# NATURE INCLUSIVE AGRICULTURE

A flexible transition towards sustainability

WAGENINGEN
UNIVERSITY & RESEARCH

Ministry of Agriculture,
Nature and Food Quality

# Nature inclusive agriculture provides elements to design farming systems of the future, a flexible transition towards sustainability

- Agriculture is a crucial sector of the national economy
- Food and Nutrition security (volumes, quality, affordability)
- Steep increase of population and urbanization
- Current farming practice is chemical based
- Farms are major users of soil, water, rural space and landscape
- Biodiversity is rapidly declining

Farmers and farms central in the innovation process

Agriculture for all countries is a key sector of economy and society. Agriculture provides food and nutrition for the growing world population. In the past decades, agricultural production intensified with a negative effect on biodiversity. Agriculture has to innovate towards a sustainable and competitive Farm of the Future.

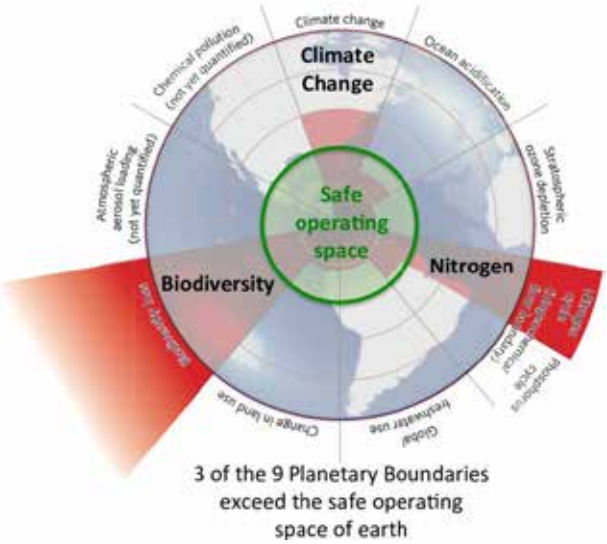
## Large scale monocrop style

Only 12 plant species provide 75% of the world's food
3 crops: rice, wheat, and maize provide >50% human energy intake

Modern agriculture has evolved into predominantly chemical based land use systems with little diversity and few crop species to feed the world.

