



Understanding Food System Transformation

The role of biocontrol in shaping the future of agriculture



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Agenda



- Transformation of the food system
- Understanding food system transformation in the course of time
- Today's challenges
- Diversity in solution pathways, the role of biocontrol
- How to support the change to environmental-friendly methods
- Conclusion

Today's keywords about Food systems

Hunger

Malnutrition

Climate
change

Obesity

Feeding the world

Status quo isn't anymore a solution

Genom Editing

Food Security

Food Systems

Transformation

Resilience

Biocontrol

Sustainability

Agroecology

Food Waste, Losses

Zero pesticides

Biodiversity



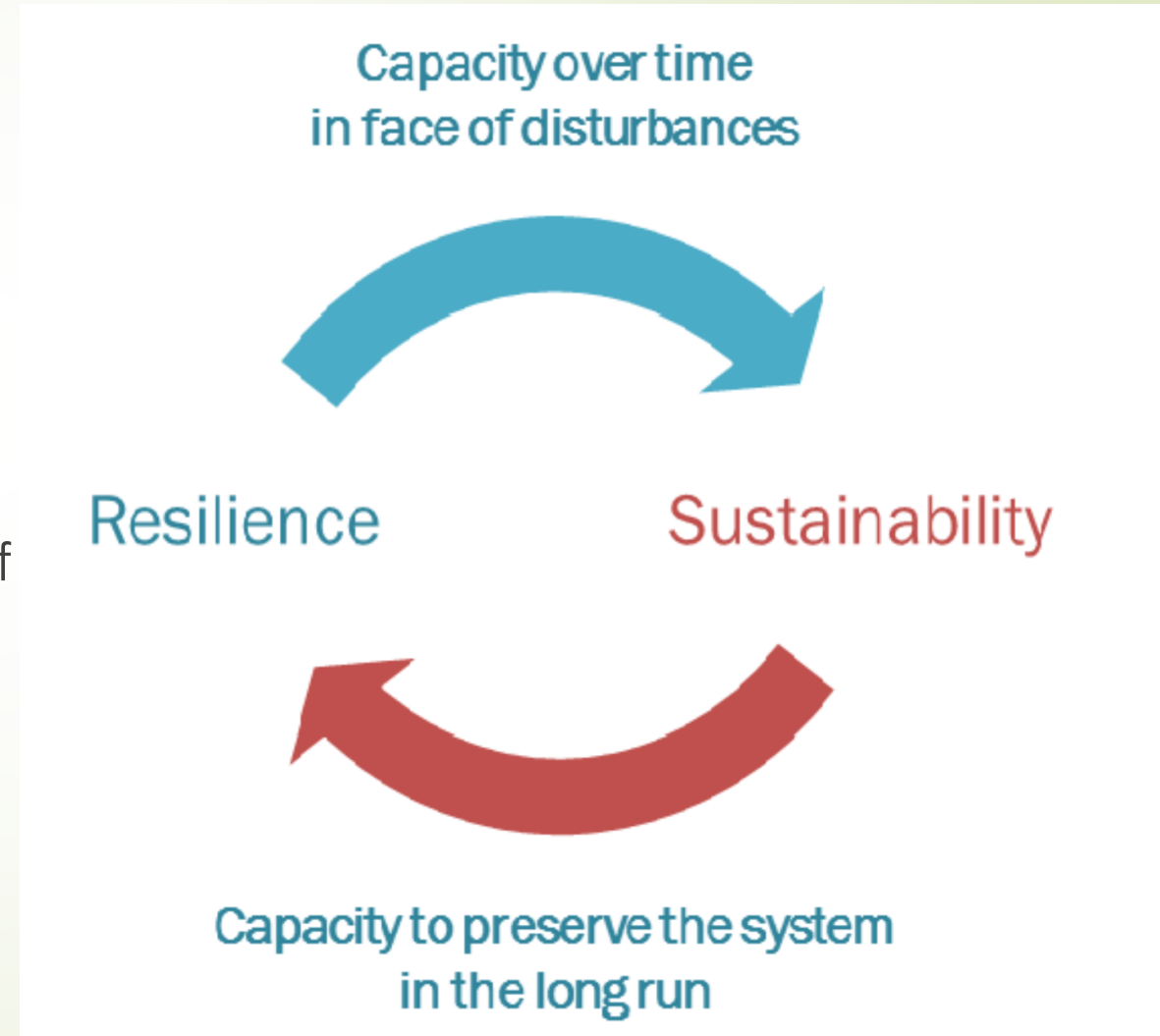
Transformation



- For thousands of years, food systems have constantly been undergoing transformation
- Transformation was necessitated by many factors, including
 - population growth
 - Shortages, productivity of the used resources
 - new findings in technology, biology, chemistry, ecology, requirements of **sustainability, of resilience**, etc.
- Transformation: continuum in the past and the future. **Never the status quo was a solution**
- A transformation is necessary today in order not to destroy people's sources of food.

Resilience & Sustainability

- Resilience is the ability of a system to thrive in the face of change
- Sustainability is the ability of a system to continue important functions indefinitely without a decline in quality





