000s

- Genetically modified organisms are cultivated around the world.

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2000s

- ***Biotechnology***, the science to change organisms or their environment, or to get products from organisms, begins to be used.

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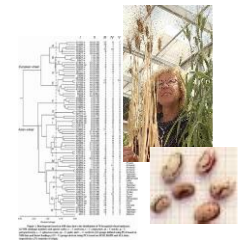
Landraces, Diversity

Refers to the particular kinds of old seed strains and varieties that are farmer-selected in areas where local subsistence agriculture has long prevailed. Landraces are highly adapted to specific locales or groups.

Definition :
modified by native and also immigrant farmers.

The term is usually applied to varieties of corn, squash, and beans that were domesticated by native farmers,



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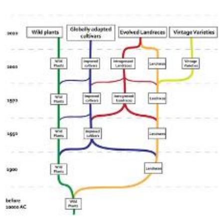
Wild, cultivars, races, varieties



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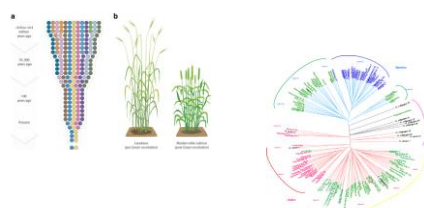
Crop diversity, characterstics



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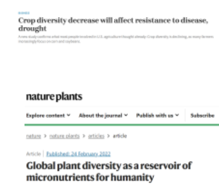
Value of Diversity , traits



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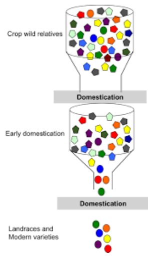
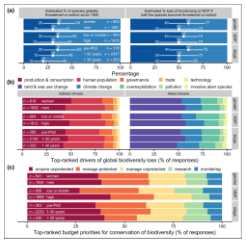
Loss of diversity





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CGIAR Consultative Group on International Agricultural Research.

http://www.cgiar.org

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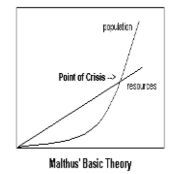
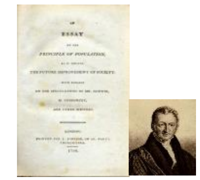
T. Malthus: 1766- 1834

Crisis in food production





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Models for population growth and food security:

Pessimistic or Alarmist Theory

Malthus - 19th century, Coale & Hoover (1958), Paul Ehrlich (Population Bomb), Meadows (Limits to Growth) – 1960s and 1970s. Focus on population policy & fixed, non-renewable resources.

Optimistic Theory
Ester Boserup – 1960s – 70s (agric. Intensification)
Julian Simon – 1970s - 80s (human capital)

Neutralist or Revisionist Theory

Allen Kelley/Ron Lee/Simon Kuznets/Nat'l Academy of Sciences 1986 Report – mid 1980s to the present. Focus on longer-term, policy feedbacks, mixed impacts, renewable resources & property rights.
Population Matters by Nancy Birdsall et al – 1990s (surveys confirm overall negative impact of population growth on per capita output growth across a large # of countries)

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GREEN Revolution

Term coined by U.S. Agency 1968)
Movement to increase yields by using:
. New crop cultivars
. Irrigation
. Fertilizers
. Pesticides
. Mechanization
A planned international effort funded by:
Rockefeller Foundation
Ford Foundation
Many developing country governments
Purposed to eliminated hunger by improving crop performance Norman Borlaug (1970 Nobel price)

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Green Revolution

Development of new varieties (originally of wheat in Mexico and rice in the Philippines) during the 1950s and 60s.

High yielding varieties (HYVs) (also known as modern varieties (MVs)) were more responsive to inorganic fertilizer and irrigation, and faster maturing. Bred with pest and disease resistance.

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Green revolution

Table 10.1 Trends in Yields in 93 Developing Countries

Crop Type	Yield (kilograms per hectare) 1961/63	1969/71	1979/81	1990/92
All cereals	1,171	1,461	1,894	2,466
Excluding China	1,116	1,271	1,557	1,951
China	1,336	2,078	3,817	4,329
Wheat	868	1,153	1,637	2,364
Excluding China	964	1,146	1,460	1,997
China	673	1,169	2,846	3,208
Rice	1,818	2,218	2,653	3,459
Excluding China	1,850	1,855	2,145	2,798
China	2,355	3,281	4,236	5,722
Maize	1,157	1,456	1,958	2,531
Excluding China	1,122	1,291	1,572	1,837
China	1,295	2,005	3,838	4,545

Source: Nikos Alexandratos, Chief of Global Perspective Studies Unit, Economic and Social Department, Food and Agriculture Organization of the United Nations, Rome, 1995 (personal communication, based on data from FAOSTAT-Mainframe).

Figure 1
Global Pesticide Production
1945–1985

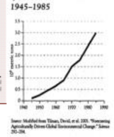
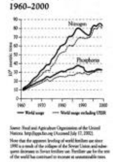


Figure 2
Global Fertilizer Use
1960–2000



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Green revolution: Sustainability

From the perspectives of feeding a growing population, the Green Revolution was a smashing success.

Behind this success story, however, are some disturbing issues:
Planting with identical high yield varieties:
- reduces genetic diversity and increases vulnerability to pests,
- necessitating heavy use of pesticides.
- Agriculture makes heavy use of fresh water.
- High dependency on technology.
- Questionable sustainability.

Cropland per capita is declining world-wide, as agriculture land is degraded, or urbanized. Increasing the yields from available farmland appears to be the key to increased food production ?

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Critiques of Green Revolution

1. "Social" critique
   a. the green revolution didn't fix problems associated with access by the poor
   b. technology destroys social fabric
2. "Scientific" critique
   a. the green revolution escalated uses of technology, especially environmentally damaging technologies
   b. GR reduced genetic diversity

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Millennium Ecosystem assessment, 2001-2005

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Overview of Findings

- Over the past 50 years, humans have changed ecosystems more rapidly and extensively than in any comparable period of time in human history, largely to meet rapidly growing demands for food, fresh water, timber, fiber and fuel
- The changes that have been made to ecosystems have contributed to substantial net gains in human well-being and economic development, but these gains have been achieved at growing costs in the form of the degradation of many ecosystem services, increased risks of nonlinear changes, and the exacerbation of poverty for some groups of people
- The degradation of ecosystem services could grow significantly worse during the first half of this century and is a barrier to achieving the Millennium Development Goals
- The challenge of reversing the degradation of ecosystems while meeting increasing demands for their services can be partially met under some scenarios that the MA has considered but these involve significant changes in policies, institutions and practices, that are not currently under way

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Focus: Ecosystem Services

The benefits people obtain from ecosystems

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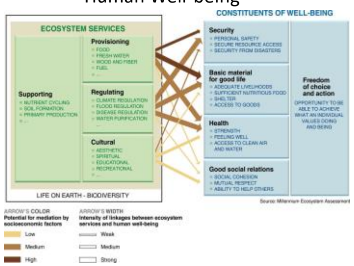
Focus: Consequences of Ecosystem Change for Human Well-being



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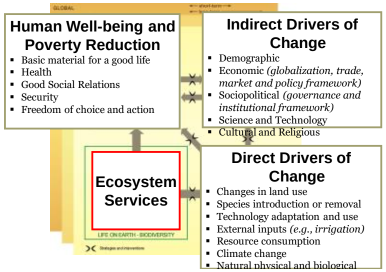
MA Framework



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MA Findings - Outline

- 1. Ecosystem Changes in Last 50 Years
- 2. Gains and Losses from Ecosystem Change

Three major problems may decrease long-term benefits

  - Degradation of Ecosystem Services
  - Increased Likelihood of Nonlinear Changes
  - Exacerbation of Poverty for Some People
- 3. Ecosystem Prospects for Next 50 Years
- 4. Reversing Ecosystem Degradation

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Finding #1

- Over the past 50 years, humans have changed ecosystems more rapidly and extensively than in any comparable period of time in human history
- This has resulted in a substantial and largely irreversible loss in the diversity of life on Earth

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Unprecedented change in structure and function of ecosystems

•More land was converted to cropland in the 30 years after 1950 than in the 150 years between 1700 and 1850.

Cultivated Systems in 2000 cover 25% of Earth's terrestrial surface

(Defined as areas where at least 30% of the landscape is in croplands, shifting cultivation, confined livestock production, or freshwater aquaculture)

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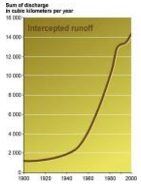
Unprecedented change: Ecosystems

- 20% of the world's coral reefs were lost and 20% degraded in the last several decades
- 35% of mangrove area has been lost in the last several decades
- Amount of water in reservoirs quadrupled since 1960
- Withdrawals from rivers and lakes doubled since 1960



Intercepted Continental Runoff: 3-6 times as much water in reservoirs as in natural rivers

(Data from a subset of large reservoirs totaling ~65% of the global total storage)

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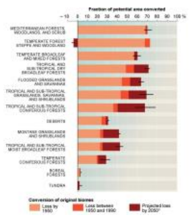
Limits of Carrying capacity : MA, Changes in direct drivers

Habitat transformation:
- Further 10–20% of grassland and forestland is projected to be converted by 2050

Overexploitation, overfishing:
- Pressures continue to grow in all scenarios

Invasive alien species:
- Spread continues to increase



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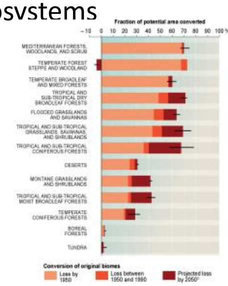
Unprecedented change: Ecosystems

- 5-10% of the area of five biomes was converted between 1950 and 1990
- More than two thirds of the area of two biomes and more than half of the area of four others had been converted by 1990



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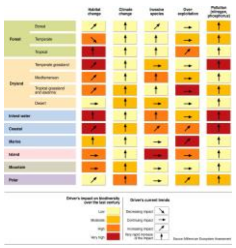
Direct drivers growing in intensity



•Most direct drivers of degradation in ecosystem services remain constant or are growing in intensity in most ecosystems

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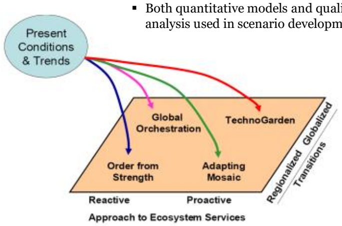
MA Scenarios

- Not predictions – scenarios are plausible futures
- Both quantitative models and qualitative analysis used in scenario development



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Scenario Storylines

- **Global Orchestration** Globally connected society that focuses on global trade and economic liberalization and takes a reactive approach to ecosystem problems but that also takes strong steps to reduce poverty and inequality and to invest in public goods such as infrastructure and education.

- **Order from Strength** Regionalized and fragmented world, concerned with security and protection, emphasizing primarily regional markets, paying little attention to public goods, and taking a reactive approach to ecosystem problems.

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Scenario Storylines

- **Adapting Mosaic** Regional watershed-scale ecosystems are the focus of political and economic activity. Local institutions are strengthened and local ecosystem management strategies are common; societies develop a strongly proactive approach to the management of ecosystems.

- **TechnoGarden** Globally connected world relying strongly on environmentally sound technology, using highly managed, often engineered, ecosystems to deliver ecosystem services, and taking a proactive approach to the management of ecosystems in an effort to avoid problems.

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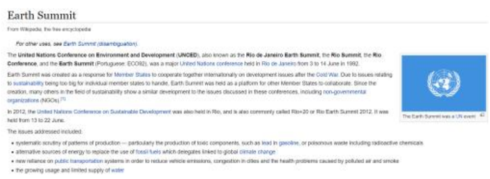
Earth Summit (RIO) 2012



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http://www.resalliance.org/

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ESSP:http://www.essp.org/

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http://ecotippingpoints.org/resources/understanding-how-ecotipping-points-work.html

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Case study environmental tipping point: Apo Island

http://www.sdvillage.ph/biodive/apoislan

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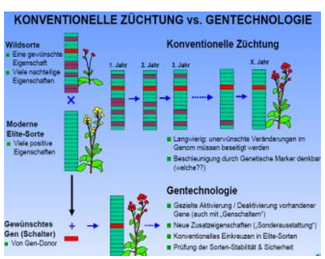
Plant breeding, selection

Breeding, yield, time for development



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Selection

- Artificial versus natural selection (pp.
- Humans have selected for the properties they desired in plants. Selection has been both unconscious and purposeful.
- With either type, there must be heritable variation upon which selection can work.

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Genes and alleles

- The plant nucleus contains pairs of homologous chromosomes that contain the genes.
- A duplicate set of these homologous chromosomes occurs in each cell of the plant (diploid number).
- But, the same form of the gene may not occur in both. Different alleles. Homozygous and heterozygous.
- Many important crop characters appear to be controlled by one gene, but others not.

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Genes and alleles II

- In populations of plants under natural selection, there are often individuals with different alleles for any particular gene.
- Sexual reproduction (meiosis and fertilization) normally tends to maintain variation in populations. Inbreeding tends to reduce variation.
- Although we usually consider a single gene, in practice, thousands are being crossed each time meiosis and fertilization occur.

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Mutations

- Sometimes mutations create new allelic combinations. Ultimately, the only source of new alleles in a population is mutation.
- Mutations that are better for the plant or for humans are quite rare. For new alleles derived from mutations to be established in a population of plants, sexual reproduction must occur.

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Variation

- Sexual recombination is the mechanism for maintaining variation in natural populations.
- Sometimes alleles enter a population by immigration from other populations.
- "Crossing over" is an important effect in making new combinations of genetic material.
- Other changes involve deletions, duplications, or inversions of genetic material.
- In nature, gene frequencies vary in populations of plants over geographic distance.
- At some point, limits as to how much the plant can tolerate are reached and this helps to define the range of a plant.
- There are various kinds of culture methods including tissue culture, cell culture, hairy root cultures. Genes can be introduced by "shooting them in", by protoplast fusion, or other molecular methods.

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Polyploidy

- Sometimes plants end up with more than the diploid number of chromosomes. This often occurs when some of the reproductive cells don't divide properly.
- Polyploids. Diploid, tetraploid, hexaploid, triploid etc. Many crop plants involve polyploidy in their formation.
- Many types of polyploids are sterile. Polyploid plants are often larger than diploid plants. Polyploidy often occurs by chance. Humans often take advantage of the plants in which it has occurred.

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Artificial vs natural selection in plants

- Humans usually want uniform plants, but in nature just the opposite is favored. Variable offspring tend to have better survival and fitness under natural conditions.
- Humans provide a more or less uniform environment and enough care to make sure crops survive.

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Plant species

Botanists tend to consider a species to be a group of populations that are derived from a single ancestor and which can be distinguished morphologically from other groups of populations.
Plant species are not defined well by reproductive barriers as in many groups of animals. Polyploids are often derived from diploid ancestors.
Many hybrids occur between related plant species. Often cultivated plants have been given different names than their wild progenitors. One of the big problems is deciding what are the wild progenitors of cultivated plants.
Evolutionary relationships. How do we know how closely related plants are?

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BREEDING METHODS

A). Inbreeding B). Outbreeding C). Heterosis

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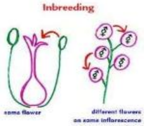
INBREEDING

- Mating of Parents who are Closely Genetically related.
- Results in Increased Homozygosity which can increase the Chance of
- Offspring being affected by Recessive traits.



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METHOD OF INBREEDING

- Marriage between Brother and Sister is an Ideal Inbreeding.
- Royal Family of Egypt Cleopatra was famous for inbreeding between Brothers and Sisters.
- In Plants, It Occurs in the Form of Self Pollination.

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RESULTS OF INBREEDING

- Reduced Fertility both in Litter size and in
- Sperm viability.
- Increased Genetic Disorders.
- Lower Birthrates
- Higher Infant Mortality
- Slower Growth rate.
- Loss of Immune System function.