# Biodiversity decline with unknown consequences

- Biodiversity
- Nitrogen
- Climate change



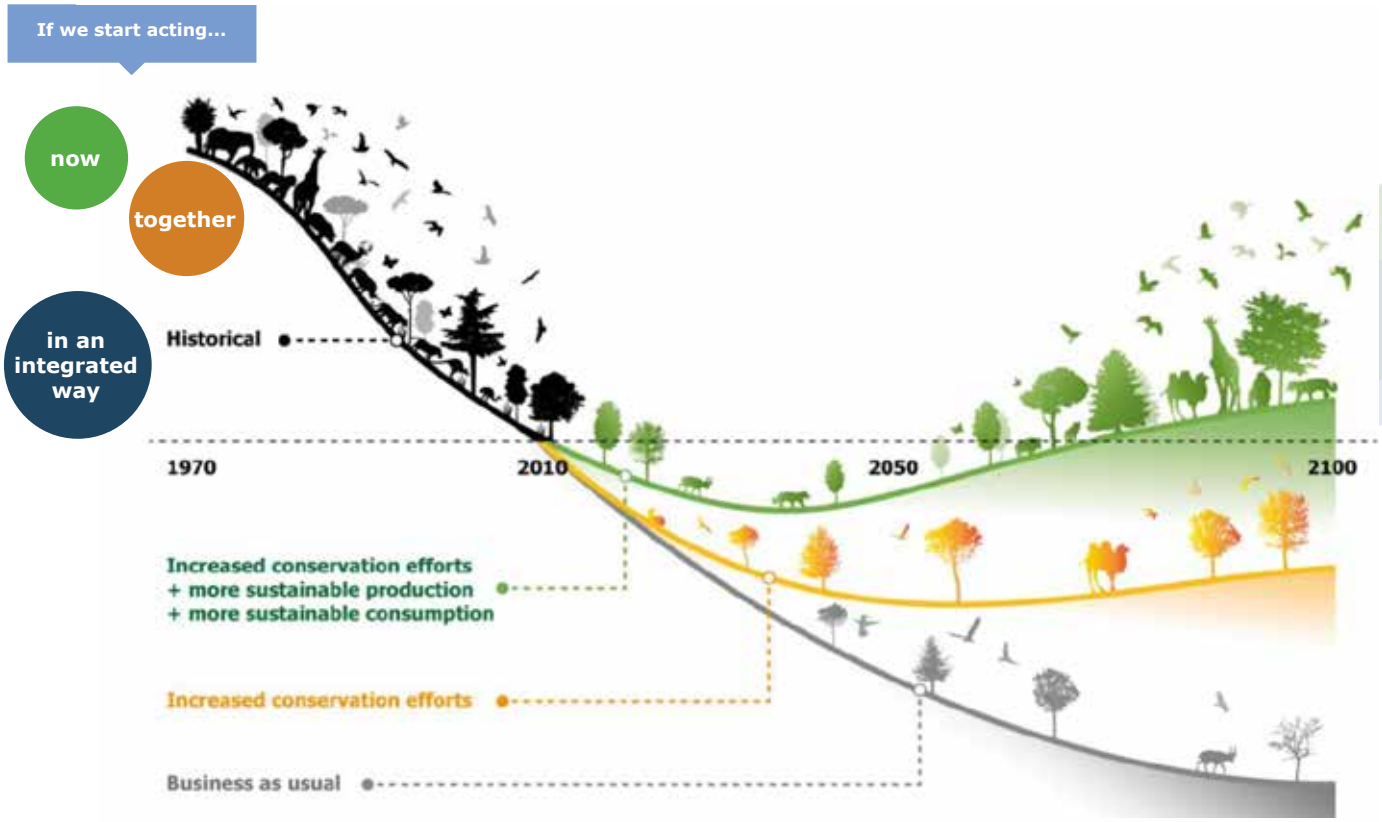
3 of the 9 Planetary Boundaries exceed the safe operating space of earth

Intensive agricultural systems have been segregated from nature, which resulted in significant loss of biodiversity. Future agriculture should accomodate the minimum ecological requirements to conserve nature and biodiversity. Natural species need to move across agricultural areas, and agriculture needs ecosystem benefits from nature to maintain productivity in the long run.

# Biodiversity collapse


For a number of years science and politics have been warning for the impact of climate change. Evidence of climate change is no longer questioned and the world experiences increasing weather extremes and natural disasters. The biodiversity collaps is less known to most people and the consequences are yet unknown. Agriculture is in the centre of influence in the biodiversity crisis.

# **Not too late to save** biodiversity /ecosystem services / nature




What is required is a holistic strategy of diversifying farms, farm landscapes, less agro chemicals and optimizing the interaction between species in the agro ecosystem.

# Nature Inclusive Agriculture NIA

Farmers, scholars and policymakers in the Netherlands have fairly recently developed the concept of nature-inclusive agriculture (NIA). It was introduced as a policy term in a vision document for Dutch nature by the Dutch Ministry.

Its three underlying and interconnected principles are to

- Employ ecosystem services rather than external inputs;
- Minimize environmental pressures and
- Contribute to 'non- functional' biodiversity and landscape quality

(*Vermunt et al. 2022*)

Nature inclusive agricultural management includes the use of nature based solutions to promote productivity or to prevent or control a pest or disease. An example is the use of antagonists or predators in a specific crop. The use of cover crops is a nature based solution to enhance soil quality and crop nutrition management.

Nature inclusive agriculture also addresses the integration of nature elements on the farms. These natural structures may generate direct ecosystem services for the farm, or contribute to the general quality and infrastructure of biodiversity, landscape and environment. Soil conservation and regeneration, water management and carbon sequestering are part of NIA. NIA starts with good Good Agricultural Practices, gradually reducing the use of agrochemicals and introduces advanced technologies to meet high standards of produce at a competitive price.

# Designing farming systems along 4 tracks

1 Good Agricultural Practice

2 Towards less agro-chemicals

3 Agro-ecology in practice

4 Innovative technologies

The four tracks that lead towards more sustainable agricultural production include an array of common and advanced agricultural practices, in an integrated manner. Not all interventions are suitable under all conditions. In the design process of a farming system for the future, it is important that farmers include their experience, knowledge and skills and that natural processes and modern technologies are combined. The starting point is Good Agricultural Practice.