Transformation- strategies in a historical perspective

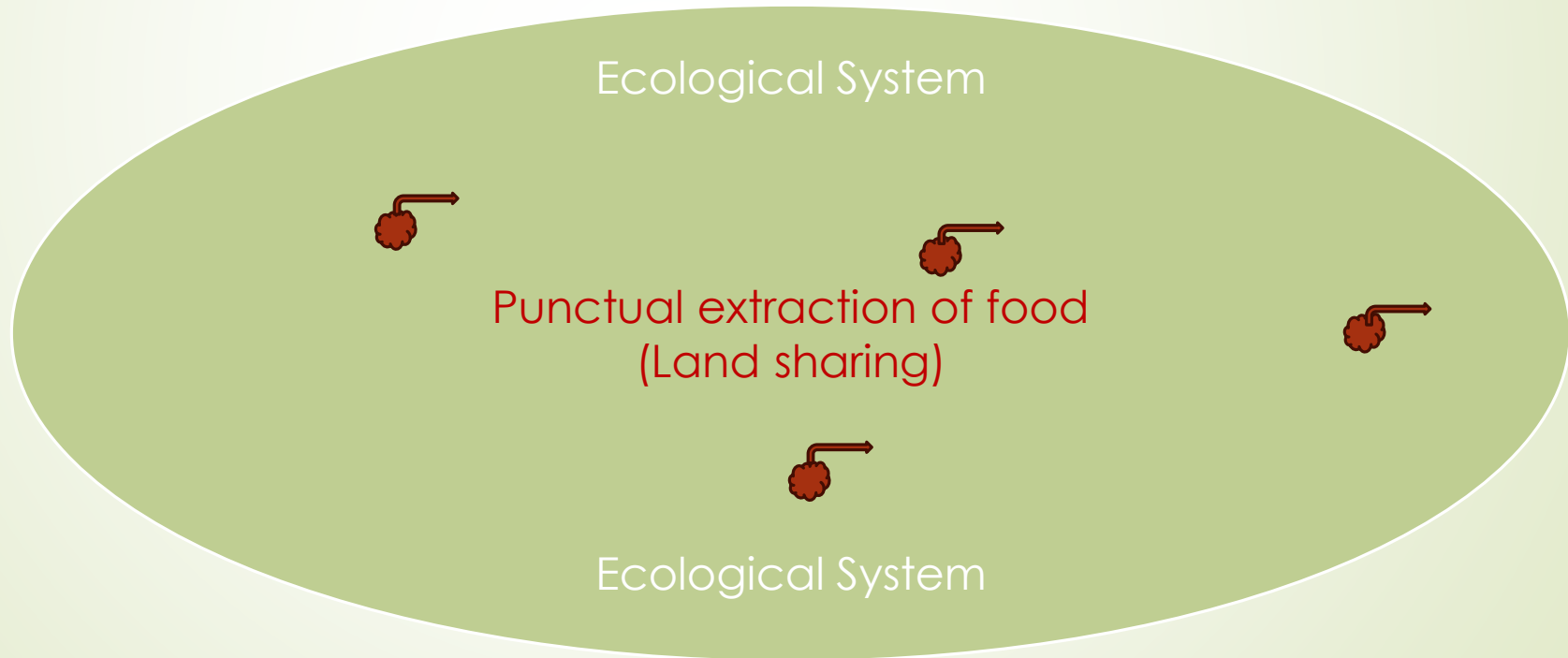
Hunting and fruit picking

About 50000 to 160000 years ago

- **Emigration** in case of depletion of the utilized resources (overuse)
- This permitted the resources to **regenerate**
- **Resilience** of the natural system after the impact of use
- STRATEGY: SEEK OTHER HUNTING GROUNDS.

Food procurement from the ecosystem

Hunting and fruit picking





Transformation- strategies in a historical perspective

Hunting and moving crop-fields

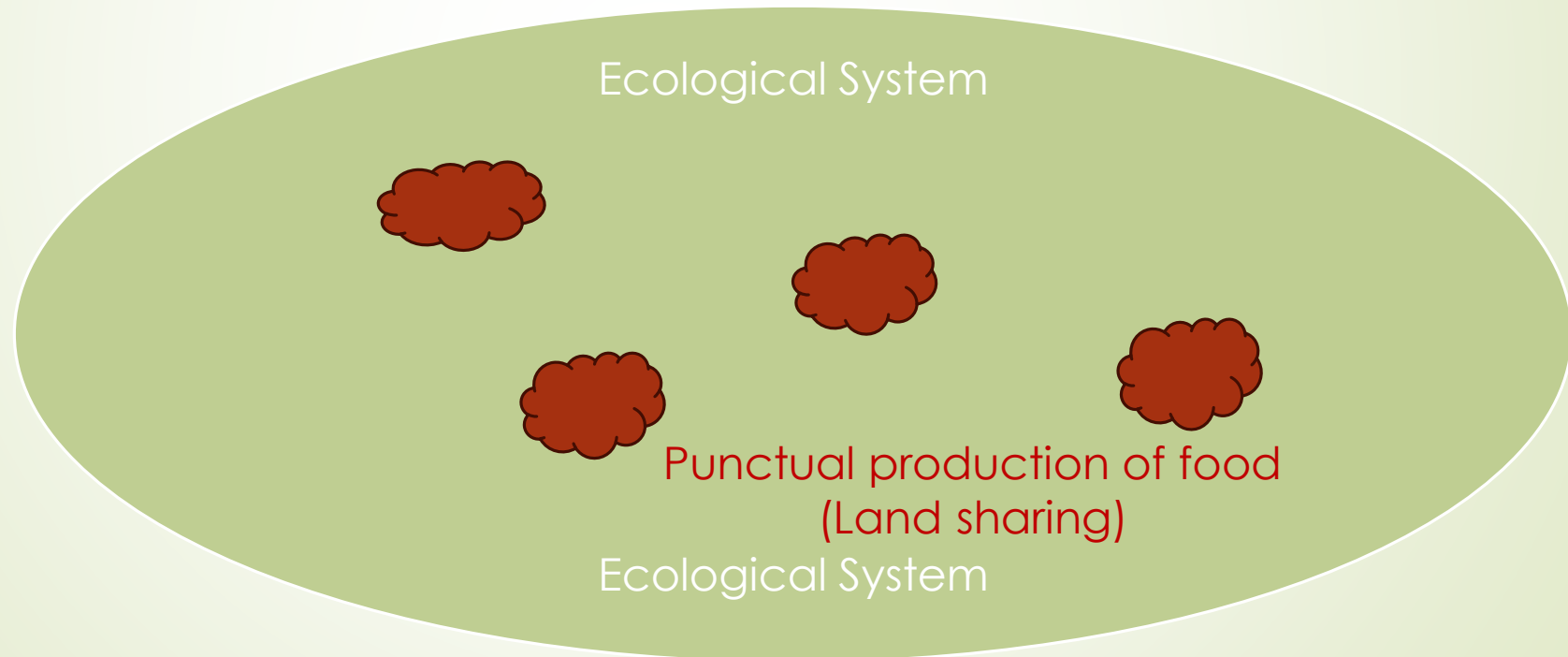
About 10000 to 50000 years ago

- First steps of **plant breeding**
- **Migratory cultivation** of wild relatives of our crops
- **Expansion** of the migration **perimeter** in case of population growth
- This permitted the resources to **regenerate**
- **Resilience** of the natural system after the impact of use
- The agricultural landscape used is changing (transformed)

- STRATEGY: PRODUCTIVITY & MOVING AWAY.