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MERITS & DEMERITS

MERITS OF INBREEDING

- A) Increase of Homozygotes, B)Production of Pure lines. C)Elimination of Deleterious Recessive Characters. D)Production of Valuable Breeds.

DEMERITS OF INBREEDING

- A) Low yield B)Inbreeding Depression C)Appearance of Deleterious Characters.

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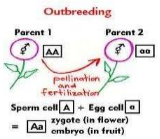
OUTBREEDING

- Mating of Unrelated individuals
- Also known as Cross Breeding.
- The offspring formed by mating of Two unrelated parents.



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TYPES OF OUTBREEDING

A)INTRASPECIFIC : Matting between Members of Same Species.

B)INTERSPECIFIC : Matting between Members of Different Species.

C) INTERGENERIC :
Matting between the Members of Different Genera.

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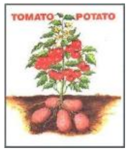
TYPES OF OUTBREEDING

INTERSPECIFIC

INTERGENERIC



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RESULTS OF OUTBREEDING

A)Numerous varieties of better Yielding crop plants.
B) Paddy hybrids produce more Grains.
C)Tall and Dwarf coconut hybrid yields more number of Nuts
D)Caddish is a hybrid Between Cabbage and Radish
E)Pomato is a hybrid between Potato and Tomato.

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Hybrid breeding; Heterosis: crossing of homozygotic Llnes

- Hybridization occurs when inbred parents are mated (cross pollinated)
- Creates a heterozygous individual
- Benefits
  - Increased heterosis (vigor) in F_1 generation

- Heterosis occurs when two homozygous individuals are cross pollinated.
  - This causes all loci to become heterozygous
  - The increased heterozygosity causes increased plant vigor
- Benefits of Increased Vigor
  - Increased yield
  - Better standability
  - Better germination
  - Overall better plant performance

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HETEROSIS BREEDING

- The Increased growth vigour or yield of hybrids over the Parents is
  known as Heterosis or Hybrid vigour.
- Crop breeding to manifest heterosis is called Heterosis breeding.
- It brings out the Superiority in F1 individuals but the vigour tends to Decrease from F2 generation onwards.

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HETEROSIS BREEDING

- Heterosis means Deviation of Offspring from the Actual Character of Parents.
- In Plants, Heterosis appears due to Developmental stimulation induced by the Union of Gametes coming from Two genetically complementing parents.

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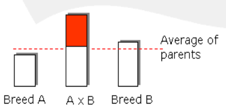
Hybrid: Heterosis effect

The purpose of crossing is to make use of the heterosis effect partly to improve fertility and partly to combine the different characteristics for which the lines were previously selected. For meat production a desirable quality in the final product is to produce large numbers of rapidly growing individuals. This requires good fertility in the mother combined with good growth rate in the progeny.

The heterosis effect makes the hybrid pigs better than the average of the parents. The traits with the lower heritability show the largest heterosis effect. This is particularly true for fertility, mothering abilities and body structure, which have a low heritability.



Heterosis Effect

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ADVANTAGE & DISADVANTAGE

ADVANTAGE

1. In many crops, F1 hybrids are Early in Maturity.
   EX : Cabbage, Onion, Tomato etc.
2. They produce goods with Uniform size.
   Ex : Onion and Cabbage.
3. They are resistance to Biotic and Abiotic stresses.
   Ex : Cucumber, Tomato and Onion.
4. They are always high yielding varieties

DISADVANTAGE

1. Production cost is High.
2. Fresh seeds is to be Purchased every time to raise new crop.
3. Sometimes F1 hybrids are Vulnerable to disease.

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Requisites of hybrid seed production

Breeders responsibilities

- Develop inbred lines
- Identification of specific parental lines
- Develop system for pollen control

Major problems for breeders & producers

- Maintenance of parental lines
- Separation of male and female reproductive organs
- Pollination

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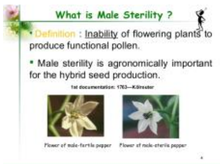
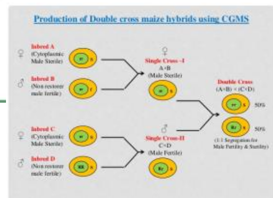
genetic male sterility





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Hybrid Seed production

Hybrid seed production field
The lower number of male pollinator rows (whitish-yellow) alternate with the larger number of female seed parent (male-sterile) rows (red).
Lowering the ratio of female to male pollinator rows is one method that the commercial industry is using to ensure rapid and more complete pollination of the female.

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Precision breeding
Marker assisted breeding

In molecular or marker-assisted breeding (MB), DNA markers are used as a substitute for phenotypic selection and to accelerate the release of improved cultivars.

Marker-assisted selection (MAS). Selection of individuals with specific alleles for traits controlled by a limited number of loci (up to 6-8).

Marker-assisted backcrossing (MABC). Transfer of a limited number of loci (e.g. transgene, disese resistance loci, etc.) from one genetic backgrond to another.

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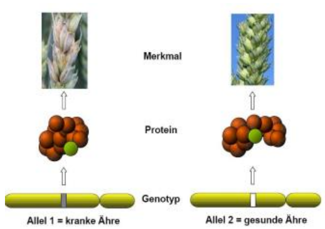
Breeding for an improved trait using markers



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Breeding with Markers

In der Züchtung wird ein genetischer Marker für die indirekte Selektion eines gewünschten Merkmals verwendet

Voraussetzung für die Züchtung: Marker und Merkmal werden gemeinsam vererbt
➪ Kopplung

Marker:

Morphologische Marker:
z.B. Farbe
Biochemischer Marker:
Enzyme
Molekulare Marker

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Breeding, Molecular Markers

Was sind molekulare Marker?

Sequenz-Unterschiede in einer genomischen Region (Locus).

Variationen in der DNA-Sequenz (Polymorphismen) nutzen.

Markerklassen

▶ RFLP	Restriction Fragment Length Polymorphism	DNA-DNA-Hybridisierung
▶ AFLP	Amplified Fragment Length Polymorphisms	PCR
▶ SSR	Simple Sequence Repeats bzw. Mikrosatelliten	PCR
▶ SNP	Single Nucleotide Polymorphisms	Sequenzierung
▶ DArT	Diversity Array Technique	DNA-DNA-Hybridisierung

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Advantages molecular marker

Some of the advantages of using molecular markers instead of phenotypes to select are:

- o Early selection (at seedling, or even for seeds) ➡ Chance to select the right plant before flowering
- o Reduced cost (fewer plants, shorter time)
- o Reduced cycle time (if gene is recessive or measured after flowering) ➡ Chance to select heterozygous plant
- o Screening more efficient (if it is a complex trait)

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Sweetcorn

Marker Assisted Selection

Important gene controlling endosperm in sweet corn

Category	Gene	Sweetness	Texture	Flavor	Germination /Vigor	Shelf life
Standard sweet	su1	10% sucrose ⬇	creamy ⬆	good ⬆	good ⬆	short ⬇
Sugar-enhanced	se	2X sucrose	creamy	good	good	longer
Super sweet	sh2,bt1, bt2	3X-8X sucrose ⬆	Less creamy ⬇	poor ⬇	poor ⬇	Long ⬆

In recent years new varieties have been developed that have different combinations of the three major genes (su, se and sh2) 'stacked' together.

Category	Kernels type	Advantage	Variety name
High sugar sweet corn	• 25% sh2 kernels • 25% se kernels • 50% su kernels	• su vigor • higher sugar ⬆⬆	• Sweet Chorus • Sweet Rhythm
High sugar sweet corn	• 100% sh2 kernel • se trait in all kernels	• high sugar • long shelf life • tender ⬆⬆⬆	• Gourmet Sweet™ • Multisweet™ • Xtra-Tender Brand™

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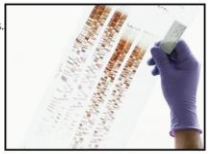
Use of fingerprinting

DNA fingerprinting is used in several ways.

- Paternity and Maternity test
- Plant Variety Protection
- Genetic purity test
- Studying biodiversity
- Tracking genetically modified crops



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Testing can be done on seed or leaf

F = female parent, M = male parent

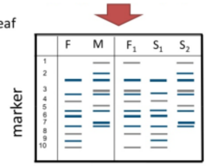
F1 = Hybrid

S1 = Sample#1

: Same female / different male

S2 = Sample#2

:Different female / Same male



DNA profile using 10 different marker (dominant marker)

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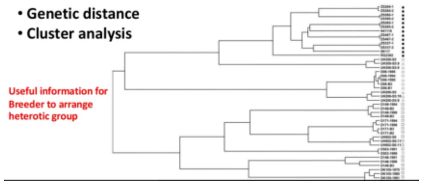
Genetic mapping

- Genetic distance
- Cluster analysis

Useful information for Breeder to arrange heterotic group



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Introducing new traits in a plant family:(Random) Mutation Breeding

Examples of plants that were produced via mutation breeding are given in the table below

Crop	Cultivar Name	Method Used to Induce Mutation
rice	Calrose 76	gamma rays
wheat	Above	sodium azide
	Lewis	thermal neutrons
oats	Alamo-X	X-rays
grapefruit	Rio Red	thermal neutrons
	Star Ruby	thermal neutrons
burmuda grass	Tifeagle	gamma rays
	Tifgreen II	gamma rays
	Tift 94	gamma rays
	Tifway II	gamma rays
lettuce	Ice Cube	ethyl methanesulphonate
	Mini-Green	ethyl methanesulphonate
common bean	Seafarer	X-rays
	Seaway	X-rays
lilac	Prairie Petite	thermal neutrons
St. Augustine grass	TXSA 8202	gamma rays
	TXSA 8212	gamma rays

Quite a few flower cultivars have been developed via mutation breeding, among them some of the cultivars of Alstroemeria, begonia, carnation, chrysanthemum, dahlia, and snapdragon.

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Mutation breeding

Mutation refers to sudden heritable change in the phenotype of an individual.

Mutation occurs in two ways:

(1) By alteration in nuclear DNA (point mutations)

(2) By change in cytoplasmic DNA(cytoplasmic mutation)

The best example of useful cytoplasmic mutation is cytoplasm male sterility.

1927 – First proof of induced mutations in plants; radium ray treatment of Datura stramonium (Gager and Blakeslee).

1927 - Muller working with Drosphila provides proof of mutation induction by X-rays Muller champions induced mutation for animal and plant breeding and opens a new era in genetics and breeding.

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A. Spontaneous mutations : Mutation occurin natural populations .

B. Induced mutations: Mutation may be artificially induced by various mutagenic agents.

Induced mutations are of two types:

1. Macro-mutations: Mutation with distinct morphological changes in the phenotype.

2. Micro-mutations: Mutations with invisible phenotypic changes.

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Chemical mutagens

1. Alkylating agents: EMS `(ethyl methane sulphonate),methyl methane sulphonate (MMS),sulphur mustard, nitrogen mustard

2. Acridine dyes: proflavin,acridine orange, acridine yellow and ethidium bromide.

3. Base Analogues:5 Bromo Uracil,5-chlorouracil.

4. Other mutagens: Nitrous Acid, Sodium Azide.

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a) Mutation breeding is a cheap and rapid method of developing new varieties.
b) Induced mutagenes is used for the induction of CMS. Ethidium bromide (EB) has been used for induction of CMS in barley.
c) Mutation breeding is more effective for the improvement of oligogenic characters.
d) Mutation breeding is the simple, quick and the best way when a new character is to be induced.

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Limitations

a) The process is generally random and unpredictable.
b) Useful mutants are rare and predominantly recessive.
c) Mutants can have strong negative pleiotropic effects on other traits.
d) Health risks: handling, chemical mutagens; radiations, fast neutrons treatments.
e) Most mutants are of no use to breeding even if a large number of mutants can be produced.
f) Field trialling and germplasm storage can be expensive and require a lot of space and careful management if large mutant populations are handled.

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- ❖ Higher yield Barley (DL 253), Pea (Hans), Groundnut (Co 2, TG 17).
- ❖ Short stature Barley (RDB 1),Rice (Prabhavati).
- ❖ Earliness Rice (IIT 48,IIT 60,Indira,Padmini)
- ❖ Stress resistance Salt tolerance in Rice (Mohan)
- ❖ water logging tolerance in jute (Padma)
- ❖ Bold seed size Groundnut (PB 1,PB 2,Vikram) and Rice (Jagannath).

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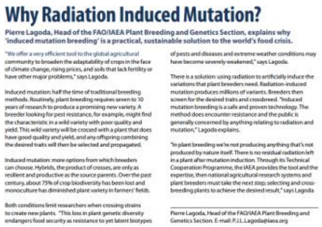
IAEA



Why Radiation Induced Mutation?

Pierre Lagoda, Head of the FAO/IAEA Plant Breeding and Genetics Section, explains why 'induced mutation breeding' is a practical, sustainable solution to the world's food crisis.

"We offer a very efficient tool to the global agricultural community to broaden the adaptability of crops in the face of climate change, rising prices, and soils that lack fertility or have other major problems," says Lagoda.

Induced mutation: half the time of traditional breeding methods. Routinely, plant breeding requires seven to 10 years of research to produce a promising new variety. A breeder looking for pest resistance, for example, might find the characteristic in a wild variety with poor quality and yield. This wild variety will be crossed with a plant that does have good quality and yield, and any offspring combining the desired traits will then be selected and propagated.

Induced mutation: more options from which breeders can choose. Hybrids, the product of crosses, are only as resilient and productive as the source parents. Over the past century, about 75% of crop biodiversity has been lost and monoculture has diminished plant variety in farmers' fields.

Both conditions limit researchers when crossing strains to create new plants. "This loss in plant genetic diversity endangers food security as resistance to yet latent biotypes of pests and diseases and extreme weather conditions may have become severely weakened," says Lagoda.

There is a solution: using radiation to artificially induce the variations that plant breeders need. Radiation-induced mutation produces millions of variants. Breeders then screen for the desired traits and crossbreed. "Induced mutation breeding is a safe and proven technology. The method does encounter resistance and the public is generally concerned by anything relating to radiation and mutation," Lagoda explains.

"In plant breeding we're not producing anything that's not produced by nature itself. There is no residual radiation left in a plant after mutation induction. Through its Technical Cooperation Programme, the IAEA provides the tool and the expertise, then national agricultural research systems and plant breeders must take the next step: selecting and cross-breeding plants to achieve the desired result," says Lagoda.

Pierre Lagoda, Head of the FAO/IAEA Plant Breeding and Genetics Section. E-mail: P.J.L.Lagoda@iaea.org

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Breeding: Irradiation

Breeding: Irradiation

Irradiator at Institute of Radiation Breeding
Ibaraki-ken, JAPAN
(http://www.irb.affrc.go.jp/)

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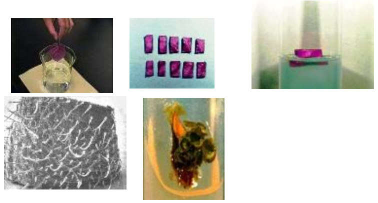
Breeding: Tissue culture , Clones ?



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Somaclonal variation

・Production of a new variety of japanese butterbur using somaclonal variation.(upper:new variety, lower:native variety)

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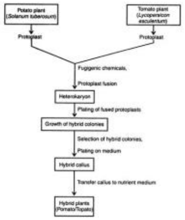
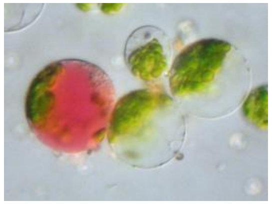
Protoplast fusion





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Tomoffel

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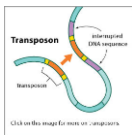
Breeding using transposons

Ein Transposon ist ein DNA-Abschnitt bestimmter Länge im Genom, der seine Position im Genom verändern kann (Transposition). Man unterscheidet Transposons, deren mobile Zwischenstufe von RNA gebildet wird (Retroelemente oder Klasse-I-Transposon), von denjenigen, deren mobile Phase DNA ist (DNA-Transposon oder Klasse-II-Transposon).