# **All efforts contribute, combining 4 tracks.** Each track contains locally relevant tools for farmers to consider to promote sustainable production.

**1**

Good Agricultural Practice
- Irrigation
- Fertilizer
- IPM
- Variety
- .....

**2**

Shift towards non chemical practices
- Advanced IPM
- Organic matter in soil
- Cover crops
- Rotations
- .....

**3**

Inviting nature on the farms
- Planting trees and shrubs
- Buffer strips
- Ecological services (natural enemies)
- Water retention
- .....

**4**

New technologies
- Biotechnology
- Smart mechanization
- Mobile applications
- E.g. Camera operated weed control
- .....

# **Agro ecology:** Inviting nature on the farms

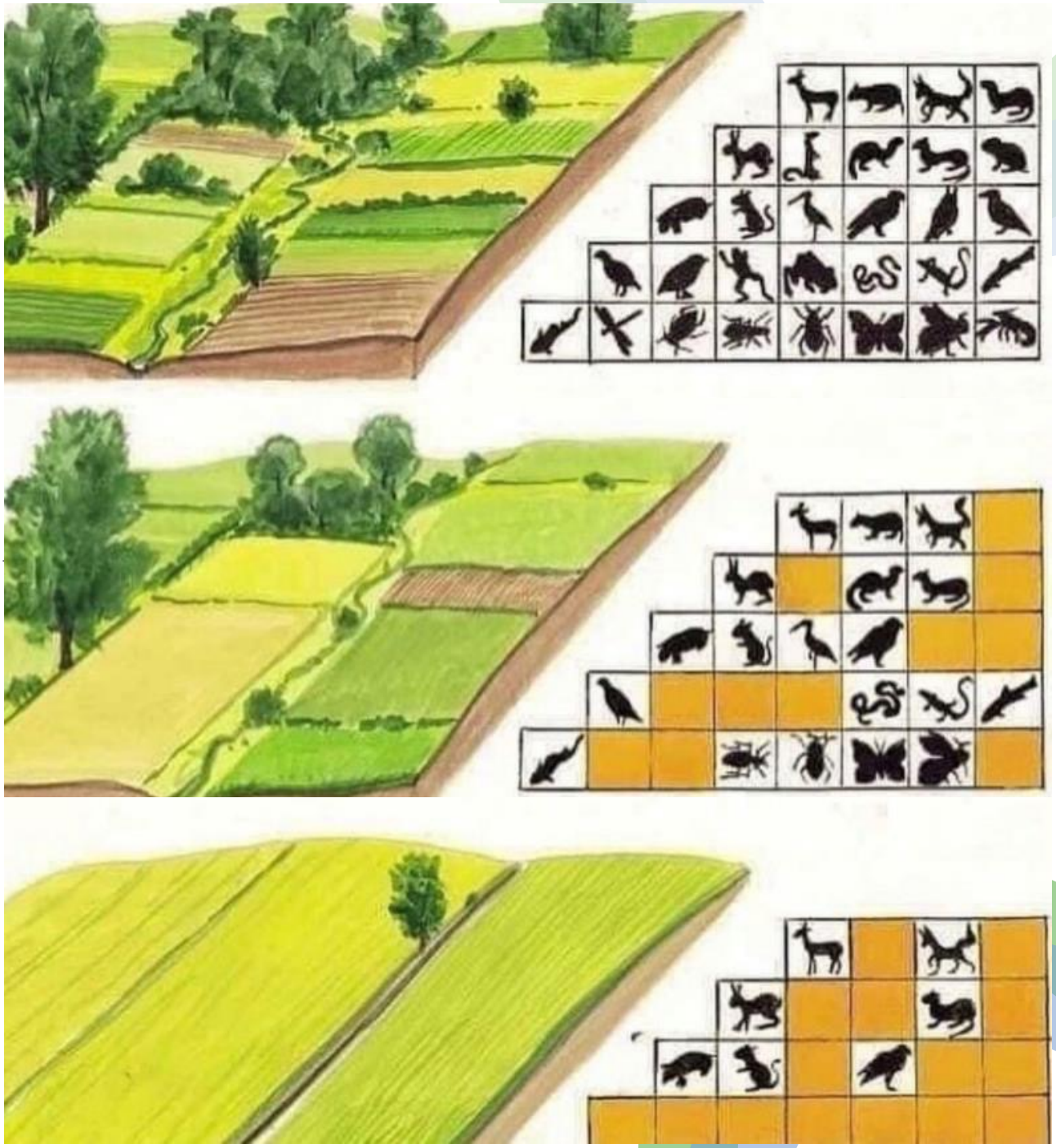
- Nature on farms is usually "common nature"
- Providing habitats for species: micro fauna, soil life, insects, reptiles, amphibia, mammals, birds, water organisms
- Providing infrastructure for nature networks (regional)
- Landscape, experience, tourism, cultural aspects (history)
- Water retention, wind break, visual, air quality, prevent erosion
- Contribution to biodiversity