Food procurement from the ecosystem

- ▶ **Hunting and moving crop-fields** : Cultivating plants and domesticating animals is an intervention in nature. **Man has developed an agricultural system within the system of nature.**





Transformation- strategies in a historical perspective

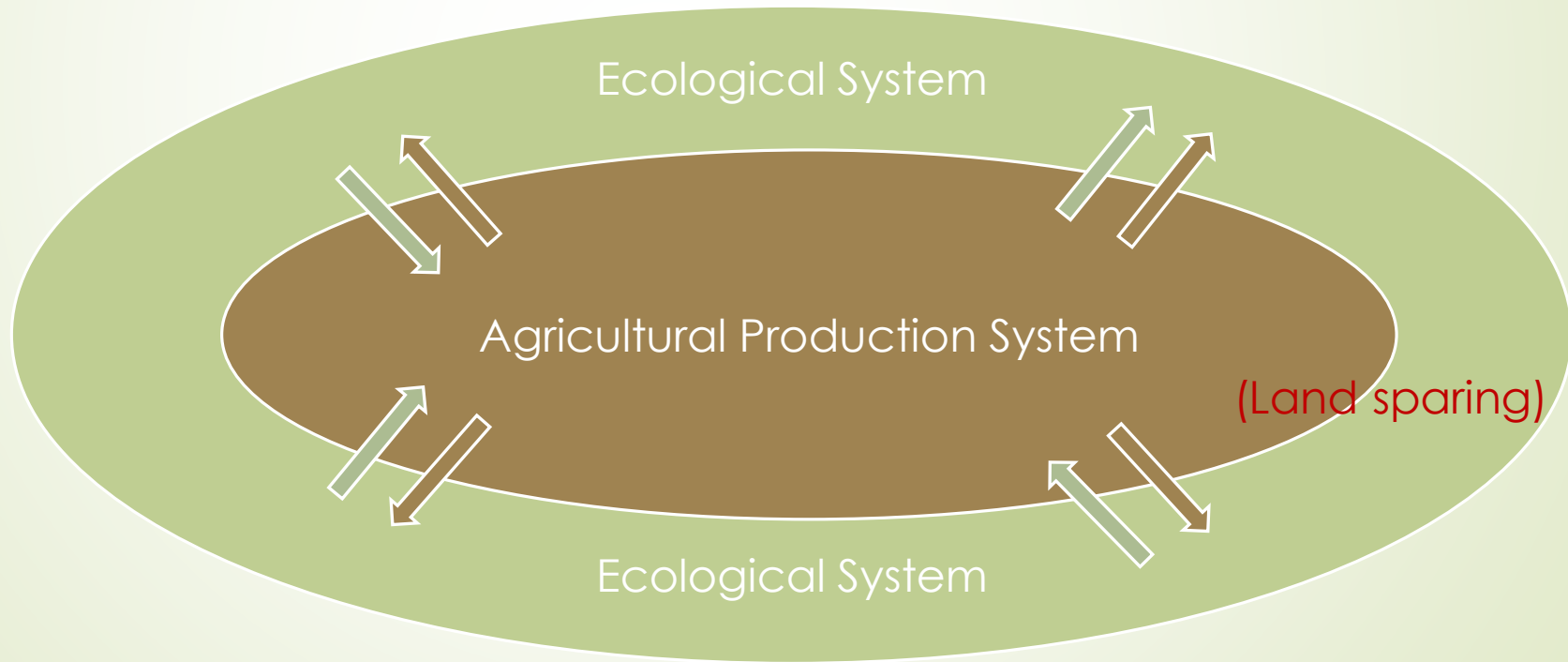
Settled agriculture - agrarian societies

About 8000 to 10000 years ago

- **Explicitly defined agricultural perimeter**
- **Agronomic intensification** with plant breeding and animal husbandry: **productivity**
- **Limits** of productivity: Plant diseases
- **Resilience** of the used system: first steps of biocontrol through experience (crop rotation)
- STRATEGY: PRODUCTIVITY & EXPANSION OF THE UTILISED AREA.

Food procurement from the agricultural system, embedded in the ecosystem

- ▶ Cultivating plants and domesticating animals is an intervention in specific agricultural plots. Embedded in the ecosystem.





Biocontrol of type “conservation” without importation & augmentation

Transformation-strategies in a historical perspective

Roman agriculture until middle age

- **Agronomic intensification** with plant breeding and animal husbandry: productivity
- **Mechanisation.** Nutrient cycles
- **Triennial crop rotation** for resource regeneration, biocontrol (**resilience** after use impact; **sustainability** in a long run perspective)
- **Expansion** of used perimeter (productivity limits & population growth, famines)
- STRATEGY: PRODUCTIVITY, FERTILITY MANAGEMENT, EXPANSION OF THE UTILISED AREA.

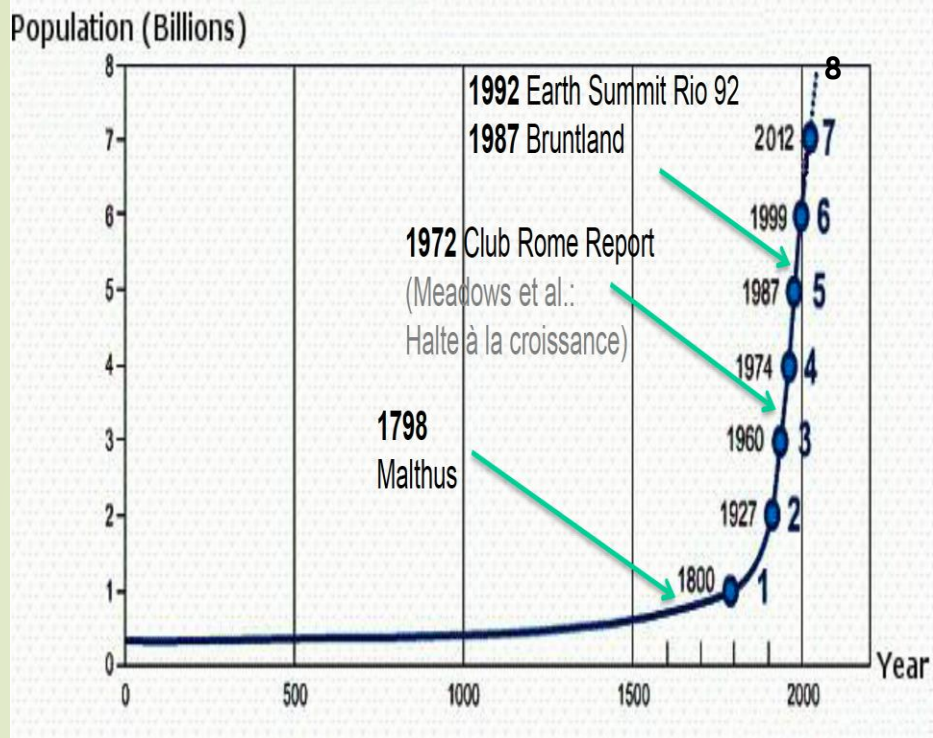


Transformation- strategies in a historical perspective

Late middle age until 19th century

Two groundbreaking findings about fertilization

- **Albrecht Thaer** (1752-1828)
humus as **fertiliser**
- **Justus von Liebig** (1803-1873); NPK, **mineral theory**
- From tools to mechanisation (19th century)
- Population growth, famines. **Malthus** (1766-1834): the need for food will always grow faster than production possibilities (creates productivity pressure)
- STRATEGY: PRODUCTIVITY, FERTILITY INCREASE, EXPANSION OF THE UTILISED AREA.