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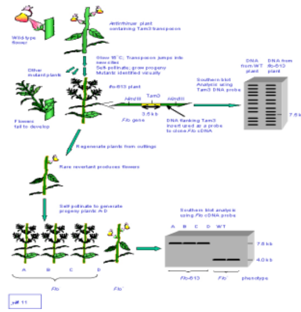

Transposon tagging

The molecular isolation of transposable elements now permits the cloning of genes in which the element resides. The major advantage of this system is that genes whose function is not known can be cloned

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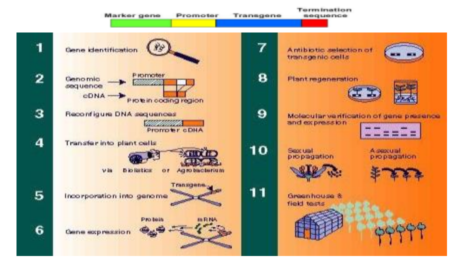
GM plants, Tranferring traits in ways which are not used in nature: GMOs



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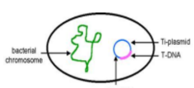
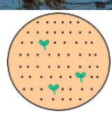
Agrobact. tumefaciens





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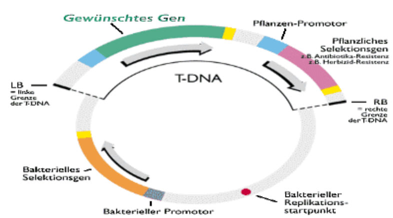
T DNA



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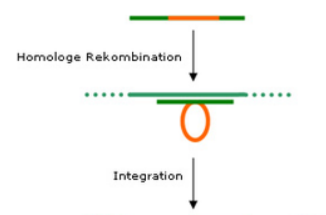
Homolog recombination



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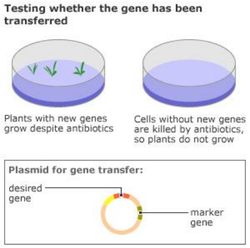
Antibiotic resistance marker gene



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An assessment of the risks associated with the use of antibiotic resistance genes in genetically modified plants: report of the Working Party of the British Society for Antimicrobial Chemotherapy

Marker Genes

Alternatives to Antibiotic Resistance Markers

New marker systems have been developed, but whether these new systems truly offer a safety advantage remains to be investigated.

Possible alternative marker gene systems:

- Herbicide resistance genes: After treatment with an herbicide, only the plants harbouring the herbicide resistance gene and gene of interest survive.
- Marker genes that enable the plant cell to use a particular food source: If the plant cells are fed only this one energy source, only the plants that have successfully incorporated the new genes will be able to grow. An example of this approach is the PMI gene. This marker gene enables the plant cell to use mannose, a type of sugar, as a source of energy. This marker gene was used to develop 3272 maize, a GM maize line recently submitted to European Commission for authorisation.

Visible markers: A fluorescent protein marks transformed plant cells

- Genes that enable the plant to produce proteins that bind to toxic heavy metals, thereby allowing transformed cells to survive heavy metal treatments (e.g. cadmium).
- Visible markers: These marker genes make transgenic plants visually recognisable. The gene for the green fluorescent protein (GFP) makes genetically modified plant cells appear green when exposed to UV light. A

http://www.gmo-compass.org/

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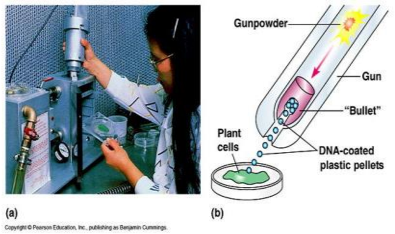
Gene gun



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Methods, overview

Table 1. Genetic manipulation technologies.

Technology	Definition
Genetic manipulation	Introduction of new genetic material via laboratory methods.
Biolistics	Use of helium-, gunpowder-, or electrical-discharge-mediated force to propel DNA-coated tungsten or gold microprojectiles into cells.
Agrobacterium tumefaciens	Soilborne bacterium causing crown gall disease of fruit trees. Used by biotechnologists to transfer any DNA into plant cells, from which transgenic plants are regenerated.
Agrobacterium rhizogenes	Soilborne bacterium causing hairy root disease. Transfers bipartite piece of bacterial DNA into plant genome, inducing elevated auxin synthesis and auxin sensitivity characterized by fluffy white hairy roots.

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Transformation using Agrobaccterium tumefaciens, gene gun .. And virus vectors (also in human gene therapy ?

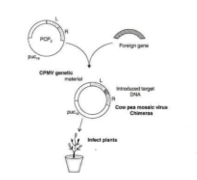

Fig. 14.14 CpMV expression vector construction and infection of plants

Gene Therapy	
viral vector	non-viral vectors
Advantage: high transfection efficiency	Advantage: better safety profile, lower production cost
Disadvantage: high immunogenicity, high production cost, low packaging capacity	Disadvantage: low transfection efficiency, insufficient cellular uptake, poor targeted delivery

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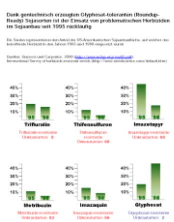
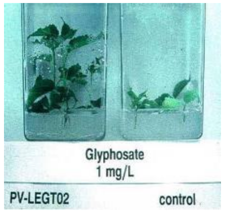
Herbicide tolerance, glyphosate





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Herbicide Resistant Soybean

BEFORE AFTER

HERBICIDE APPLICATION

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Herbicide Resistance: more or less herbicide? depending on local agricultural background

- Roundup Ready Soy, Corn, Canola
- Allows post-emergence herbicide spraying
- Increases yield
- Facilitates no-till farming
- 89% U.S. Soy crop (2006)

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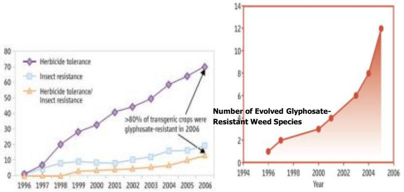
Old and new Problems: Resistance

Herbicide Resistant Weeds Evolve



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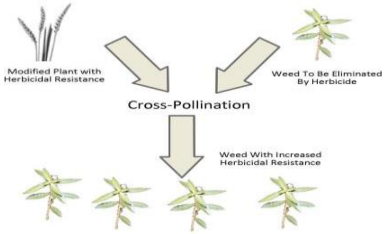
Herbizide resistance, gene transfer



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Gene flow: multiresistant Rape

Environ. Biosafety Res. 5 (2006) 77–87
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DOI: 10.1051/ebr:2006017

Detection of feral transgenic oilseed rape with multiple-herbicide resistance in Japan

Mitsuko AONO[1*], Seiji WAKIYAMA[2], Masato NAGATSU[2], Nobuyoshi NAKAJIMA[1], Masanori TAMAOKI[1], Akihiro KUBO[1] and Hikaru SAJI[1]

[1]Environmental Biology Division, National Institute for Environmental Studies, 16-2 Onogawa, Tsukuba, 305-8506, Japan
[2]Japan Wildlife Research Center, 3-10-10 Shitaya, Taito-Ku, Tokyo, 110-8676, Japan

Repeated monitoring for escaped transgenic crop plants is sometimes necessary, especially in cases when the crop has not been approved for release into the environment. Transgenic oilseed rape (*Brassica napus*) was detected along roadsides in central Japan in a previous study. The goal of the current study was to monitor the distribution of transgenic oilseed rape and occurrence of hybridization of transgenic *B. napus* with feral populations of its closely related species (*B. rapa* and *B. juncea*) in the west of Japan in 2005. The progenies of 50 *B. napus*, 82 *B. rapa* and 283 *B. juncea* maternal plants from 95 sampling sites in seven port areas were screened for herbicide-resistance. Transgenic herbicide-resistant seeds were detected from 12 *B. napus* maternal plants growing at seven sampling sites in two port areas. A portion of the progeny from two transgenic *B. napus* plants had both glyphosate-resistance and glufosinate-resistance transgenes. Therefore, two types of transgenic *B. napus* plants are likely to have outcrossed with each other, since the double-herbicide-resistant transgenic strain of oilseed rape has not been developed intentionally for commercial purposes. As found in the previous study, no transgenic seeds were detected from *B. rapa* or *B. juncea*, and more extensive sampling is needed to determine whether introgression into these wild species has occurred.

Keywords: *Brassica / establishment / glufosinate / glyphosate / herbicide / introgression / outcrossing / transgenic plant*

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Insect resistance, BT maize

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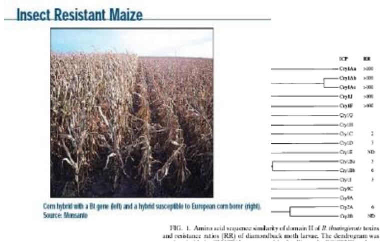
BT resistance: B. thuringiensis proteins



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Roundup ready, Monsanto

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Maiszünsler: wirtschaftlich bedeutendster Maisschädling

Es gibt mehrere Strategien zur Bekämpfung des Maiszünslers:

- **mechanisch durch Zerkleinern und Unterpflügen der auf dem Feld verbliebenen Pflanzenreste**
- **chemisch durch Einsatz von Insektiziden**
- **biologisch mit Hilfe von Trichogramma (Schlupfwespen)**
- **BT Toxin Präparate**
- **gentechnisch vermittelte Insektenresistenz besitzt (Bt-Mais)**

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Bt Corn

- Natural insecticide from *Bacillus thuringiensis*
- Non-toxic to humans
- Target insect: corn borer
- Potential to:
  - reduce insecticide use
  - reduce mycotoxins
- 40% U.S. Corn crop Bt (2006)

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Bt Concerns

- Bt pollen harms non-target species?
- Bt crops select for resistant insects
- Bt pollen can drift to organic fields
- Food system failed to keep BT Starlink corn out of human food products

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Insect Resistant Cotton

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Disease Resistance, viruses

Genetically engineered papaya resistant papaya ringspot virus

- **Cantaloupes**
- **Cucumbers**
- **Corn**
- **Rice**
- **Papaya**
- **Potatoes**
- **Soybeans**
- **Squash**
- **Tomatoes**
- **Wheat**

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Growth-enhanced fish

Salmon Growth hormone expressed in cold waters & unlinked from seasonal temp.

(Devlin et al. 1994)

Auto-transgenic mud loach: β-actin promoter linked to GH gene.

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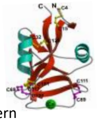
GM Salmon

- Probleme der Lachsindustrie
- gv Lachs von Aqua Bounty
- Produktionssteigerung über Ernährung, Krankheitsresistenz

- Gefahr für die Wildlachspopulationen
- Abhängigkeit des Fischfutters
- Umweltverschmutzung durch Lachszucht

147

- Atlantischer Lachs von Aqua Bounty
- **Wachstumshormon-Gen** des Chinook Lachs
- **Frostschutz-Protein-Gen**
- bessere Entwicklung in kalten kanadischen Gewässern
- Wachstum über das ganze Jahr
- normales Gewicht in der Hälfte der Zeit erreicht



BELFOND-CURIEUX, O.L et al.: Factors to consider before production and commercialization of aquatic genetically modified organisms: the case of transgenic salmon; Environmental Science & Policy 12: 170-189; 2009.

148

Golden Rice

Goldener Reis,

Unter **Goldenem Reis** (engl. *Golden Rice*) versteht man eine gentechnisch veränderte Reissorte. Es wurden zwei artfremde Gene und damit ein mehrschrittiger Syntheseweg in das Genom eingefügt. Das Phytoensynthase-Gen (*psy*) stammt von der Osterglocke (*Narcissus pseudonarcissus*) und das Carotindesaturase-Gen (*crtI*) von einem Bakterium Namens *Erwinia uredovora* (neuer Name: *Pantoea ananatis*).

Dank dieser zwei Gene kommt es zur Bildung von Beta-Carotin (Provitamin A) im Endosperm der Reiskörner, die deshalb (gold-)gelb / orange gefärbt sind. Das Provitamin wird dann im Körper zu Vitamin A (Retinol) umgewandelt.

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149

GMO tobacco, expression of human proteins in plants

150

GMOs in development:
CLAIMED BREEDING OBJECTIVES

152

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CLAIMED BREEDING OBJECTIVES

153

152

09.12.2008

Claimed breeding objectives

154

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BREEDING OBJECTIVES

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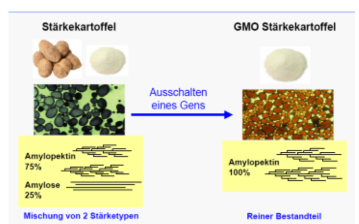
Breeding objectives



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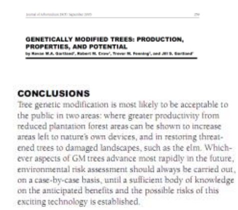
GMO Trees



GENETICALLY MODIFIED TREES: PRODUCTION, PROPERTIES, AND POTENTIAL

CONCLUSIONS

Tree genetic modification is most likely to be acceptable to the public in two areas: where greater productivity from reduced plantation forest areas can be shown to increase areas left to nature's own devices, and in restoring threatened trees to damaged landscapes, such as the elm. Whichever aspects of GM trees advance most rapidly in the future, environmental risk assessment should always be carried out, on a case-by-case basis, until a sufficient body of knowledge on the anticipated benefits and the possible risks of this exciting technology is established.

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GM FLowers

Auto Toyota Turns to GMO Flowers to Relieve it of Prius Manufacturing Pollution

Source: DailyTech • October 30, 2009

A rather unusual way of rectifying manufacturing emissions has been developed by the world's leading automaker.

Are you overcome with guilt about how much carbon, sulfides, nitrides, and other emissions goodies were pumped into the atmosphere in the making of your new Toyota Prius? Do you feel dirty?

Well, Toyota has just the thing for you. It has genetically engineered two new species of flowers that soak up air pollution.

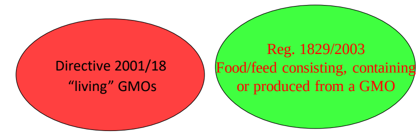
157

Regulations: Directive 2001/18/EC

- Directive 2001/18/EC on the deliberate release into the environment of GMOs
  - Clear definition of GMO and relative techniq.
  - Scope: product containing GMOs or consisting of such organisms
  - The experimental release of GMOs into the environment (for example field trials)
  - The placing on the market of GMOs (for ex. cultivation, importation or transformation)

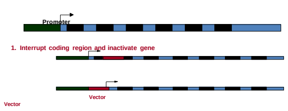
158

New directive. Scope of Directive 2001/18 and Regulation 1829/2003



159

Safety: Random integration, Insertional mutagenesis



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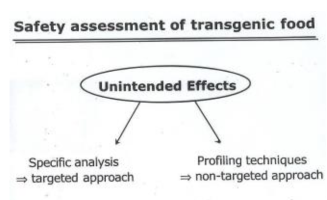

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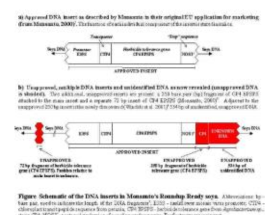
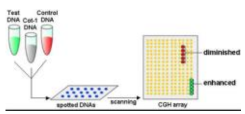


162

Detection of unintended effects in vitro, in vivo



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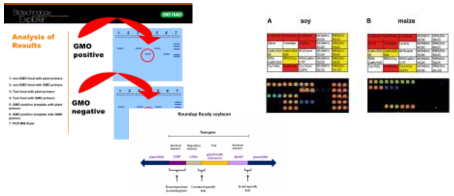
Toxicology Asessment: Difficulties Animal Feeding Studies Whole Foods

- **Small doses to be fed (bulk, satiety)**
- **Nutritional imbalance of the diet**
- **Many confounding factors**
- **Small safety margins, if any**
- **Insufficient sensitivity for specific endpoints**

164

GMO tests: PCR, primers, areas, array



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Umwelt Sicherheit LMOs

166

Cloning, Definition

Cloning is the process of making an identical copy of something

In biology, it collectively refers to processes used to

-- copies of DNA Fragments (molecular cloning)
-- cells (cell cloning)
-- organism

The term also covers when organisms such as bacteria, insects or plants reproduce asexually.