- Looking at a farm from a bee's perspective.

The farmer landscape can host common nature and provide a network connecting habitats for a variety of species. The agricultural land can host and accommodate a range of services for the communities.

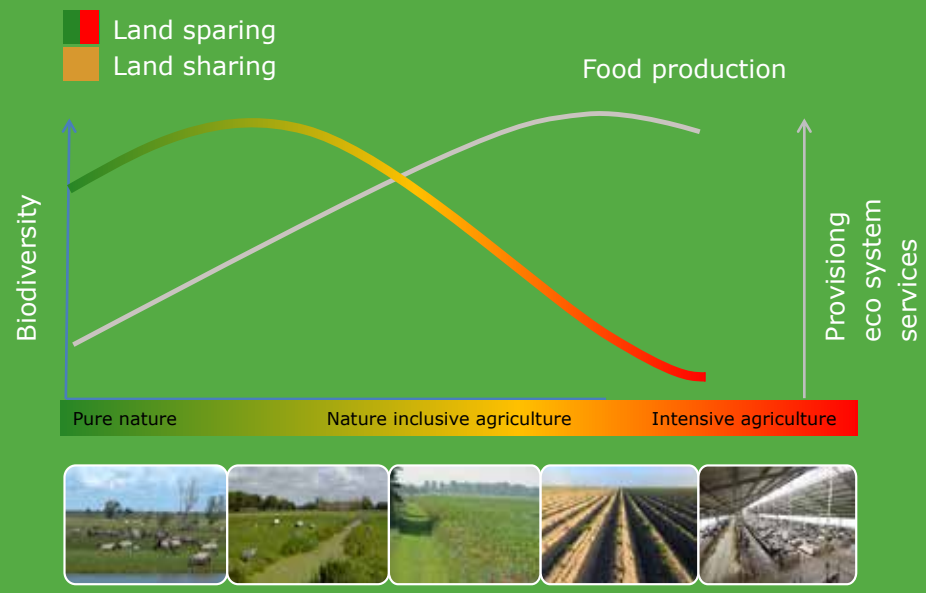
# Agro-ecology at a glance

- Shelter
- Fruit
- Flowers
- Water
- Soil
- Gradient
- Network of nature in landscape



The Farm of the Future is using a string of agro-ecological principals as management components such as, recycling of nutrients, enhancement of soil health and functional biodiversity. This is done with landscape planning, planting of service crops and flower strips.