Transformation-strategies in a recent historical perspective

Feed the world

Recent 150 years

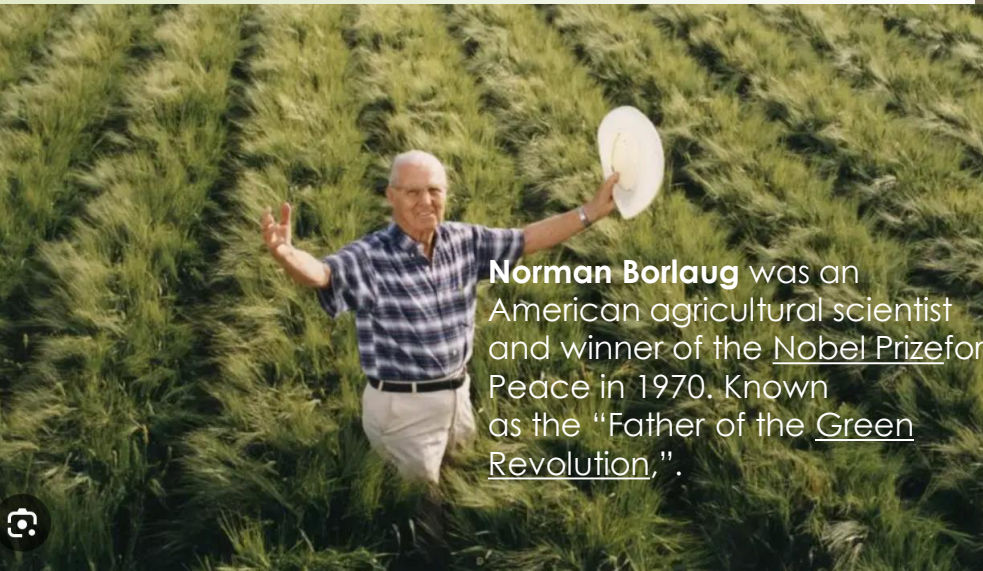
World population since 1850: x 5.5

Green Revolution. Crop production since 1850: x 8

- Knowledge / Knowhow
- Plant Breeding
- Animal Husbandry
- Mineral / synthetic fertilizer
- Plant protection mainly synthetic
- Technical progress

- STRATEGY: PRODUCTIVITY ABOVE ALL (constant area since 1950).

Simplicity, effectiveness and economic advantage



Norman Borlaug was an American agricultural scientist and winner of the Nobel Prize for Peace in 1970. Known as the "Father of the Green Revolution."



In parallel



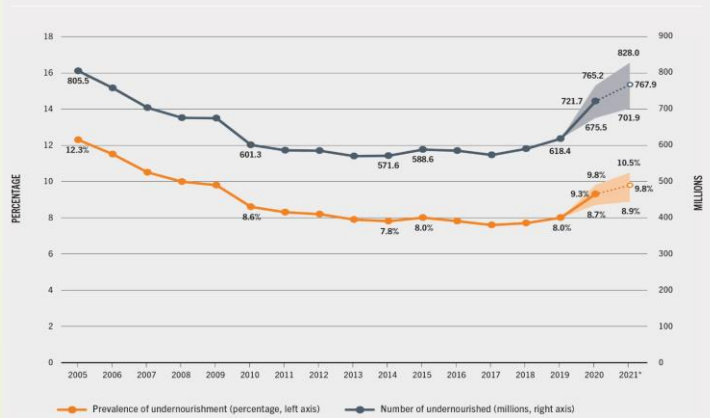
- Organic movement, organic agriculture (Steiner, 1924)
- Biocontrol (100 years)
- Integrated Pest Management
- Integrated Production
- STRATEGY: PRODUCTIVITY BASED ON BIOLOGICAL PRECESSES

But the mainstream has still its roots in the classical green revolution.

Despite all the positive aspects, it is evident that our modern food system is far from being as flawless

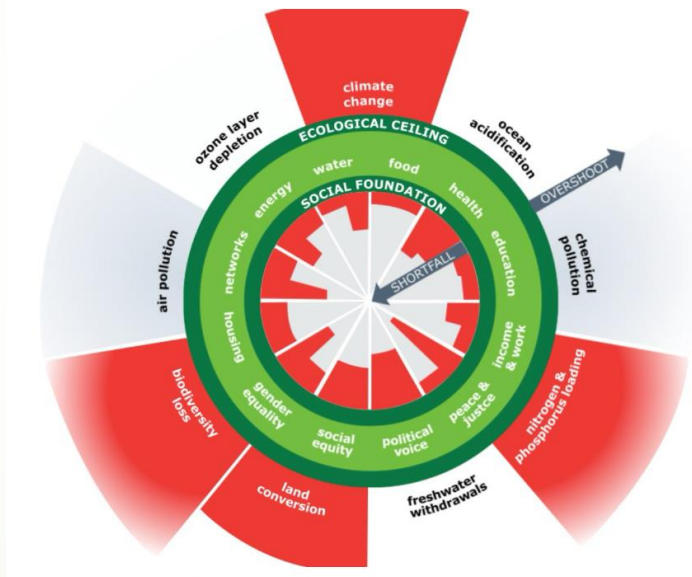
Hunger & malnutrition

FIGURE 2 BETWEEN 702 AND 828 MILLION PEOPLE IN THE WORLD FACED HUNGER IN 2021. CONSIDERING THE MIDDLE OF THE PROJECTED RANGE (768 MILLION), HUNGER AFFECTED 46 MILLION MORE PEOPLE IN 2021 COMPARED TO 2020, AND A TOTAL OF 150 MILLION MORE PEOPLE SINCE 2019, BEFORE THE COVID-19 PANDEMIC