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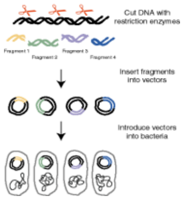
DNA cloning:



To clone a piece of DNA, DNA is cut into fragments using restriction enzymes that recognize specific sequences of bases in DNA. The fragments are pasted into vectors that have been cut by the same restriction enzyme. Vectors (e.g., plasmids or viruses) are needed to transfer and maintain DNA in a host cell.

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Reproductive Cloning

Reproductive cloning is a technology used to generate an animal that has the same nuclear DNA as another currently or previously existing animal. Dolly was created by reproductive cloning technology. In a process called "somatic cell nuclear transfer" (**SCNT**), scientists transfer genetic material from the nucleus of a donor adult cell to an egg whose nucleus has been removed. The reconstructed egg containing the DNA from a donor cell must be treated with chemicals or electric current in order to stimulate cell division. Once the cloned embryo reaches a suitable stage, it is transferred to the uterus of a female host where it continues to develop until birth.

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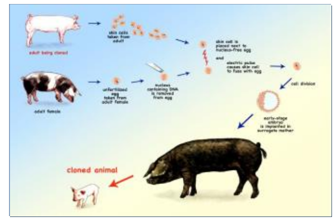
Reproductive Cloning



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Therapeutic Cloning

Therapeutic cloning, also called "embryo cloning," is the production of human embryos for use in research. The goal of this process is not to create cloned human beings, but rather to harvest stem cells that can be used to study human development and to treat disease. Stem cells are extracted from the egg after it has divided for 5 days.
The extraction process destroys the embryo, which raises a variety of ethical concerns. Many researchers hope that one day stem cells can be used to serve as replacement cells to treat heart disease, Alzheimer's, cancer, and other diseases.

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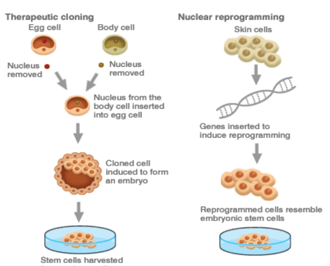

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New Objectives

Conventional Transgenic Approaches

Drawbacks:

- Random insertion of transgene
- Not suitable for gene targeting or precise gene mutation
- Difficult to perform gene replacement or create allelic variation
- Introduction of undesirable DNA fragments (T-DNA, selection markers)
- Extensive regulatory requirements
- Public concerns over transgenic crops

New technology is much needed:

- To precisely and efficiently manipulate genome for crop improvement
- To reduce regulatory hurdles and public concerns

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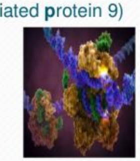
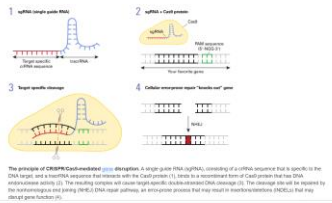
Cas-9 (CRISPR associated protein 9)

- **is an RNA guided DNA endonucleases enzyme.**
- **associated with CRISPR**
- **which plays an role in adaptive immunity system, found in bacteria Streptococcus Pyogenes.**
- **involved in Type II CRISPR mechanism**



174

CRISPR/CAS9



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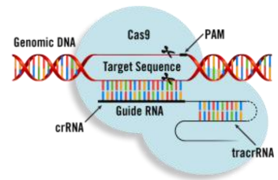
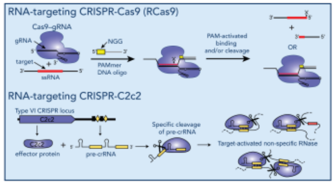


176

Targeting RNA



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CRISPR-Cas9

Broad Application of CRISPR-Cas9 Technology

Technical advantages for basic plant biology and crop breeding

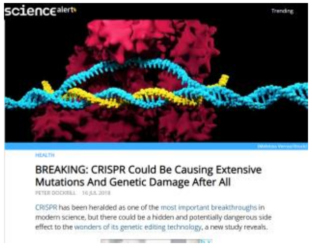
- Targeted gene mutation (multiple or redundant genes)
- Site-specific integration and gene stacking
- Gene replacement via homologous recombination
- Site-directed mutagenesis to create allelic variation
- Chromosomal engineering such as deletion or translocation
- Modification and labeling of multiple genomic sites
- Transcriptional modulation of multiple genes and pathways
- Epigenome editing such as methylation and demethylation
- Cisgenesis without introducing undesirable foreign DNA

Economic, regulatory and societal benefits:

- Reduce costs for precise and efficient molecular breeding
- Eliminate or significantly reduce regulatory requirements
- Alleviate public concerns about GM crops

178

CRISPR-Cas9 makes mutation



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Prime editing: brand new gene editing tool could fix most harmful DNA mutations in humans and plants

180

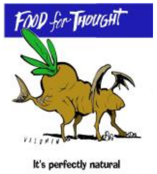
Video: Agrobacterium mediated

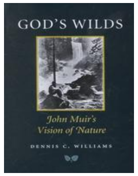
181

Video, CRISPR CAS 9

182

Values: Food production and conservation of Nature: What is NATURE ?





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What to protect why ?

INTERMEDIATE

ENVIRONMENTAL ETHICS | Lead Editor: Ben A. Minteer

Ethics of Wildlife Management and Conservation: What Should We Try to Protect?

By: Christian Gamborg (*University of Copenhagen, Danish Centre for Forest, Landscape and Planning*), Clare Palmer (*Texas A&M University, Philosophy Department*) & Peter Sandoe (*University of Copenhagen, Danish Centre for Bioethics and Risk Assessment*) © 2012 Nature Education

Citation: Gamborg, C., Palmer, C. & Sandoe, P. (2012) Ethics of Wildlife Management and Conservation: What Should We Try to Protect? *Nature Education Knowledge* 3(10):8

What should we protect when managing and conserving wildlife? There's no single answer. Competing values, and different prioritizations of values create ethical dilemmas and disagreements.

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Values of Nature

Box 1. Alternative Values Assigned to Nature

Nature tends to be valued for multiple different reasons. There is little agreement over terminology, but we can distinguish at least three different types of value:

(i) Utilitarian value (or instrumental value): refers to the many uses that humans derive from nature. These uses include services such as decomposition, pollination, climate regulation, water purification, and recreation [21]. Here it is the function of nature that is valued [22]. Utilitarian value is often associated with monetary valuation [7].

(ii) Intrinsic value (or inherent value): refers to the perceived value of nature irrespective of humans. The view is that nature has a right to exist regardless of function ('existence value') and that it is morally right to conserve nature aside from human interests [22]. People commonly object to converting intrinsic value into monetary value: nature is valued for what it is, rather than for what it does, so its value is not open to quantification or monetary transaction [2,5,22].

(iii) Non-use value: refers to the value of nature to humans even when there is no direct use. Humans place non-use value on knowing that nature continues to exist and can be bequeathed to future generations, possibly for future use [21]. There are similarities between intrinsic and non-use values in that both value nature irrespective of human use (e.g., existence value), but non-use value is distinguished in that the value is regarded as being to humans rather than regardless of human interests. Since non-use value is based on human interests (like utilitarian value) it is open to quantification (unlike intrinsic value) and has been used in assessments of ecosystem services, including the UK National Ecosystem Assessment [21].

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Values of Nature

Value	Definition	Function
Utilitarian	Practical and material exploitation of nature	Physical sustenance/security
Naturalistic	Direct experience and exploration of nature	Curiosity, discovery, recreation
Ecologistic-Scientific	Systematic study of structure, function	Knowledge, understanding, observational skills
Aesthetic	Physical appeal and beauty of nature	Inspiration, harmony, security
Symbolic	Use of nature for language and thought	Communication, mental development
Humanistic	Strong emotional attachment and "love"	Bonding, sharing, cooperation, companionship
Moralistic	Spiritual reverence and ethical concern for nature	Order, meaning, kinship, altruism
Dominionistic	Mastery, physical control, dominance over nature	Mechanical skills, physical prowess, ability to subdue
Negativistic	Fear, aversion, alienation from nature	Security, protection, safety, awe

https://www.youtube.com/watch?v=q8AZHtF2f50

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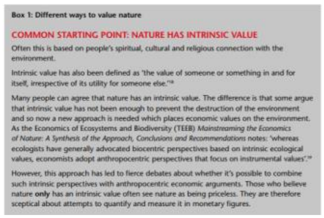
Economy and nature, Value an intrinsic value?



Box 1: Different ways to value nature

COMMON STARTING POINT: NATURE HAS INTRINSIC VALUE

Often this is based on people's spiritual, cultural and religious connection with the environment.

Intrinsic value has also been defined as 'the value of someone or something in and for itself, irrespective of its utility for someone else.'

Many people can agree that nature has an intrinsic value. The difference is that some argue that intrinsic value has not been enough to prevent the destruction of the environment and so now a new approach is needed which places economic values on the environment. As the Economics of Ecosystems and Biodiversity (TEEB) *Mainstreaming the Economics of Nature: A Synthesis of the Approach, Conclusions and Recommendations* notes: 'whereas ecologists have generally advocated biocentric perspectives based on intrinsic ecological values, economists adopt anthropocentric perspectives that focus on instrumental values'.

However, this approach has led to fierce debates about whether it's possible to combine such intrinsic perspectives with anthropocentric economic arguments. Those who believe nature **only** has an intrinsic value often see nature as being priceless. They are therefore sceptical about attempts to quantify and measure it in monetary figures.

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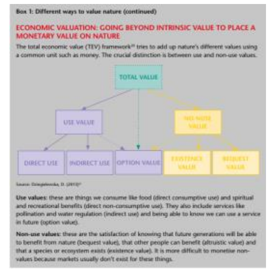
Monetary value



Box 1: Different ways to value nature (continued)

ECONOMIC VALUATION: GOING BEYOND INTRINSIC VALUE TO PLACE A MONETARY VALUE ON NATURE

The total economic value (TEV) framework tries to add up nature's different values using a common unit such as money. The crucial distinction is between use and non-use values.

Use values: these are things we consume like food (direct consumptive use) and spiritual and recreational benefits (direct non-consumptive use). They also include services like pollination and water regulation (indirect use) and being able to know we can use a service in future (option value).

Non-use values: these are the satisfaction of knowing that future generations will be able to benefit from nature (bequest value), that other people can benefit (altruistic value) and that a species or ecosystem exists (existence value). It is more difficult to monetise non-values because markets usually don't exist for these things.

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Rise of natural science and nature

Francis Bacon, 1561 – 1626

"Nature, to be commanded, must be obeyed"

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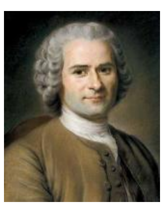
Return to eden



Jean-Jacques Rousseau
1712-1778

Rousseau postulierte einen Menschen, der im Naturzustand den Einklang mit der Natur sucht

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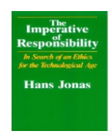
Property and responsibility



"Handle so, daß die Wirkungen deiner Handlungen verträglich sind mit der Permanenz echten menschlichen Lebens auf Erden."

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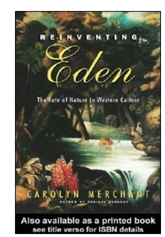
The problem of land use, transformation and Conservation



Carolyn Merchant

Conservation history,
Univ. of Berkley

https://www.youtube.com/watch?v=HSZuyPA5-1Y

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Carolyn Merchant

https://www.youtube.com/watch?v=HSZuyPA5-1Y&t=2543s

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Carolyn Merchant

https://www.youtube.com/watch?v=pqa1akoQIJE

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Farming values, middle ages autark?

195

Landuse and property

conservation : expolitation

use : property

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Nature and property

Science 13 December 1968:
Vol. 162. no. 3859, pp. 1243 – 1248

Articles
The Tragedy of the Commons

Garrett Hardin
professor of biology, University of California, Santa Barbara.

When a resource is held "in common," with many people having "ownership" and access to it, Hardin reasoned, a self-interested "rational" actor will decide to increase his or her exploitation of the resource since he or she receives the full benefit of the increase, but the costs are spread among all users.

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Nature and property. Public goods

Industrial and Corporate Change
Pp. 131-159

OSTROM, E. © 1995 Oxford University Press

research-article

Self-organization and Social Capital
(building public goods)

ELINOR OSTROM

(Workshop in Political Theory and Policy Analysis, Indiana University Bloomington, IN 47408–3895, USA)

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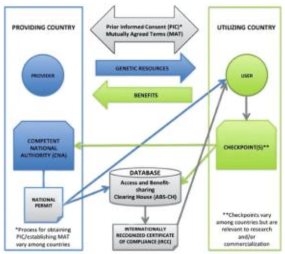
Benefit sharing, genetic ressources



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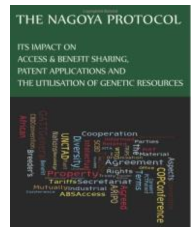

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RIO 1992 Diversity, sustainability and equal access to natural ressources

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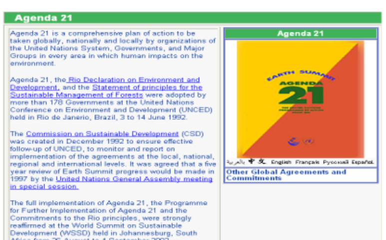
UN: sustainability: Agenda 21



Agenda 21

Agenda 21 is a comprehensive plan of action to be taken globally, nationally and locally by organizations of the United Nations System, Governments, and Major Groups in every area in which human impacts on the environment.

Agenda 21, the Rio Declaration on Environment and Development, and the Statement of principles for the Sustainable Management of Forests were adopted by more than 178 Governments at the United Nations Conference on Environment and Development (UNCED) held in Rio de Janerio, Brazil, 3 to 14 June 1992.

The Commission on Sustainable Development (CSD) was created in December 1992 to ensure effective follow-up of UNCED, to monitor and report on implementation of the agreements at the local, national, regional and international levels. It was agreed that a five year review of Earth Summit progress would be made in 1997 by the United Nations General Assembly meeting in special session.

The full implementation of Agenda 21, the Programme for Further Implementation of Agenda 21 and the Commitments to the Rio principles, were strongly reaffirmed at the World Summit on Sustainable Development (WSSD) held in Johannesburg, South Africa from 26 August to 4 September 2002.

Agenda 21

English Français Русский Español

Other Global Agreements and Commitments

202

The eight MDGs – reduce poverty and hunger; achieve universal education; promote gender equality; reduce child and maternal deaths; combat HIV, malaria and other diseases; ensure environmental sustainability; develop global partnerships – **failed** to consider the root causes of poverty and overlooked gender inequality as well as the holistic nature of development. The goals made no mention of human rights and did not specifically address economic development. While the MDGs, in theory, applied to all countries, in reality they were considered targets for poor countries to achieve, with finance from wealthy states. Conversely, every country will be expected to work towards achieving the SDGs.

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1) End poverty in all its forms everywhere
2) End hunger, achieve food security and improved nutrition, and promote sustainable agriculture
Advertisement
3) Ensure healthy lives and promote wellbeing for all at all ages
4) Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
5) Achieve gender equality and empower all women and girls
6) Ensure availability and sustainable management of water and sanitation for all
7) Ensure access to affordable, reliable, sustainable and modern energy for all
8) Promote sustained, inclusive and sustainable economic growth, full and productive employment, and decent work for all
9) Build resilient infrastructure, promote inclusive and sustainable industrialisation, and foster innovation
10) Reduce inequality within and among countries
11) Make cities and human settlements inclusive, safe, resilient and sustainable
12) Ensure sustainable consumption and production patterns
13) Take urgent action to combat climate change and its impacts (taking note of agreements made by the UNFCCC forum)

14) Conserve and sustainably use the oceans, seas and marine resources for sustainable development
15) Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification and halt and reverse land degradation, and halt biodiversity loss
Advertisement
16) Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
17) Strengthen the means of implementation and revitalise the global partnership for sustainable development

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WTO

Location: Geneva, Switzerland
Established: 1 January 1995
Created by: Uruguay Round negotiations
(1986-94)
Membership: 149 countries (11.12.2005)
Budget: 169m Swiss francs, 2005
Secretariat staff: ~600
Head: Director-General Pascal Lamy

Functions:
- Administering WTO trade agreements
- Forum for trade negotiations
- Handling trade disputes
- Monitoring national trade policies
- Technical assistance and training for developing countries
- Cooperation with other international organizations

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What is the WTO?