# **Nature & Agriculture:** sharing vs sparing

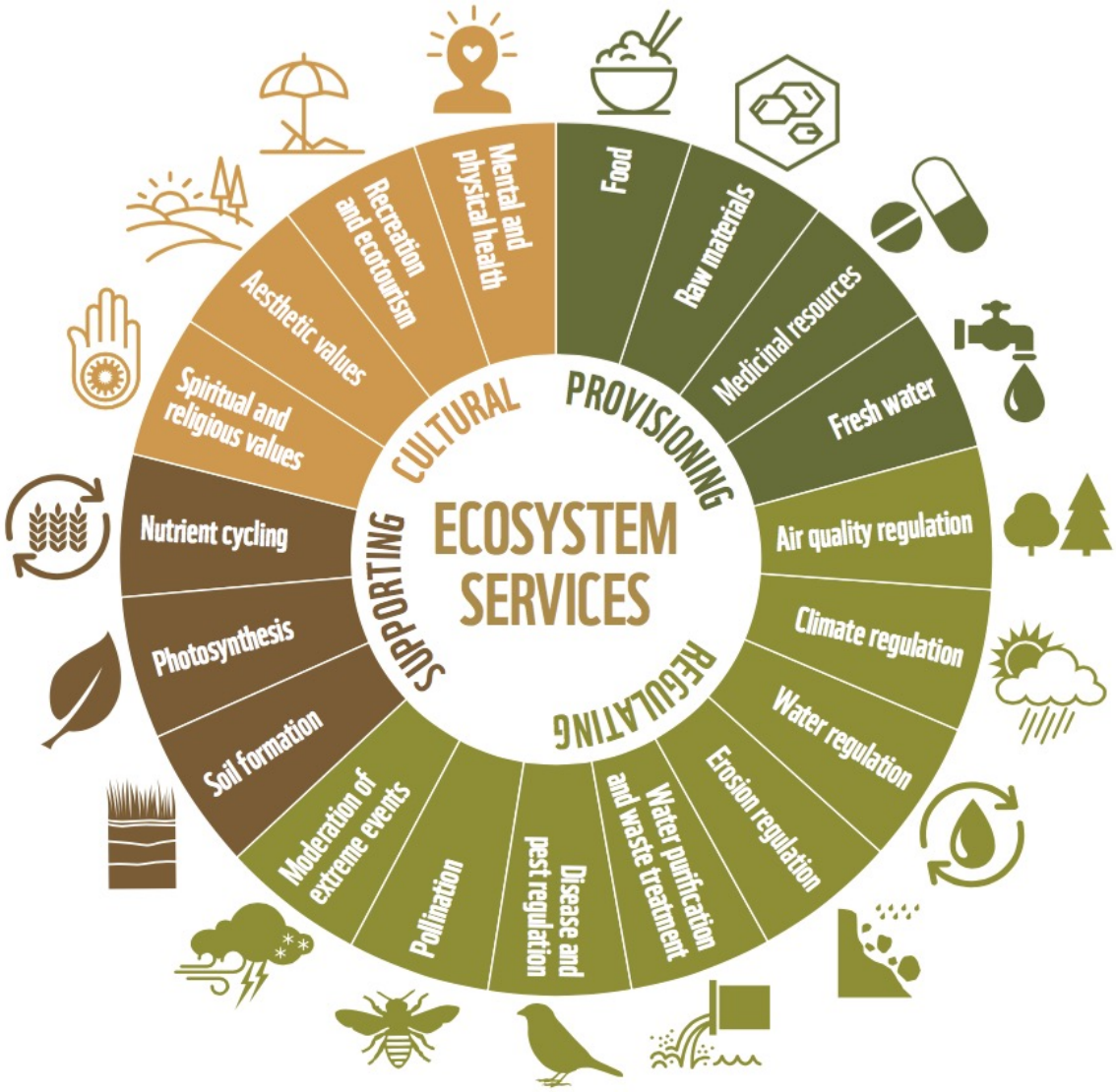



In the past decades, intensive agricultural systems achieved high levels of productivity while segregating agriculture from nature. This resulted in a high loss of biodiversity. The farm of the future embraces more diversity of species because it needs the ecosystem services from nature to stay productive.

The central region of The Netheralnds shows limited nature in the agricultural landscape.