Hunger- Malnutrition.
Periodical and territorial food crises

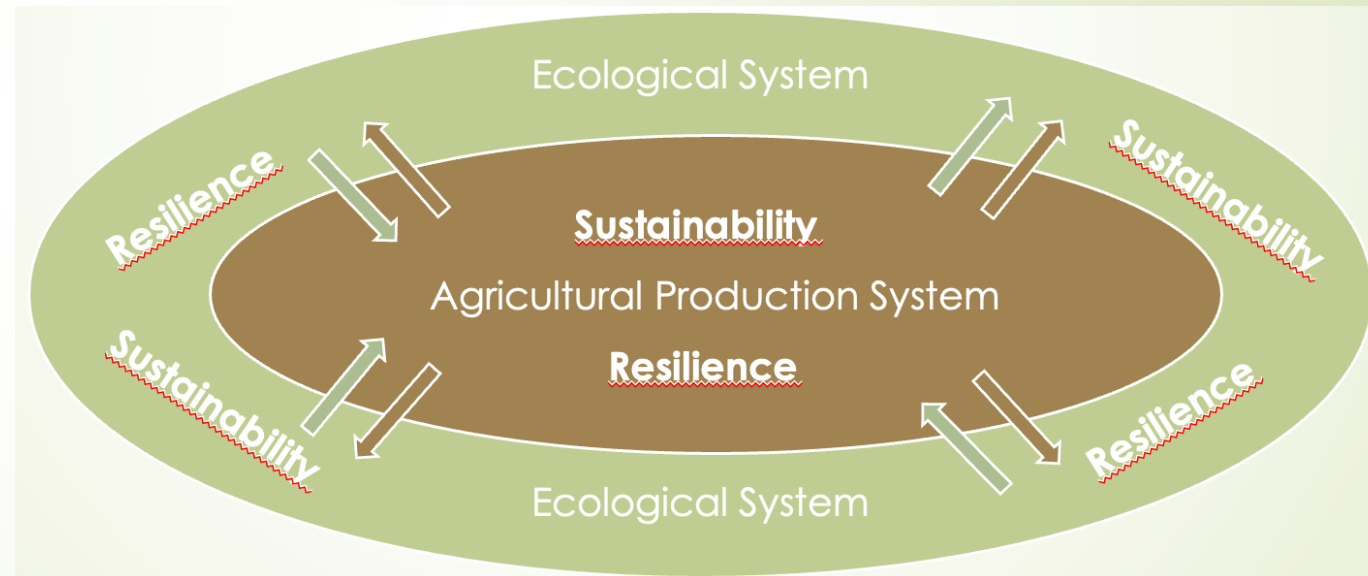
Planetary boundaries



Severe ecological and social (distribution) deficits
Externalities

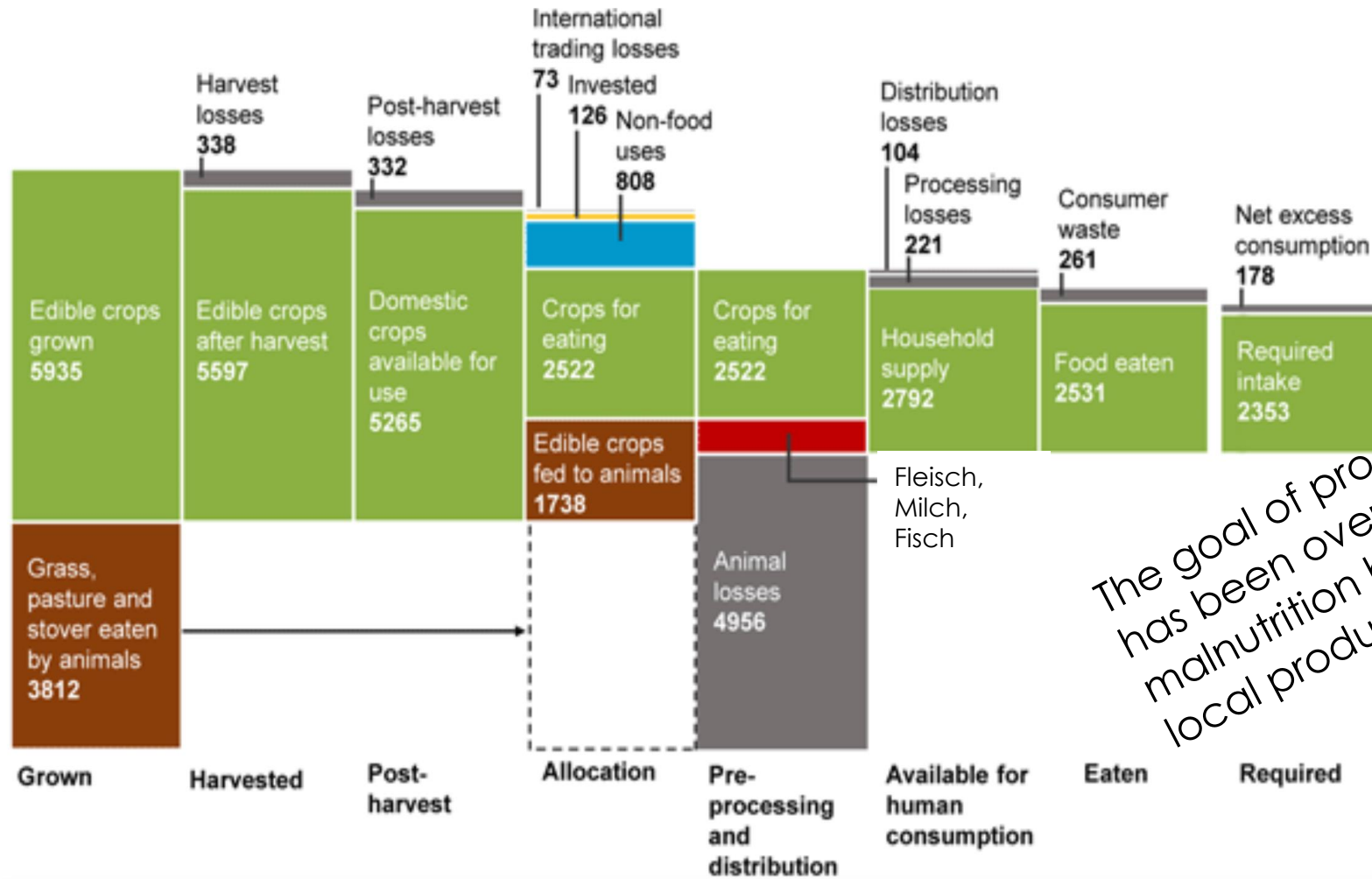
Right to the point: Disturbances within the food system and within the ecosystem.

1. The food systems as such are **not resilient enough against shocks** (global trade, climate change, conflicts, deficits of agency, etc.)
 - Hunger, Malnutrition (South)
2. The food systems as such **don't have a sustainable design** for themselves
 - Hunger, Malnutrition (South)
3. The food systems **endanger the sustainability of the natural environment and its resilience**
 - Hunger, Malnutrition (?)



Transformation is by no means limited to agriculture. It encompasses the entire **food system**.

Path of edible plant energy from the field to the plate



The goal of producing enough food has been overshoot. Hunger and malnutrition have other causes: local production and access to food.