- forum for negotiations
- agreed rules and commitments
- … with basic principles for trade
- … and dispute settlement
- member-driven
- supporting Secretariat

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TRIPS: Main features (1)

- Coverage of TRIPS

  Areas of intellectual property covered:
  - copyright and related rights
  - trademarks including service marks;
  - geographical indications including appellations of origin;
  - industrial designs;
  - patents including the protection of new varieties of plants;
  - the layout-designs of integrated circuits; and
  - undisclosed information, including trade secrets and test data.

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The role of trade regulations

OBJECTIVES OF WTO

- The primary aim of WTO is to implement the new world trade agreement.
- To promote multilateral trade .
- To promote free trade by abolishing tariff & non-tariff barriers.
- To enhance competitiveness among all trading partners so as to benefit consumers.
- To increase the level of production & productivity with a view to increase the level of employment in the world.
- To expand & utilise world resources in the most optimum manner.
- To improve the level of living for the global population & speed up economic development of the member nations.
- To take special steps for the development of poorest nations.

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2001 Doha Declaration: TRIPS

- Emphasized that TRIPS should be supportive of public health
  - See separate declaration
- September 2003 deadline for negotiations on wine and spirit GI registration
- TRIPS Council reviews to consider biological diversity, traditional knowledge and development objectives

DOHA DEVELOPMENT AGENDA

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TRIPS: Main features (2)

- Enforcement Provisions
  - General Principles applicable to IPRs
  - Specifies Procedures that must be available
- Dispute Settlement
  - Part of the integrated Dispute Settlement System of the WTO
  - No unilateral action by Members allowed

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TRIPS Basic Principles (1)

- Freedom to determine the appropriate method of implementing the Agreement (Art. 1.1)
- **National treatment (Art. 3)**
- **Most-favoured nation treatment (MFN) (Art. 4, 5)**
- Exhaustion of rights (Art. 6); see (WT/MIN(01)/DEC/2)
- Objectives (Art. 7); see WT/MIN(01)/DEC/2
- Principles (Art. 8); see WT/MIN(01)/DEC/2

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TRIPS: Basic principles (2)

- National treatment
  - forbids discrimination between a Member's own nationals and the nationals of other Members
- Most-Favoured-Nation Treatment
  - forbids discrimination between the nationals of other Members

212

SPS Agreement, Article 2.1.

All countries have rights to take Sanitary and Phytosanitary (SPS) Measures for protection of human, animal and plant life and health

213

SPS measures:

- Must be based on scientific evidence and risk assessment
- Must not create any sort of unjustified barriers and
- Must not create any restrictions in international trade.

214

Definition of an SPS Measures

To protect	***From***
• animal or plant life	• pests, • diseases or • disease-causing organisms

215

Beneficiaries of the SPS Agreement:

- The consumers,
- The exporters of agricultural products,
- The importers of food and other agricultural products.

216

Appropriate level of sanitary or phytosanitary protection:

- **The level of protection deemed appropriate by the country establishing a sanitary or phytosanitary measure to protect human, animal or plant life or health within its territory.**

Many countries refer to this concept as the "acceptable level of risk".

217

SPS a critical perspective

- Can trade- limitations restricted to sanitary and phytosanitay aspects ensure local biodiversity threatened by global trade (see problem of exotic species, see global homogenisation of diversity).

218

UN 2015, 2020

219

UN sustainable developmental goal

220

Organic farming

Previou Next End

221

Organic farming; Nature: Elements for mainstream farming ?

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222

Entwicklung Biolandbau

223

Entstehungskontext des Biolandbaus

- Hohes Bevölkerungswachstum durch Industrialisierung
  - Wissen über Prozesse im Boden und über Nährstoffkreisläufe gering
  - Suche nach technischen und wissenschaftlichen Lösungen zur Steigerung der landwirtschaftlichen Produktivität

- Erfindungen zur Steigerung der Nahrungsmittelproduktion
  - 1828 Carl Sprengel: Minimumgesetz (knappster Nährstoff limitiert Wachstum)
  - 1849 Justus von Liebig: Mineralstofftheorie, Erfinder von künstlichem Phosphatdünger,
  - 1910 Haber-Bosch-Verfahren: synthetische Stickstoffherstellung

- Landwirtschaft im Wandel
  - Industrialisierung, Motorisierung der Betriebe
  - Pflanzenzucht, Kunstdünger, Wachstumsregler und Pestizide

224

Entstehungskontext des Biolandbaus

1920-1950

- Biolandbau als Antwort auf Krisen
  - Grosse Wirtschaftskrise der 1930er Jahre
  - Ökonomischer Zwang zur Produktivitätssteigerung
  - Verschuldung, Abhängigkeit
  - Ökologische Krise

- Lebensreformbewegung («zurück zur Natur»)
  - für Aussteigerinnen, Visionäre und rebellische Bauern

- Von Bio-Pionieren entwickeltes Landbausystem gilt bis heute als Leitbild für eine nachhaltige Land- und Ernährungswirtschaft
  - Zusammenschluss in Organisationen
  - wissenschaftliche Erkenntnisse und Praxiserfahrungen als Basis
  - Markt orientiert sich an Konsumentenbedürfnis
  - umweltschonend und tiergerecht

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Pioniere in der Geschichte des Biolandbaus

Dr. Rudolf Steiner *1861; †1925

- Besondere Leistungen
  - Gründer des biologischen-dynamischen Landbaus
  - Gründer der Anthroposophie

- Leben und Werk
  - Studium in Wien: Mathematik, Naturwissenschaft (Lehrveranstaltungen in Literatur, Philosophie und Geschichte)
  - Promotion zum Doktor der Philosophie an der Universität Rostock
  - Herausgeber der naturwissenschaftlichen Schriften J. W. von Goethes
  - Aufbau der Anthroposophie: Vortragsreisen in Berlin und ganz Europa zu Pädagogik, Kunst, Medizin, Theologie, Landwirtschaft (>5000 Vorträge)
  - Beginn der Waldorf-Schulbewegung in Stuttgart (CH: Steinerschule)
  - Vortragsreihe für Landwirte: «Geisteswissenschaftliche Grundlagen zum Gedeihen der Landwirtschaft» (1924)
  - Gründung der Anthroposophischen Gesellschaft

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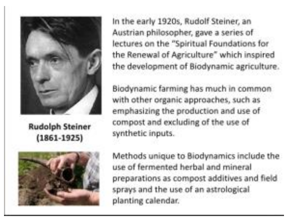
Attending the First Organic Agriculture Course: Rudolf Steiner's Agriculture Course at Koberwitz, 1924



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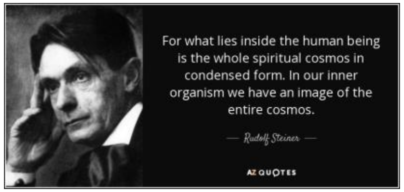
Rudolf Steiner



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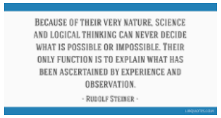

Rudolf Steiner

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Steiner and thereafter

The beginning of organic farming could trace back to 1924 in Germany with Rudolf Steiner's course on Social Scientific Basis of Agricultural Development, in which his theory considered the human being as part and parcel of a cosmic equilibrium that he/she must understand in order to live in harmony with the environment. Therefore, a balance must be struck between the spiritual and material side of life (Herrmann and Plakolm 1991).

H. Pfeiffer applied these theories to agriculture and gave birth to biodynamic agriculture (Kahnt 1986). It was developed at the end of the 1920s in Germany, Switzerland, England, Denmark and the Netherlands (Herrmann and Plakolm 1991; Kahnt 1986; Diercks 1986)

In Switzerland in 1930, politician Hans Mueler gave impetus to organic-biological agriculture

230

Australias demeter farm

Australia's original Demeter Farm (1934-1954)

231

The Farm as Organism:
The Foundational Idea of Organic Agriculture

John Paull

School of Geography and Environmental Studies, University of Tasmania

Archived at http://orgprints.org/10138

Elementals – Journal of Bio-Dynamics Tasmania (2006) #83, 14-18

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Pioniere in der Geschichte des Biolandbaus

Mina Hofstetter *1883; †1963

- Besondere Leistungen
  - Landw. Experimente auf ihrem viehlosen Betrieb
  - Publikationen, Vorträge, Kurse (Lebensreformbewegung)
  - Lehrstätte für biologischen Landbau auf ihrem Hof
- Ihre Kerngedanken waren
  - Gesunde Nahrung aus gesundem Boden
  - Mehr Qualität statt Quantität
  - Nur oberflächliche Bodenbearbeitung (da Boden lebendiger Organismus)
  - Bodenbedeckung so oft als möglich
  - Kompost ist der ideale Dünger
  - Steinmehl ist ein wertvoller Bodenverbesserer
  - Gründüngung an Stelle von Brache

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Pioniere in der Geschichte des Biolandbaus

Dr. Hans Müller *1891; †1988, Maria Müller *1899; †1969

- Besondere Leistungen
  - Gründerpaar des organisch-biologischen Landbaus als eigene Richtung (zusammen mit Hans Peter Rusch)
  - Eröffnung Hausmutterschule und Bildungsstätte «Möschberg» BE

Maria Müller
- Aufarbeitung der Literatur org. Landbaus und der Landbauwissenschaften
- Leitung Hausmutterschule und Bildungsstätte «Möschberg»

234

Etappen in der Entwicklung des Biolandbaus

1950-2000 Marktwirtschaftliche Organisationen

1946	Gründung AVG (heute: AV-AG) Biogemüse AV-AG in Galmiz
1947	Gründung SGBL (heute: Bioterra) Bioterra iOrganisation für den Bio- und Naturgarten in der Schweiz
1954	Eintragung Schutzmarke «Demeter»
1972	Gründung Biofarm
1981	Gründung VSBLO (heute: BIO SUISSE) Eintragung Schutzmarke «Knospe»

- Vermarktung von Bioprodukten entwickelte sich erst nach gesetzlichen Schutz der Kennzeichnung von Bioprodukten

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Etappen in der Entwicklung des Biolandbaus

1970-2000 Politische Verankerung von Bio

1971	Dr. Hans Müller fordert rechtliche Anerkennung des Begriffes «Bio»
1973	Gründung Forschungsinstitut für biologischen Landbau (FiBL)
1976	1. Kongress der International Federation of Organic Agriculture (IFOAM)
1980	erste gemeinsame Richtlinien des Biolandbaus in der Schweiz
1981	Gründung VSBLO (heute: BIO SUISSE) Eintragung der Schutzmarke «Knospe»
1991	EU-Bioverordnung tritt in Kraft (auf Grundlage der Richtlinien der IFOAM und des Codex alimentarius)
1993	Bund definiert Mindestanforderungen für Bio bezügl. Direktzahlungen
1997	CH-Bioverordnung tritt in Kraft
2000	13. Wissenschaftskonferenz der IFOAM, organisiert durch FiBL

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Initiative von Pionieren wächst zur Bewegung

Forschungsinstitut, internationale Dachorganisation

- FiBL, heute eine der weltweit führenden Forschungseinrichtungen zur biologischen Landwirtschaft (Gründung 1973)
- Stärken
  – interdisziplinäre Forschung, Innovationen mit Landwirten und Lebensmittelindustrie
  – lösungsorientierte Entwicklungsprojekte und rascher Wissenstransfer
- IFOAM, internationale Dachorganisation der Bioorganisationen mit etwa 800 Mitgliedern in 120 Ländern (Gründung 1972)

Bilder: FiBL, IFOAM

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Initiative von Pionieren wächst zur Bewegung

Erste Richtlinien und Dachverband (Bio Suisse)

- Bio-Verbände Demeter, Biofarm, SGBL Bio (später: Bioterra) und Progana vereinen sich
- Erstellung gemeinsamer Richtlinien für Schutz und Kontrolle des biologischen Landbaus (unter Leitung des FiBL)
- weltweit erste Bio-Richtlinien entstehen in der Schweiz (1980)

- erfolgreiche Zusammenarbeit der Bio-verbände: Gründung der heutigen Bio Suisse (Dachverband der Schweizer Biolandbau-Organisationen, Name ab 1997)

Bilder: Bio Suisse

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Initiative von Pionieren wächst zur Bewegung

Zertifizierung: garantierte Qualität, seriöser Handel

- bio.inspecta (Gründung 1998)
- Ziel: Unterstützung von Landwirtschafts-betrieben und Unternehmen der Lebensmittelbranche in der nachhaltigen Entwicklung und der Stärkung Ihrer Marktposition

Bilder: bio.inspecta, Bio Test Agro

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Initiative von Pionieren wächst zur Bewegung

Einstieg der Grossverteiler führt zu Bio-Boom

- Einstieg von Coop (1994)
  – Einstieg von Coop als Detailhändlerin in den Bio-Markt und zunehmendes Interesse der Konsumenten führen zu Bio-Boom
  – Parallel dazu Einführung von Direktzahlungen des Bundes an Biolandwirte

Bilder: Coop, Migros

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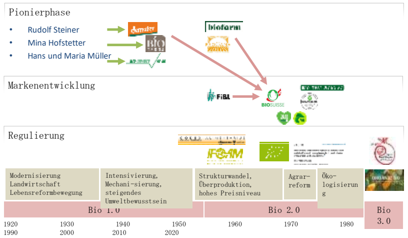
Übersicht: Meilensteine in der Bio-Geschichte

Personen, Organisationen und Meilensteine



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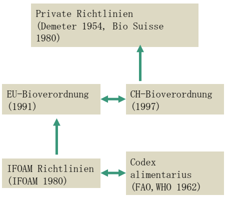
Übersicht: politische Verankerung von Bio

Anerkennung der Biorichtlinien bringt gesetzl. Schutz



- privatrechtlich
  - private Biorichtlinien für Schweizer Produkte über Mindestanforderungen der CH-Bioverordnung hinaus
- staatlich
  - EU-Bioverordnung und CH-Bioverordnung sind fast gleichwertig
- international
  - Codex al.: lebensmittel-rechtliche Bestimmungen in Mitgliedsstaaten
  - IFOAM: int. Biorichtlinien

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Übersicht: Agrarsysteme im Vergleich

Zeitliche Entwicklung und Ökologisierungsgrad

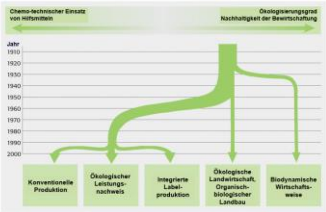

Bild: «Biologischer Landbau» LmZ (O. Schmid, R. Obrist)

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Bio 3.0

Mit Bio zu einer modernen nachhaltigen Landwirtschaft

- Ziele
  - Weiterentwicklung des Biolandbaus ab 2015

- Bio/Organic 3.0
  - Ist ein Diskussionspapier für die zukünftige Entwicklung der Biobewegung
  - Ist die 3. Phase der Biobewegung (siehe nächste Folie)
- Wer
  - IFOAM
  - Bioland, Naturland, Bio Suisse, Bio Austria (alle Verbände > 28'000 Mitglieder)
  - Forschungsinstitut für biologischen Landbau FiBL (D, A, CH)

Quelle: Diskussionspapier Bio 3.0 (Niggli et al., 2015)

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Organic 3.0

Organic 1.0 was started by our numerous pioneers, who observed the problems with the direction that agriculture was taking at the end of the 19th century and the beginning of the 20th century and saw the need for a radical change.