Source: Berners-Lee, M, Kennelly, C, Watson, R and Hewitt, CN. 2018. Current global food production is sufficient to meet human nutritional needs in 2050 provided there is radical societal adaptation. Elem Sci Anth, 6: 52. DOI: <https://doi.org/10.1525/elementa.310>



**FOOD SECURITY
AND NUTRITION
BUILDING
A GLOBAL
NARRATIVE
TOWARDS 2030**



Evidence-based reports and solution proposals

HLPE-FSN, recent reports

- **Agroecological** and other innovative **approaches** for sustainable agriculture and food systems that enhance food security and nutrition, 2019
- **Food security and nutrition: building a global narrative towards 2030**, 2020
- **Promoting youth** engagement and employment in agriculture and food systems, 2021
- **Data collection** and analysis tools for food security and nutrition: towards enhancing effective, inclusive, evidence-informed, decision making, 2022
- **Reducing inequalities** for food security and nutrition, 2023
- **Strengthening urban and peri-urban food systems** to achieve food security and nutrition, in the context of urbanization and rural transformation, 2024
- Strengthening **food system resilience**, in progress, 2025
- Reports of IPCC, IPBES.

Transformation - diversity

Hunger

Malnutrition

Climate
change

Obesity

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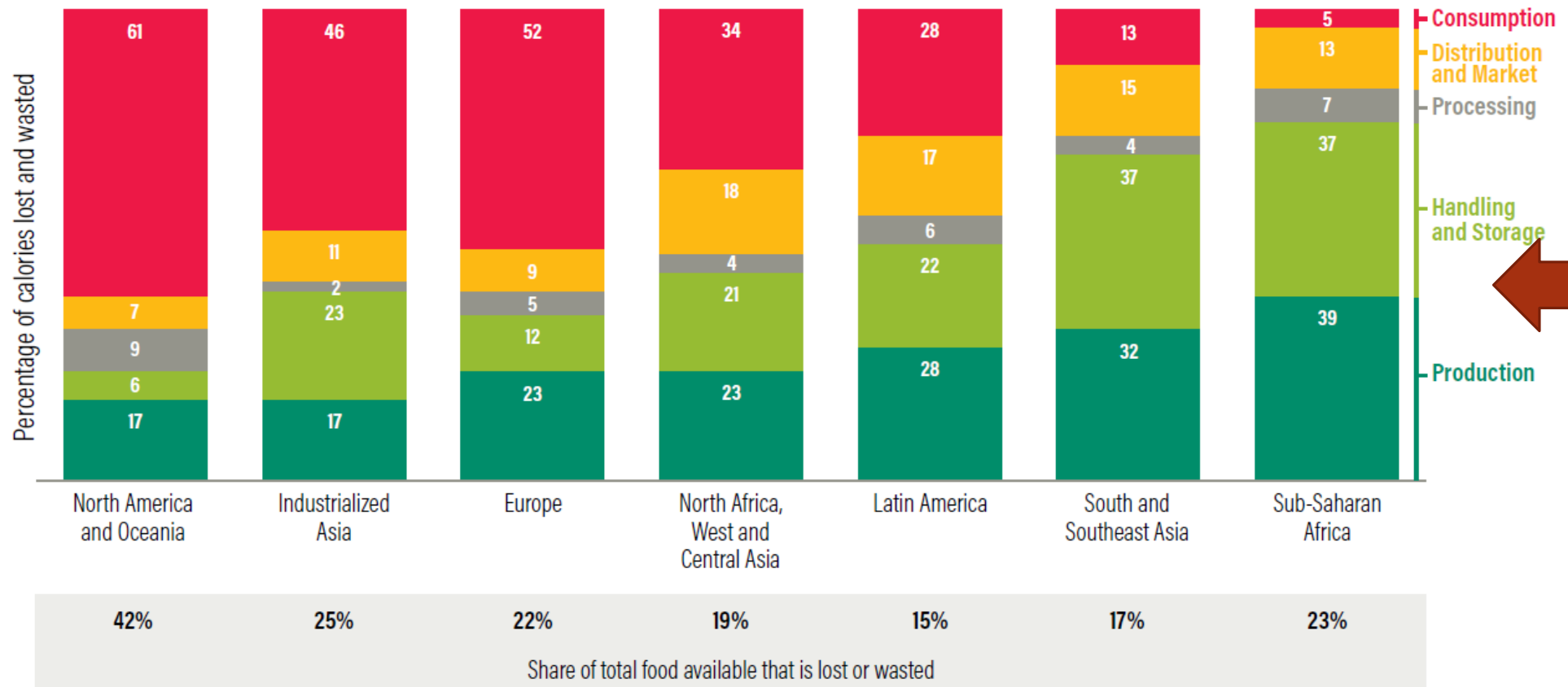
Food Waste, Losses