Organic 2.0 started in the 1970s when the writings and agricultural systems developed by our pioneers were codified into standards and then later into legally-mandated regulatory systems.

Organic 3.0 is about bringing organic out of its current niche into the mainstream and positioning organic systems as part of the multiple solutions needed to solve the tremendous challenges faced by our planet and our species.

MANIFESTING ORGANIC 3.0

Organic 3.0 forms from the top down and the bottom up: We work collectively toward a common framework that emerges out of the diversity of like-minded initiatives from around the world. IFOAM - Organics International and its network, while striving to unite these efforts, also leads with its own initiatives:

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Bio 3.0

Entwicklungsphasen der biologischen Landwirtschaft

Bio 1.0 *Organic 1.0*	Bio 2.0 *Organic 2.0*	Bio 3.0 *Organic 3.0*
Eine Idee wird geboren	Aus der Idee wird ein weltweiter Standard	Garant für eine nachhaltige Landwirtschaft und Ernährung jenseits der Nische
1900 bis 1970	**1970 bis 2015**	**2015 bis**
Zurück zur Natur. Lebensreform. Der Landwirtschaftliche Kurs. Organisch-biologischer Landbau. Die Grenzen des Wachstums.	Verbandsrichtlinien IFOAM-Richtlinien EU-Ökoverordnung. Codex Alimentarius Harmonisierung zwischen 80 staatlichen Verordnungen. Weltweiter Handel mit Ökoprodukten	Umfassende Innovationskultur. Ständige Verbesserung in Richtung Beste Praxis. Transparente Integrität. Allianzen und Partnerschaften.

Quelle: Diskussionspapier Bio 3.0 (Niggli et al., 2015)

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Bio 3.0

Wettbewerb der Agrarsysteme steht erst am Anfang (1)

- Landwirtschaft muss sich ändern, weil zentrale gesellschaftliche Erwartungen nicht erfüllt werden
  - Steigender Pestizideinsatz trotz integriertem Pflanzenschutz und neuen Techniken zur Pestizidreduktion (z.B. GVO)
  - Industrialisierung der Tierhaltung trotz Tierwohlinitiativen
  - Verlust an Artenvielfalt trotz internationalen Abkommen, Vertragsnaturschutz
  - Verlust an Boden und Bodenqualität

Wettbewerbsziele	Nachhaltigkeit, konsequente Kreislaufsysteme, artgerechte Tierhaltung, Klimawandel, Systemdienstleistungen, Ressourceneffizienz, Urbanisierung, Verbrauchererwartungen usw.
Bisherige Konzepte der Lösungssuche	Standortanpassung, Aquaponik, Urban Farming, Vertical Agriculture, Robotik und Biotechnologie
«Wettbewerbsjury»	Verbraucher Landwirte Wissenschaft und Politik

Quelle: Diskussionspapier Bio 3.0 (Niggli et al., 2015)

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Bio 3.0

Wettbewerb der Agrarsysteme steht erst am Anfang (2)

Teilnehmer	Verschiedene Agrarsysteme Biolandbau bisher zu wenig beachtet
Lösungen aus dem Biolandbau	standortangepasstes Fruchtfolgekonzept, betriebliche Stoff- und Energiekreisläufe, biologischer Pflanzenschutz, vorbeugende Tiergesundheitsstrategien, regionale Eiweissfutterversorgung mit Flächenbindung, usw.

- Biolandbau hat
  - 40 Jahre Entwicklungs- und Erfahrungsvorsprung
  - Systemansatz für Landwirtschaft und Ernährung

- Biolandbau soll
  - Eigene Schwachstellen angehen
  - Referenz werden für weltweit funktionierenden Systemansatz in der Landwirtschaft

Quelle: Diskussionspapier Bio 3.0 (Niggli et al., 2015)

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Bio 3.0

Herausforderungen

- Schwaches Wachstum der **landwirtschaftlichen Erzeugung** (hauptsächlich in Europa, wo die absatzstärksten Märkte liegen)
- Ungenutztes oder fehlendes Potential des Biolandbaus für eine **nachhaltige Ernährungssicherheit**
- Zunehmende Konkurrenz durch andere **Nachhaltigkeitsinitiativen**
- **Transparenz und Sicherheit** in den Wertschöpfungsketten
- Zu verbessernde differenzierte **Kommunikation mit Verbrauchern**

Quelle: Diskussionspapier Bio 3.0 (Niggli et al., 2015)

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Bio 3.0

Rahmenbedingungen Weiterentwicklung Biolandbau

Quelle: Diskussionspapier Bio 3.0 (Niggli et al., 2015)

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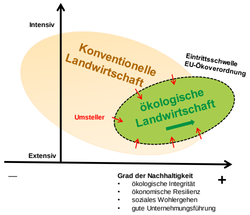
Bio 3.0

Erhöhte Produktivität dank ökologischer Intensivierung



- Biolandbau kann Produktivität steigern dank noch besserer Nutzung betriebseigener Kreisläufe und Ressourcen (Nachhaltigkeit erhalten).
- Konventionelle Landwirtschaft kann nur dann ökologisch nachhaltiger werden, wenn betriebsfremde Abhängigkeiten von Stoffflüssen und Mitteln (Dünger, PSM) reduziert werden.

Quelle: Diskussionspapier Bio 3.0 (Niggli et al., 2015)

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Bio 3.0

Dynamisches Entwicklungskonzept: «Beste Praxis»

- **Beste Praxis:** Weitergehende Leistungen (Richtlinien Bioverbände, private Labels) bedeutend für Marketing und Kommunikation (Nische)
- **Staatliche Ökoregelung:** Genau definierte Mindestanforderungen für den Biolandbau als Modell für die ganze Landwirtschaft (Innovationsstrategie)

Quelle: Diskussionspapier Bio 3.0 (Niggli et al., 2015)

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Bio 3.0

IFOAM Best Practice Guideline

- **International Federation of Organic Agriculture Movements**
- **Auch in Zukunft:** Kerndokument für die globale Diskussion über Nachhaltigkeit
- für Landwirtschaft und Wertschöpfungsketten
- innerhalb und ausserhalb der Biobranche

Quelle: IFOAM

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Basically, it is all a question about values

- There is a fight about the term sustainability
- Sustainability is something everyone wants
- Sustainability is a normative word: Related to values, attitudes
- We have to reflect about our values and attitudes, and be open and honest about our goals and visions
- There is no such thing as an «objective» researcher
- Research has to be reliable; which is not the same as «objective»
- Working to promote organic food and farming does not mean that your research is not as reliable as research made by people claiming a «neutral» position

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Herausforderungen

1. Produktion von gesundem, ausreichendem, sicherem und preiswertem Essen für 9-11 Milliarden Menschen
2. Reduktion der Umweltbelastung und Treibhausemissionen
3. Entwicklung von neuen Lebensmittelketten
4. Anpassung an den Klimawandel und das Reduzieren der Treibhausgase
5. Schutz für Böden, Wasser, Luft, Biodiversität und Landschaften
6. Berücksichtigen von laufend auftauchenden Sitten, Essgewohnheiten, Lifestyles und Konsumentenbedürfnisse

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Herausforderungen Kleinbauern in Entwicklungsländern

- **Niedriger Ertrag/Gewinn**
- **Nährstoffmanagement**
- **Zertifikation und Markt**
- **Bildung und Forschung**: Bezüglich Vermarktung, Zertifizierungsprozessen und ökologische Prozesse

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Gegenmaßnahmen

1. Konventionelle Landwirtschaft kann von ökologischer lernen
2. Ökologische Landwirtschaft kann von konventioneller lernen
3. Maßstäbliche Vergrößerung der besten Bio-Landwirtschaft- Praktiken: Förderung von Communities welche sich mit organic farming beschäftigen und diese fördern.
4. Lebensmittelproduktion sollte enger verbunden werden mit dem Konsumenten/Innen

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Gegenmaßnahmen

5. Landwirtschaftlichen Systeme sollten sich ändern:
   a) „commodity production“ (Warenproduktion) zu „need-based“ production
   b) b) weniger Viehzucht und eine Änderung der Bewirtschaftung von Tieren. *
   c) Local versus Global food
   d) landless food production

***Less livestock and changed animal husbandry systems:** “Numbers of livestock needs to be reduced by a significant number, from ethical point of view probably even towards zero” (Rahmann,2017)

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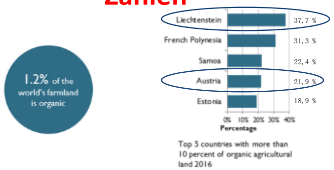
ökologische Landwirtschaft in Zahlen



[FiBL und IFOAM, 2018]

Abbildungen 3 und 4:
Organic Farmland 2018: https://www.organic-world.net/fileadmin/images_organicworld/yearbook/2018/graphs-world/world-infograph_organic_farmland.png (Stand:15.01.2019)

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From niche to volume: 0 → 5 % of European farmland

- Since 1985, a rapid growth in organic production and consumption, linked to public support, research and increased acceptance in the scientific community
- Organic agriculture is still not fully accepted, and still actively counteracted and questioned especially for food security, soil fertility and partly for animal welfare

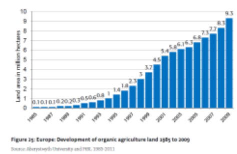

Figure 25: Europe: Development of organic agriculture land 1985 to 2009

Source: http://orgprints.org/19310/1/world-of-organic-agriculture-2011.pdf

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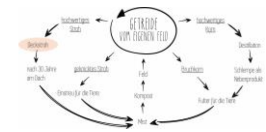
Biodynamik und Demeter

- Regelungen gleich wie bei der Biolandwirtschaft
- Unterscheidungsmerkmale
  - Hofkreislauf
  - Arbeiten nach kosmischen Rhythmen
  - Biodynamische Präparate
  - Züchtung samenfester Sorten
- Ganzheitliches Konzept



Quelle: http://www.thauerboeck.com/unser-beitrag-zum-klimaschutz/cradle-to-cradle-kreislauf-getreide2//

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Richtlinien von Demeter

- Bioanbauverband, gegründet 1932 in Deutschland
- Verwendung Demeter-Zeichen nur für Vertragspartner
- Lückenlose Überprüfung – vom Anbau bis zur Verarbeitung
- Leitsatz ist Voraussetzung für verantwortliches Handeln
- Kennzeichnung „Demeter" rechtlich geschützt

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Qualitätssicherung von Demeter

- Zweijähriger Anbau zur Anerkennung
- Demeter-Qualität wird laufend überprüft
- Stichproben werden durchgeführt
- Gesetzliche Bestimmungen
  - Verordnung (EWG) 834/2007
  - Verordnung 889/2008
- Verbreitung von Demeter weltweit

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Verwendete Präparate

- Abstimmung mit Mondphasen und Planetenposition
- Hauptmerkmal für biodynamische Produktion
- Verbindlich vorgeschrieben
- Kauf der Präparate auch möglich
- Ziel ist die Verstetigung der Erträge
- Begriff „Harmonisieren"

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Verwendete Präparate

„Feld- und Spritzpräparate"

- Hornmistpräparat
  - Kuhhorn gefüllt mit Kuhmist
  - Kräftigung des Bodens
- Hornkieselpräparat
  - Kuhhorn gefüllt mit Bergkristall
  - Wirkt auf oberirdische Pflanzenorgane

„Düngerzusatzpräparate"

- Werden dem Stallmist oder Kompost zugegeben
- Bsp.: Schafgaben Blüten, Löwenzahn, Eichenrinde

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Acker- und Pflanzenbau

- Ausgewogene Fruchtfolgengestaltung
- „Düngen heißt, den Boden verlebendigen"
- Intensivierung biologische Vorgänge im Boden
- Schutz der Integrität der Pflanze
- Transparenz bei der Züchtung
- Gentechnik ist ausnahmslos verboten

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Viehhaltung

- Für das Tierwohl gelten hohe Standards
- Integrität und natürliche Entwicklung soll gefördert werden
- Enthornung bei Rindern nicht erlaubt
- Futter wird selbst erzeugt
- Tiermehle, Zusatzstoffe und Medikamente sind verboten
- Produktqualität steht an 1. Stelle

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Vergleich der Anbauweisen

Erzeuger / Kriterien	Konventionelle Landwirtschaft		Naturland	Bioland	demeter
Max. Hennen pro Gebäude	keine Beschränkung	20.000	12.000	6.000	3.000
Anzahl von erlaubten Lebensmittel-Zusatzstoffen	über 300	47	22	23	13
Schweine pro Hektar	keine Beschränkung	14	10	10	10
Legehennen pro Quadratmeter	10	6	6	6	4,4
Enthornung von Rindern	erlaubt ohne Betäubung	erlaubt	Nicht empfohlen	Zulässig im Ausnahmefall	Nicht erlaubt
Bio-Futter	keine Vorschrift	95%	100%	100%	100%
Einsatz von Gentechnik	erlaubt	bis zu 5%	nein	nein	nein

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Kritik & Diskussion

- Ideen ohne wissenschaftliche Forschungsweisen entwickelt
- Wirkung eine Frage des Glaubens (?)
- Durch Untersuchungen keine Rückschlüsse auf spezifischen Beitrag
- Keine Beweise für positive Pflanzenentwicklung und Qualität

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IFOAM

HISTORY

The humble beginnings of IFOAM – Organics International trace back to a meeting in Versailles, France in 1972. Roland Chevriot of Nature et Progrès envisioned the need for Organic Agriculture movements to coordinate their actions and to enable scientific and experimental data on organic to cross borders. In order to realize this vision, he invited organic pioneers including Lady Eve Balfour, founder of the UK Soil Association, Kjell Arman from the Swedish Biodynamic Association and Jerome Goldstein from the Rodale Institute to join him in Versailles to set the International Federation of Organic Agriculture Movements (IFOAM) in motion. See Roland Chevriot's invitation

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Important and impressive international network: IFOAM

International Federation of Organic Agriculture Movements:

- "It all started in 1972 when the President of the French farmers' organization, Nature et Progrès conceived of a worldwide appeal to come together to ensure a future for organic agriculture"
- "By the 80s, IFOAM had leaders in the US, attracted involvement from African agents of organic agriculture, and launched a unique and fruitful relationship with the Food and Agriculture Organization of the United Nations (FAO)"
- "..producing **standards** which provided a model for numerous major laws and voluntary standards, (Codex Alimentarius, EU, FAO)"
- By 2014: 732 affiliates (members, associates and supporters) in 114 countries.
- Source: www.ifoam.org

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IFOAM's 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 *(ratified in 2008)*.

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IFOAM's four basic principles

Organic agriculture is based on:

- The principle of **health:** OA should sustain and enhance the health of soil, plant, animal, human and planet as one and indivisible
- The principle of **ecology:** OA should be based on living ecological systems and cycles, work with them, emulate them and help sustain them
- The principle of **fairness:** OA should build on relationships that ensure fairness with regard to the common environment and life opportunities
- The principle of **care:** OA should be managed in a precautionary and responsible manner to protect the health and well-being of current and future generations and the environment

"..one of IFOAM's founders, Eve Balfour, said that the characteristics of truly sustainable agriculture can be summed up with the word, "permanence"

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Principle of health

- The health of individuals and communities cannot be separated from the health of ecosystems. Healthy soils produce healthy crops that foster the health of animals and people.
- Health is not simply the absence of illness, but the maintenance of physical, mental, social and ecological wellbeing.
- Immunity, resilience and regeneration are key characteristics of health.
- Organic agriculture is intended to produce high quality, nutritious food that contributes to preventive health care and wellbeing. In view of this it should avoid the use of fertilizers, pesticides, animal drugs and food additives that may have adverse health effects.