Biodiversity

Zero pesticides

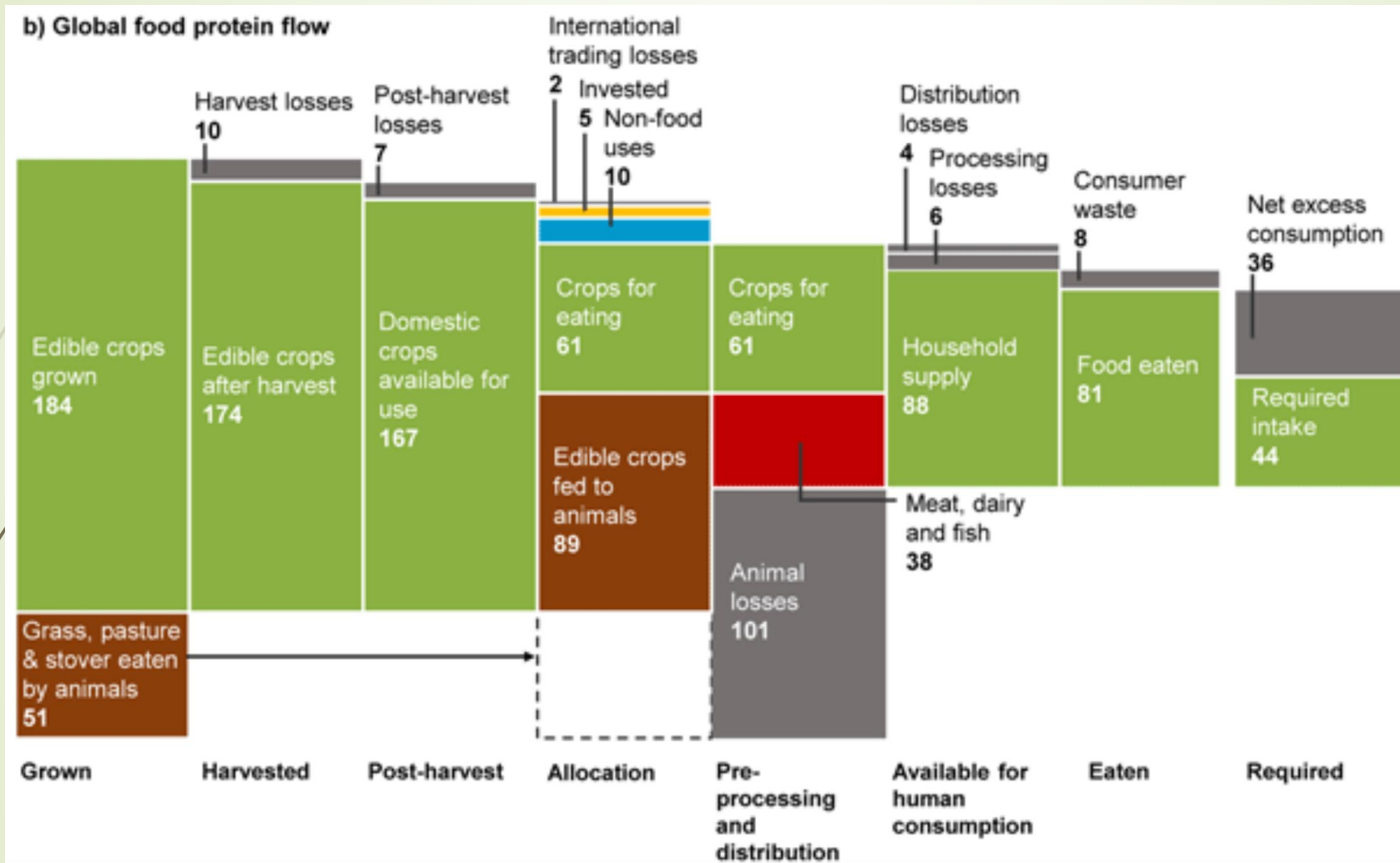
Food Waste and Losses

Figure 4 | Food loss and waste primarily occurs closer to the consumer in developed regions and closer to the farmer in developing regions



Source: WRI analysis based on FAO (2011b).

Path of edible plant proteins from the field to the plate



Source: Berners-Lee, M, Kennelly, C, Watson, R and Hewitt, CN. 2018. Current global food production is sufficient to meet human nutritional needs in 2050 provided there is radical societal adaptation. *Elem Sci Anth*, 6: 52. DOI: <https://doi.org/10.1525/elementa.310>



Where do we stand? in a nutshell

1. Even if the consumption of animal products worldwide remains at today's level, more calories and proteins are produced today than more than 10 billion people need
2. Meat: another equilibrium North-South
3. Hunger and malnutrition are the consequence especially of insufficient local production, insufficient access to food, insufficient resilience of the local food systems, climate risks and conflicts
4. The produced volume of food and the used techniques endanger environment and health
5. **The crucial question is:** Is it acceptable to consider the goal of productivism (increased production) as imperative and the goal of reducing environmental pollution as secondary?
 - Transformation or TRANSFORMATION?

Two main approaches for the transformation of the food systems: Diversity in solution pathways

Incremental changes

Agriculture

- Stricter environmental requirements for plant protection (ban included)
- CC adaptation, more IPM
- Often in global south: both: Agroecology AND continuation of classical green revolution

Food system

- Less food waste

Narrative: We have to feed the world.

Bold changes (>> boost innovations)

Agriculture

- Agroecology at large scale (13 principles), biocontrol
- Explicitly strong climate mitigation, adaptation and biodiversity protection
- Significant local production
- More regional / less global trade

Food system:

- waste, losses, concentrated feed animal products, etc.
- More equity, more fairness


Narrative: transformation brings more to the most vulnerable, the environment and our health.





What is holding up the transformation? The fear to become a loser in the transformation process - in general

- Every stakeholder in the food system is considering the possible consequences of a transformation
- All interests are well organised
- Potential losers automatically mount resistance, especially at the policy level; risk aversion is high
- It is therefore of great importance to show **perspectives** for all these groups, perspectives and **business opportunities** motivate and reduce risk aversion
- It is never possible to convince everyone. However, it is important that the early birds show potential followers the way.



Widespread convictions: Economically spoken...

Chemical-synthetic methods in agriculture

Relevant characteristics, **factual** and **perceived**

- Simplicity and rather easy access to know-how for the standard method
- High effectiveness
 - But more and more difficulties arise due to resistance and no longer approved substances. Lack in plant protection (see Swiss example)
- Economically advantageous (total effort)
 - But: Non internalised negative external effects.



A current example from Switzerland

- ▶ The federal government wants to **ban six active** chemical substances
- ▶ The farmers' union criticises: 'These bans would create many new gaps in crop protection'. In other words, farmers would no longer have any crop protection products available to protect against certain pests in certain crops.
- ▶ In its explanatory notes, the federal government also states that the loss of will have 'far-reaching consequences for agricultural production across the board'.
- ▶ Economically spoken: External effects will be given more weight than before.

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Widespread convictions: Economically spoken...