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Principle of ecology

- The production is to be based on ecological processes, and recycling. Nourishment and wellbeing are achieved through the ecology of the specific production environment, e.g. for crops, the living soil; for animals, the farm ecosystem.
- Organic management must be adapted to local conditions, ecology, culture and scale. Inputs should be reduced by reuse, recycling and efficient management of materials and energy in order to maintain and improve environmental quality and conserve resources.
- Organic agriculture should attain ecological balance through the design of farming systems, establishment of habitats and maintenance of genetic and agricultural diversity.
- Those who produce, process, trade, or consume organic products should protect and benefit the common environment including landscapes, climate, habitats, biodiversity, air and water.

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Principle of fairness

- Organic agriculture should build on relationships that ensure fairness with regard to the common environment and life opportunities.
- Fairness is characterized by equity, respect, justice and stewardship of the shared world, both among people and in their relations to other living beings.
- Organic agriculture should provide everyone involved with a good quality of life, and contribute to food sovereignty and reduction of poverty.
- Organic agriculture aims to produce a sufficient supply of good quality food and other products.
- Animals should be provided with the conditions and opportunities of life that accord with their physiology, natural behavior and wellbeing.
- Natural resources should be managed in a way that is socially and ecologically just and should be held in trust for future generations.
- Fairness requires systems of production, distribution and trade that are open and equitable and account for real environmental and social costs.

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Principle of care

- OA should be managed in a precautionary and responsible manner to protect the health and wellbeing of current and future generations and the environment.
- Practitioners can enhance efficiency and increase productivity, but this should not be at the risk of jeopardizing health and wellbeing.
- New technologies need to be assessed and existing methods reviewed.
- Given the incomplete understanding of ecosystems and agriculture, care must be taken.
- Science is necessary to ensure that OA is healthy, safe and ecologically sound. However, scientific knowledge alone is not sufficient. Practical experience, accumulated wisdom and traditional and indigenous knowledge offer valid solutions, tested by time.
- OA should reject unpredictable technologies, such as genetic engineering.
- Decisions should reflect the values and needs of all who might be affected, through transparent and participatory processes.

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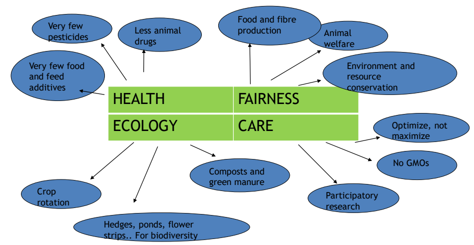
Principles and practices



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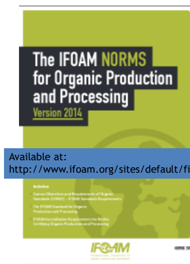
Certification and standards



Available at:
http://www.ifoam.org/sites/default/files/ifoam_norms_version_july_2014.pdf

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What is organic farming?

The simple explanation:
Organic agriculture = Refraining from mineral fertilizers and synthetic pesticides

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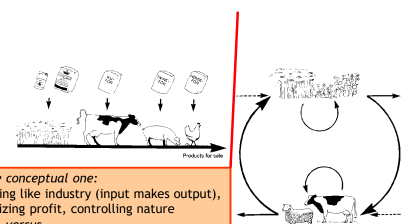
Cycles versus linearity



A more conceptual one:
•Thinking like industry (input makes output), maximizing profit, controlling nature
versus
•Thinking like nature (cycles of energy, nutrients and organic matter), optimizing the system to create a surplus, cooperate with nature

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A really conceptual one:
Organic agriculture is a practice where all parts of the production are unified as a whole, which is larger than the sum of the parts. It is environmentally friendly, fair, and socially sustainable.

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Farm individuality, farm design

- Using the resources on the farm to fulfill highly different aims
- Study the farms history and biography, link with current resources and frame conditions to plan the future

Simplify farm management for a convenient life for a family

Specialize in a production, posibly including processing and selling food

Maximize output of food for humans

Cultivate and establish biodiversity habitats

Self-sufficiency in fodder and fertiliser, balanced system

Use the farm as an arena for social work

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The farm as a living organism

- Crop rotation
- Balanced animal husbandry
- Green manures, biological N fixation
- Composting organic materials
- Diverse productions supporting each other
- Maximum of self-sufficiency, still producing a surplus for sale
- Protect and enrich the natural environment

= organs of the living organism

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How did it become like this

- 1885-86: Crucial soil biology discoveries; mycorrhiza, rhizobium bacteria, biological N-fixation. Agrological and soil microbiology developed as separate disciplines. Rhizosphere (1904), humus of large importance.
- 1842: Crucial chemistry discoveries; Liebig - plants nurture themselves from mineral nutrients, and ONLY from mineral(ised) nutrients. Liebig spoke negatively about soil organic material (humus).
- A continued conflict between soil biology and soil chemistry has formed the ground for the establishement of organic farming methods.
- Poison (organophosphates), constructed as warfare (1st WW 1914-1918) useful as insecticide; gunpowder (ammonium nitrate) useful as N fertiliser
- Technological innovations contributed to unemploydness
- Low yield levels in Germany 1920-30 due to neglecting of soil humus? Conflicting views
- Natural agriculture as a reaction towards specialization and mechanisation

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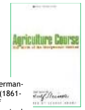
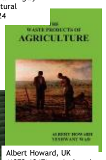
Early history of organic agriculture

- About 1920-30: Organic pioneers were caring for the soil, troubled by soil erosion, decline of crop varieties, rural poverty, the introduction of mineral fertilisers and the increasing mechanization and specialization
- «The health of a nation built on agriculture is dependent on the long-term vitality of its soil»
- The farmer is nature's partner
- Agriculture is creative, rather than mechanistic
- Howard: Law of return



Rudolf Steiner, German-speaking Europe (1861-1925), founder of anthroposophy, inspired biodynamic farming by «The agricultural course», 1924

Eve Balfour (1898-1990, founder of Soil Association(UK), book «The living soil» 1943, reprinted 9 times



Albert Howard, UK (1873-1947), agricultural advisor in India, inspired by recycling nutrients, «the father of modern composting», book «The waste products of agriculture», 1931

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Bio, eco, biodynamic, organic…

- Organic agriculture developed, and develops differently in different countries and parts of the world
- Different associations and categories of organic merged into «organic» (in Norwegian: økologisk) during the late 70-ties
- The diversity of OF practices is still reflected in labels, certification bodies and associations

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Organic = Certified- and much more

- Fulfilling conditions in EU regulations = minimum
- Several certification bodies have stricter regulations
- In several countries, producers «only» fulfilling EU regulations are seen as «second class» organic farmers
- Regulations grow very fast in volume! Simplify basic requirements, and earn «Michelin-stars» for special fields of interest?

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Developing organic regulations – the EU commission «goes organic»

- 2011:
- Current regulations state that >50 % of the feed for ruminants shall be produced on the farm. No similar regulation is found for monogastric animals.
- The commission has launched a proposal to increase the demand for *self-sufficiency* to 70-80 % for ruminants, and 40-50 % for pigs and poultry.

- 2012 (hearing in Norway before implementation):
- Demand for feed *self-sufficiency* increased from 60 to 70 % for ruminants
- Demand for feed *self-sufficiency* increased from 0 to 20 % for pigs and poultry
- Feed should come from own farm, or be produced by cooperating farmers in the same region
- Demand for organic livestock of chicken postponed from 2012 to 2015 due to lack of detailed regulations
- Due to lack of organic protein feed, up to 5 % conventional protein feed may be used for pigs and poultry until 2015

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Trends to consider for organic farming in 2014

- Organic market increases
- But the proportion of Norwegian products is decreasing!
- Still lot of scepticism among many large food actors
- Increasing imports of organic food that could have been produced in Norway threatens Norwegian agriculture in general
- Local products highly popular

- Local sells much better than organic.. Why bother about certification?

- A significant amount of farmers conduct «close to», but not certified organic

-When farming is a part-time business, the farmers has no energy to comply 100% with complicated regulations

- Most farmers wanting to stay in business specialize and increase the volume of production
  - Diverse organic production has a hard time
- Rapid decline in milk production in general

-(When) Will organic farmers establish their own dairy company?

- Can organic milk be an instrument to maintain Norwegian agriculture?

- When will TINE accept more organic producers of dairy cow milk, and pay premium price for organic goat milk?

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What is required to achieve the double15 % goal?

- Organic needs to be recognised as a part of the solution to important challenges (climate change, feeding the world, biodiversity, soil and water conservation, rural development….)
- Consumers should accept that buying organic is a measure to support sustainable development
- More information about negative effects of pesticides and other conventional inputs may be required
- People involved in food processsing and distribution should realise the importance of selling organic
- Politicians should clarify WHY they established the double 15 % goal. More focus on environmental benefits, positive health effects and animal welfare
- Farmers should acknowledge the value of the Ø label, well known and trusted by Norwegian consumers. Use it actively!

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How international and national regulations try to frame (certified) organic agriculture

- EU regulations: 2092/91, **834/2007**, 889/2008
- https://ec.europa.eu/agriculture/organic/eu-policy/eu-legislation/brief-overview_en
- Exceptionally, however, synthetic resources and inputs may be permissible if there are no suitable alternatives. Such products, which must be scrutinised by the Commission and EU countries before authorisation, are listed in the annexes to the **implementing regulation** (Commission Regulation (EC) No. 889/2008).

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2011:
Regulation (EC) No 834/2007 and its implementing Regulations (EC) No 889/2008 and No 1235/2008

In March 2014, the Commission issued a proposal for a new organic regulation to replace the current framework, and the so called "co-decision" process started. After legal checks and translation into all the EU's official languages, the text was adopted by the EU Parliament in April 2018 and by the Council in May 2018. **The new organic regulation will apply from 1 January 2021**

MAIN CHANGES COMPARED TO THE CURRENT LEGISLATION
The scope
As for the new regulation, the categories of products that can be organic certified are:
Live and unprocessed agricultural products - animals, plants and seed, mushrooms;
Processed food; andFeed.

The novelty is represented by Annex I of the new regulation, which provides a list of products that are not clearly covered by the three categories but that can still be certified. This list includes: specific yeasts, maté, vine leaves, palm hearts, hop shoots, silkworm cocoon, natural gums and resins, essential oils, cork stoppers, raw cotton, raw wool, raw hides, plant-based traditional herbal preparations.

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Objective and principles

Among the objectives, the encouragement of short distribution channels and local production is new.

Among the principles, the concept of production connected to the soil is reinforced and references to 'contribution to a non-toxic environment', 'long term fertility' and 'biodiversity' are new and positive. Another new principle is to incentivise the use of organic plant reproductive material and animal breeds with a high degree of genetic variety, resistance against diseases and longevity.

For food, the exclusion of food containing or consisting of engineered nanomaterials is new.

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Production rules for farmers

Today "group certification" is only allowed in developing third countries. With the new regulation it will be allowed everywhere in the world, including the EU. Group certification means that a certain number of small farmers can get organised and be certified as a single entity. One certificate will cover all the farmers, who cannot sell their certified products other than through the group itself. Specific criteria are established to define what categories of farmers can join the group.

With the new regulation it will be possible for organic farmers to access heterogeneous material i.e., mostly seed for arable crops. Today this seed is not 'legally' available to farmers because it is characterised by a high level of genetic and phenotypic diversity. This diversity is very good for organic farming - as opposed to the general seed law that requires high level of homogeneity of seed.

The concept of cultivating in close connection with the soil is reinforced in the new regulation. Very few exceptions to this rule are allowed, for instance the production of chicory heads or sprouts. A ten-year derogation is also given to "demarcated beds", which are traditionally used in some Nordic countries. The derogation will apply to the existing and certified operations in only three countries: Finland, Sweden and Denmark.

For livestock farmers, higher percentages of feed should come from the farm itself or from the same region. 60% (70% from 2023 on) of feed for cows, sheep, goats, horses, deer and rabbit and 30% for pigs and poultry should be of regional origin. Today, these percentages are 60% and 20% respectively.

Derogations that are currently permanent will be transitional in the new regulation. Therefore, farmers have continued access to non-organic seed or young animals when those are not available as organic - for a certain period only. The transition of derogations will be supported by national databases that will make the quantity of organic seed and young animals publicly available. It is stated clearly that these derogations can only be used when organic seed and organic young animals are not available on the market.

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Ertraege Bio: Konventionell

ökologische Landwirtschaft

Erträge

Einflussfaktoren

Lösungen

Diskussion

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The World of Organic Agriculture: Key Indicators

Organic Agriculture 2014: Key Indicators and Leading Countries

Indicator	World	Leading countries
Countries with data on certified organic agriculture[1]	2012: 164 countries	
Organic agricultural land	2012: 37.5 million hectares (1999: 11 million hectares)	Australia (12 mio. hectares, 2009) Argentina (3.6 mio. hectares) US (2.2 mio. hectares, 2011)
Share of total agricultural land	2012: 0.87 %[2]	Falkland Islands (Malvinas) (36.3 %) Liechtenstein (29.6 %) Austria (19.7 %)
Further, non-agricultural organic areas (mainly wild collection)	2012: 31 million hectares (2011: 32.5 million hectares; 2010: 43 million hectares)	Finland (7 million hectares) Zambia (6.1 million hectares; 2009) India (4.7 million hectares)
Producers	2012: 1.9 million producers (2011: 1.8 million producers; 2010: 1.6 million producers)	India (600'000), Uganda (189'610), Mexico (169'707)
Organic market size	2012: 63.8 billion US dollars (approx. 50 billion euros) (1999: 15.2 billion US dollars) Source: Organic Monitor	US (22.6 billion euros), Germany (7 billion euros) France (4 billion euros)
Per capita consumption	2012: 9.08 US dollars[3]	Switzerland (189.1 euros), Denmark (158.6 euros) Luxemburg (143 euros)
Number of countries with organic regulations 2012	2012: 88 countries (2011: 86 countries)	
Number of IFOAM affiliates	2013: 732 affiliates from 114 countries	Germany: 85 affiliates; India: 44 affiliates; United States: 37 affiliates; China: 34 affiliates

Source: FiBL and IFOAM; for total global market: Organic Monitor

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Farmers' motives for conversion: Changing with time

Motive	Early conv. 1995 or before	Convert. 2000 to 2002	Sign.
Food quality	62.2	41.7	**
Soil fertility, less pollution problems	51.1	27.1	**
Ideology, philosophy	40.0	25.0	
Professional challenges	33.3	45.8	
Health risks (pesticides etc.)	24.4	33.3	
Animal welfare	22.2	33.3	
Profitability	11.1	37.5	***
Natural conditions (soil, climate, etc.)	8.9	10.4	
Organic farming payments	6.7	35.4	***
Income stability	2.2	2.1	

Percentage of farmers ranking the motive as one of the three most important motives

Source: Flaten et al., «Risk and risk management in organic farming», project 2002-05, NILF-Bioforsk. http://orgprints.org/6124/

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Farmers' reasons for opting out

- Certification and control is too bureaucratic (and expensive)
- Organic standards: Complicated, irrational, change frequently
- Organic standards become stricter with time
- Animal welfare is cost-demanding
- Agricultural policy is risky (not predictable)
- Organic financial support is too low
- Plant production has problems with weeds and nutrient supply
- Difficulties to obtain 100% organic feed
- Hard to sell and achieve premium price for vegetables
- High employment and salaries increase off-farm employment

Source: Løes et al., «Reasons for opting out of certified organic production in Norway", project 2007-08, NILF-Bioforsk. http://orgprints.org/10629/

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VERGLEICH DER ERTRÄGE
ökologische Landwirtschaft vs. konventionelle Landwirtschaft

1 Comparing the yields of organic and conventional agriculture [Seufert et al., 2012]

2 The crop yield gap between organic and conventional agriculture [de Ponti et al., 2012]

3 Comparison of organic and conventional crop yields in Austria [Brückler et al., 2018]

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Comparing the yields of organic and conventional agriculture

Ergebnis:

25% niedrigere Erträge im Durchschnitt bei ökologischer Landwirtschaft

Erträge variieren

- je nach Fruchtfamilie und Fruchtart
- je nach System und unterschiedliche Anwendungen

[Seufert et al., 2012]

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Comparing the yields of organic and conventional agriculture

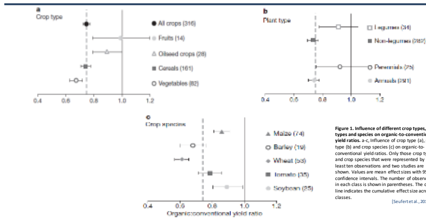

Figure 1. Influence of different crop types, plant types and species on organic-to-conventional yield ratios. a-c, Influence of crop type (a), plant type (b) and crop species (c) on organic-to-conventional yield ratios. Only those crop types and crop species that were represented by at least ten observations and two studies are shown. Values are mean effect sizes with 95% confidence intervals. The number of observations in each class is shown in parentheses. The dotted line indicates the cumulative effect size across all classes.

[Seufert et al., 2012]

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Comparing the yields of organic and conventional agriculture

Gründe für die Unterschiede in den Erträgen:

- Hülsenfrüchte und mehrjährige Pflanzen vs. Nicht-Hülsenfrüchte
- Stickstoff-Bereitstellung
- pH-Wert – Phosphor
- Wissen/Erfahrungen und gute Bewirtschaftung
- Wasserbereitstellung

[Seufert et al., 2012]

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The crop yield gap between organic and conventional agriculture

Ergebnis:

20% niedrigere Erträge im Durchschnitt bei ökologischer Landwirtschaft

Standardabweichung: 21%

Erträge variieren

- je nach Fruchtfamilie
- je nach Region

[de Ponti et al., 2012]

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Product unite / crop	Unite	Yield in % on a organic farm	Yield in % on a conventional farm
Wheat	t/ha	60	100
Vegetable (extensive crops)	t/ha	80	100
Vegetables (intensive crops)	t/ha	50	100
Potato	t/ha	30-70	100
Sugar beet	t/ha	80-100	100
Pasture (intensive)	Energy unit/ha	60-70	100
Leguminousus, i.e. Alfalfa	Energy unit/ha	80-100	100
Corn, silage corn	Energy unit/ha	50-80	100

Source: Priručnik za organsku proizvodnju za poljoprivredne proizvođače, Food and Agriculture Organization of United Nations (FAO), Biotehnički fakultet, Podgorica, 2011, p.104.

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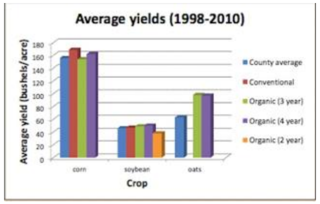

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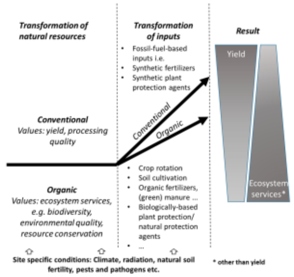

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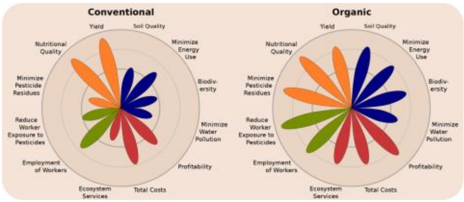

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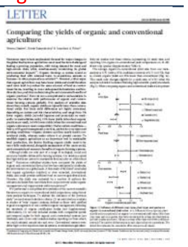
Comparing the yields of organic and conventional agriculture

- Meta-Analyse
- Kriterien festgelegt
- 66 Studien

[Seufert et al., 2012]



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Comparison of organic and conventional crop yields in Austria

Ergebnis:

Cerealien: 35% Hackfrüchte: 27 - 49% Ölsaaten: 7 - 43%

niedrigere Erträge im Durchschnitt bei ökologischer Landwirtschaft

Standardabweichung: 33,8 – 60%

Erträge variieren

– je nach Frucht
– je nach Region

[Brückler et al., 2018]

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Lösungsansätze

- System zur Entscheidungsunterstützung
- Techniken für mikrobielle Aktivität als Dünger
- Maschinenringe
- Düngemittel
- Förderung der Verwendung von Begleitbepflanzung und Deckkulturen
- Techniken für die Bodenbearbeitung

[EIP-AGRI, 2014]

Abbildungen 9:
Innovative Solutions for Organic Farmers in the EU Optimising Arable Yields: https://ec.europa.eu/eip/agriculture/sites/agri-eip/files/eip-agri_fact_sheet_organic_farming_web.pdf (Stand: 15. 01. 2019)

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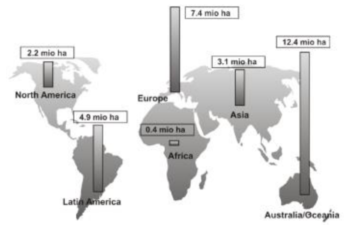
Biolandbau weltweit: 30,4 Mill. ha



© SOEL. Source: FiBL Survey 2008

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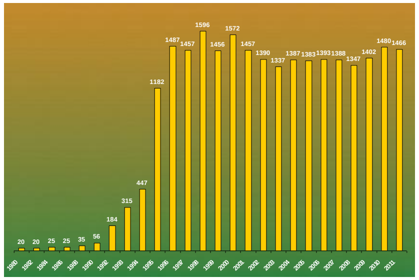
Bio in Kärnten **knapp 12 %** aller Landwirte in Kärnten sind **Biobauern**



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BIO AUSTRIA

- gemeinnütziger Verein
- Eigentum der Bauern
- Jeder soll sich einbringen!
- Österreichweit aktiv
- Heimisches Bio-Netzwerk
- den Werten verpflichtet…

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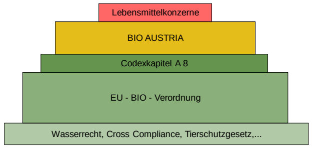
Rechtliche Grundlagen; gelebte Praxis



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Ökologische Landwirtschaft & fairtrade in Entwicklungsländern

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(BIO) Landwirtschaft in Entwicklungsländern

- Ist wesentlicher Entwicklungsfaktor und der größte Wirtschaftssektor
- Beschäftigt die meisten Arbeitskräfte
- Flächenmäßig die größte Landnutzungsform
- Wachstumsbremsen:
  - Auswirkungen des Klimawandels
  - rasch zunehmende Bodendegradation und –erosion
  - Verstärktes Auftreten von Schädlingen
  - Weltweit spürbarer Mangel an nutzbarem Was
  - Verteuerung landwirtschaftlicher Produktions
  - Verringerung der Arten- und Sortenvielfalt

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Verschiedene nicht-zertifizierte Bewirtschaftungsweisen

- folgen den Prizipien oder Ideen von IFOAM:
- Traditionelle Landwirtschaft
- Organic-by-default oder de
- integrierte Landwirtschaft

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Umstellung auf zertifiziert ökologischen Landbau

- Traditionelle Landwirtschaft hat Potential für öko-Bewirtschaftung
- Kleinbauern benötigen eine Kombination verschiedener Anreize:
  - Hauptmotiv: Wirtschaftlicher Vorteil
  - Nahrungssicherheit
  - Senkung der Bodenerosion
- Grundvoraussetzung: ausreichender und sicherer Zugang zu produktiven, natürlichen Ressourcen sowie zu Infrastruktur und Transportsystemen
- Es bedarf an intensiver Betreuung und Unterstützung während der Umstellungsphase
- Zunächst Ernteeinbußen
- Oft längerer Zeitraum, um ein ökologisches Gleichgewicht herzustellen

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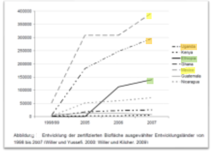
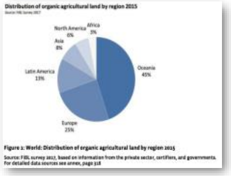
Entwicklung des öko-Landbaus in Entwicklungsländern





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Diversität, Intercropping

- **Diversität**

  - Agroforst-Systeme
  - Intercropping
  - Rotation

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Wege zur Ernährungssicherheit durch ökologische Landwirtschaft

0

Zertifizierte ökologische Landwirtschaft:
- Fokus auf exportorientierte Produkte
- Premiumpreise
- erhöhtes Einkommen
- Abhängig von Weltmarktpreisen und Exporteuren

Nicht-zertifizierte ökologische Landwirtschaft:
- Fokus auf Subsistenzprodukte
- Lokaler Markt
- keine Premium Preise
- Geringe Einkommenserhöhung

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Probleme und Herausforderungen

- Exportorientierung

  - Konkurrenz um Anbaufläche, Arbeitszeit und Investition
  →Entwicklung eines lokalen Markt
- Zertifizierung als Hürde für Kleinbauern

  - Hohe Kosten
  - Einhaltung von Richtlinien
  - Unterschiedliche Leistungen der ICS
  → Authentizität der Richtlinien und Definitionen
- Forschungsdefizite

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Herausforderungen

- Stärkung des Wissenssystems (Bildung, Beratung, Dokumentation)
- Entwicklung einer Bauernschule für die Umschulung einer Region
- Stärkung bestehender Bio Bauern
- Entwicklung eines nationalen Zertifizierungssystems

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Fair Trade

- Beginn in den 1960er Jahren
- Forderung von fairen Sozialbedingungen bei der Erzeugung in Entwicklungsländern
- Fokus: wirtschaftliche und soziale

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Fairtrade-Standards

Ökologie

- Umweltschonender Anbau
- Schutz natürlicher Ressourcen
- Verbot von Pestiziden
- Kein gentechnisch verändertes Saatgut
- Förderung des Bio-Anbaus durch einen Bio-Aufschlag auf den Preis

Ökonomie

- Bezahlung von Fairtrade-Mindestpreis
- Rückverfolgbarket des Produkts durch einen Nachweis über Waren- und Geldfluss
- Transparente Handelsbeziehungen

Soziales

- Bezahlung von Fairtrade-Mindestpreis
- Rückverfolgbarket des Produkts durch einen Nachweis über Waren- und Geldfluss
- Transparente Handelsbeziehungen
- Verbot von Kinderarbeit

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Positive Effekte von Fairtrade

- Bessere Handelsbedingungen
- Entscheidungen demokratisch
- Unterstützung verantwortlicher und umweltfreundlicher Produktionsmethoden
- Förderung kleinbäuerlicher Familien
- Stärkung der Frauenrolle
- Produzenten erhalten ein höheren Preis
- Erfüllung der grundlegenden Bedürfnisse
- Überwindung von Armut und Unterernährung

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Kritikpunkte von Fairtrade

- Etikettenschwindel
- Greenwashing
- In Mischprodukten müssen nur 20% fair sein
- Fairtrade-Produkte sind nur für den Export bestimmt
- Produzenten sind abhängig von Mindestabnehmern

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Fairtrade labels

- „Fairer Handel" ist nicht wie „bio" oder „öko" gesetzlich geschützt
- Entwicklung von neuen Marken und Gütesiegeln

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Ethische Werte, Fairer Handel und Ökologischer Landbau

- Fairer Handel unterscheidet sich vom ökologischen Massenmarkt
- Ethische Werte verursachen zusätzliche Kosten
- Konsumenten sind häufig bereit, einen höheren Preis zu zahlen
- Zusammenarbeit von Fairem Handel und Ökologischer Landwirtschaft

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Darf so etwas bio sein?

- Naturschutzverbände zweifeln z.B. beim Ananas-, Soja oder Zuckerrohranbau
- „bio"= ökologische Produktionsmethoden

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Neue Wirtschaftsformen

Community Supported Agriculture
CSA

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Marktwirtschaft in der Landwirtschaft führt weder zu gesunden Hoforganismen noch zu gesunden lebensspendenden Lebensmitteln, wie die letzten 200 Jahre der landwirtschaftlichen Entwicklung deutlich gezeigt haben.

Die Idee, dass Profiterwartung in Verbindung mit Wettbewerb auf dem Markt Qualitätsprodukte erzeugt, hat sich in der Landwirtschaft nie bestätigt.

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Was ist Solidarische Landwirtschaft?

- Teilung von Verantwortung und Risiko in der Landwirtschaft
- Brüderliche Organisation des Wirtschaftsprozesses
  - Zwischen Landwirten und Konsumenten
  - Zwischen den Konsumenten untereinander

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Brüderliches Wirtschaften

„Das Heil einer Gesamtheit von zusammenarbeitenden Menschen ist um so größer,
je weniger der Einzelne die Erträgnisse seiner Leistungen für sich beansprucht, das heißt,
je mehr er von diesen Erträgnissen an seine Mitarbeiter abgibt,
und je mehr seine eigenen Bedürfnisse nicht aus seinen Leistungen,
sondern aus den Leistungen der anderen befriedigt werden. "

Soziales Hauptgesetz (Rudolf Steiner)

Achte darauf, dass es den anderen gut geht,
dann geht es dir automatisch gut.
Achte darauf, dass es der Erde, den Pflanzen, Tieren und Menschen gut geht, dann geht es dir automatisch gut.

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Wie funktioniert SoLaWi?

- Ca. 300 Menschen können vom Hof versorgt werden – nach ihren Bedürfnissen
- Diese Menschen finanzieren die Landwirtschaft für jeweils ein Wirtschaftsjahr – nach ihrem finanziellen Leistungsvermögen

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Was stellt der Hof zur Verfügung?

- Gemüse & Kartoffeln
- Getreide & Getreideprodukte
- Brot
- Milch, Käse & andere Molkereiprodukte
- Fleisch & Wurst
- Obst
- Bildung

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Was wird möglich:

- Landwirtschaft in Freiheit – ohne ökonomischen Zwang
- Vielfalt von Betriebszweigen
  und Vielfalt in den Betriebszweigen
- SoLaWi ist kein Selbstzweck, sondern eine Methode,
- ein Vehikel, das die Verwirklichung der besonderen Hofindividualität möglich macht.

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Netzwerk Solidarische Landwirtschaft (SoLaWi)

- attac Sommer-Universität 2010 in Hamburg
- Erstes Treffen Oktober 2010 in Kassel
  Einladungen an Betriebe und andere Aktive
- Zweites Treffen Februar 2011 in Fulda
  Stauten und Definitionen beschlossen
- Gründungstreffen des Netzwerks Juli 2011 in Kassel

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**Einigung auf die Höhe der Produktionskosten in der Landwirtschaft.
Diese Kosten werden von den Konsumenten gemeinschaftlich aufgebracht.**

- Das Geld ist nicht für die Lebensmittel, sondern es ist für die Landwirtschaft
- Die Lebensmittel sind gratis!
- Die Bauern haben kein Geld

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Verlässliche Verhältnisse zwischen ihnen, die längerfristig und verbindlich angelegt sind.

- Mitgliedschaft für ein Jahr/Saison erzeugt ökonomische Sicherheit für den Hof.
- Mitglieder identifizieren sich mit „ihrem“ Hof.

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Freiheit von ökonomischem Zwang in der landwirtschaftlichen Produktion.

- Die Bauern können sich auf's Ackern konzentrieren, sie müssen nicht versuchen, Geld zu verdienen
- Nur was wirklich gebraucht wird, wird auch produziert.
  - Keine Überschussproduktion
  - Der Produktionsmaßstab wird nicht von Ökonomie bestimmt.
  - Qualität ist der Maßstab, nicht die Erntemengen

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Ökologischer Mehrwert für die bewirtschaftete Natur und deren Pflege und Entwicklung.

- Haltung gefährdeter Rassen
- Anlegen von Hecken und Teichen
- Humusaufbau mit neuen Methoden
- Größere Vielfalt auf dem Betrieb
  - Mehr Produktionszweige
  - Größere Produktvielfalt

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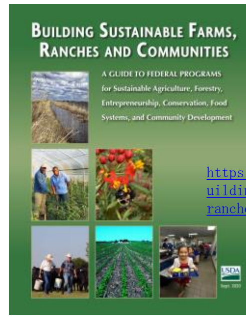

SARE Sustainable Agriculture Research and Education

https://www.sare.org/resources/building-sustainable-farms-ranches-and-communities/

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