Biocontrol methods in agriculture

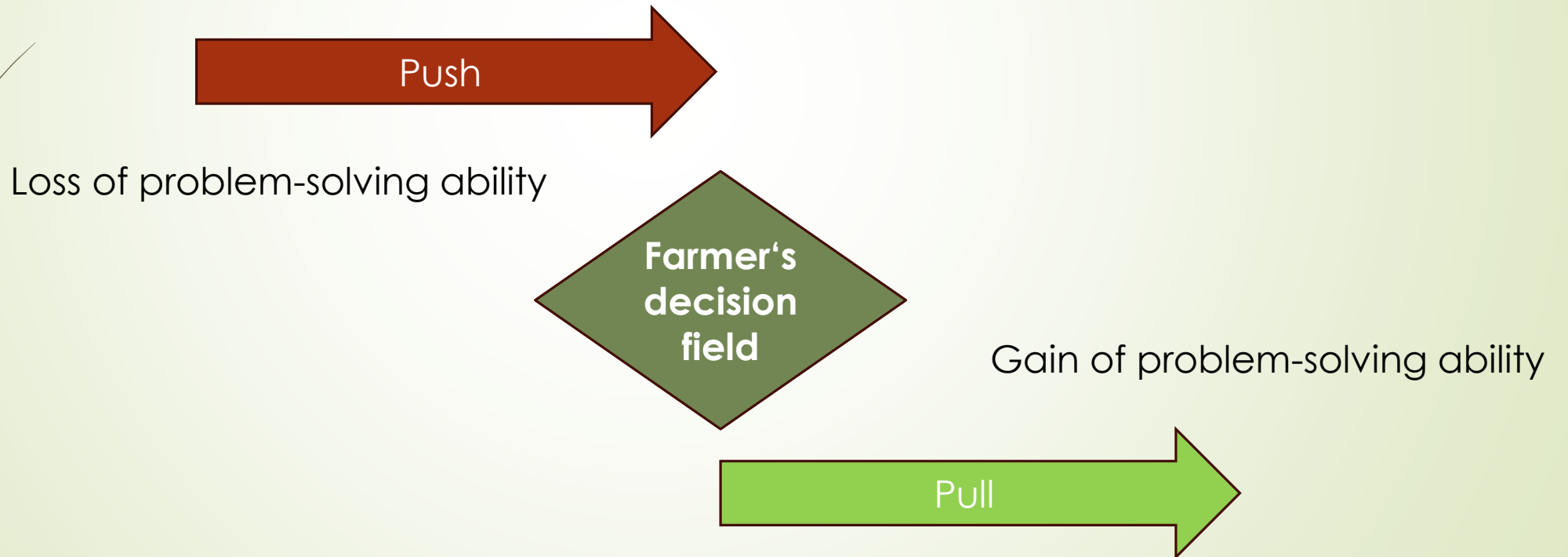
Relevant characteristics **factual** and **perceived** :

- Rather complex
- Less effective
- Economically risky, uncertain
- Non internalised positive environmental external effects
- Resilience and sustainability.

The farmers decision field: Push and pull

Classical methods

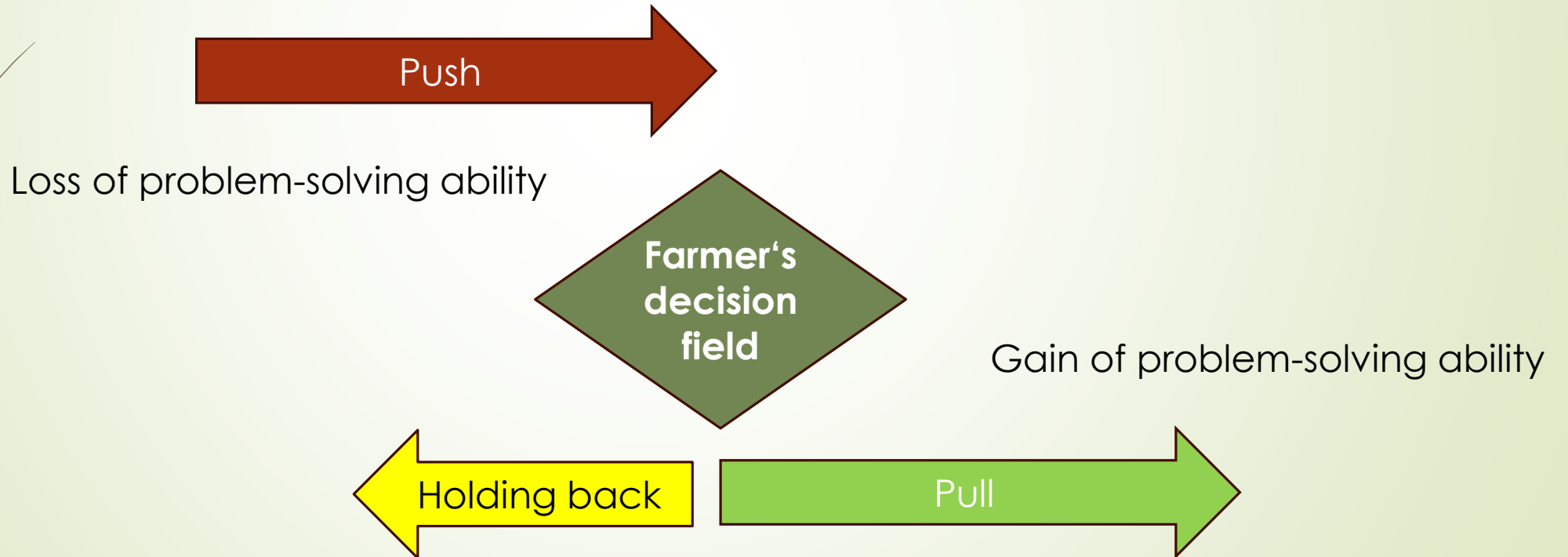
Biocontrol methods



The farmers decision field: Push and pull

Classical methods

Biocontrol methods





What is holding up the transformation? Especially around farming systems

- ▶ Farmers are not alone in their decisions
 - ▶ Extension, vocational education, agric. research
 - ▶ Input seller, business around agriculture (more added-value than agriculture)
 - ▶ Partially administration
 - ▶ Professional representation (Lobby)
- ▶ An important part of the resources are invested in the path of degradation and less in the path of alternative solutions (Cash-cows remain important in portfolio)
- ▶ >>> **Perspectives, business opportunities**
- ▶ Biocontrol therefore had and has a pioneering responsibility
- ▶ What's about the legal framework?

Framework to boost biocontrol in agriculture ¹

1: Report of the Institute for European Environmental Policy (IEEP)

- IEEP identifies the benefits of biocontrol as an alternative to environmentally harmful plant protection methods
- According to authors “the absence of a clear legal definition of biocontrol (BC) and its importance for IPM and organic agriculture highlights the need for systemic approach at EU Level” (outside-in view)

Policy Recommendations:

- **Definition of BC.** Would bring more clarity
- **Legal Framework:** recognizing the non-toxic implications of BC (incentives?)
- **Alignment Opportunities:** to SDC
- **Research needs:** BC and climate change aspects, biodiversity, economic opportunities, etc.
- **Field application:** pushing for a larger scale and accelerated application of BC supports the EU Green Deal.



Legal framework -economically spoken...

Simplicity, effectiveness and economic advantage

Classical way methods

Advantages

- Private character

Biocontrol methods

Advantages

- Public character

Disadvantages

- Public character

Disadvantages

- Private character

**Disincentives
Ban**

Legal framework answer

**Incentives
Research**

Complexity, long run advantage for sustainable food security



My conclusion

- We produce food for far more than 10 billion people
- The proposed corrective measures (BC included)
 - Do not jeopardise the food security for all
 - On the contrary, they strengthen the food security
 - They relieve the environment and thus support sustainable production and supply
 - They bring more justice to North-South and South-South
- BC methods:
 - more explanation and promotion at all levels needed
 - More research in BC and less research into ways of reducing the use of classic pesticides.

Thank you for
your kind
attention!