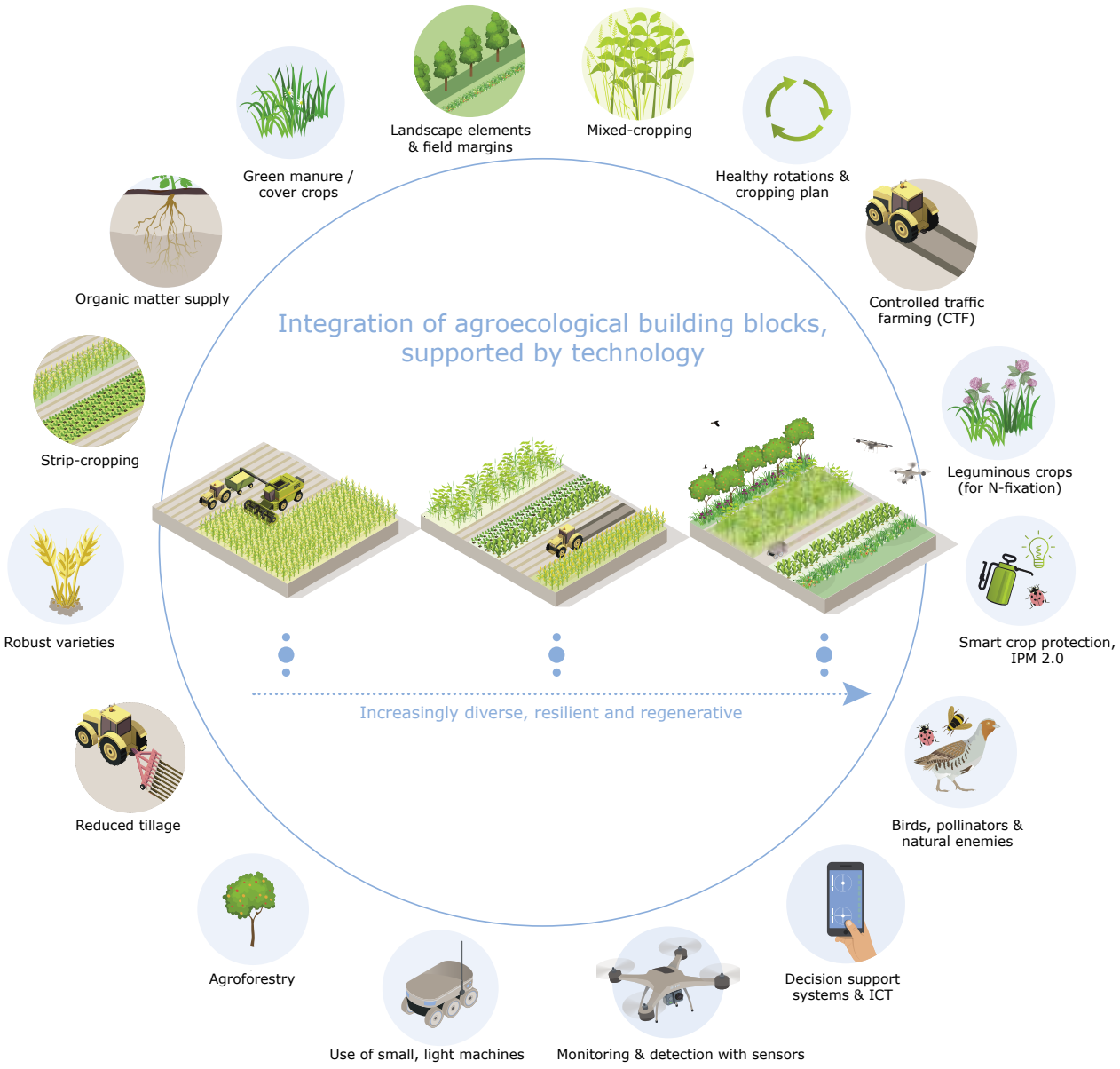
# Ecosystem services

1. **Soil quality**
2. **Robust agronomy**
3. **Water management**
4. **Inviting nature**
5. **Pest regulation**




The farm of the future focuses on food production while ensuring ecosystem services, like water regulation, disease and pest regulation et cetera. Thus creating a robust agricultural system.

# **Integration of agroecological** building blocks supported by technology




The agronomic building blocks for profitable future farming.

**The Farm of the Future**
the field lab Ecology & Technology

# Sustainable water management

- Water extremes,
  * Abundance causing erosion, soil degradation loss of fertility
  * Drought and serious shortage of irrigation water

- Agro ecology practices checked for effects on water productivity and water use efficiency to avoid negative trade-offs on the water system.

- Water balance

Arid regions with critical levels of water require a water balance assessment to determine if the introducing agricultural practices is affecting the water systems.

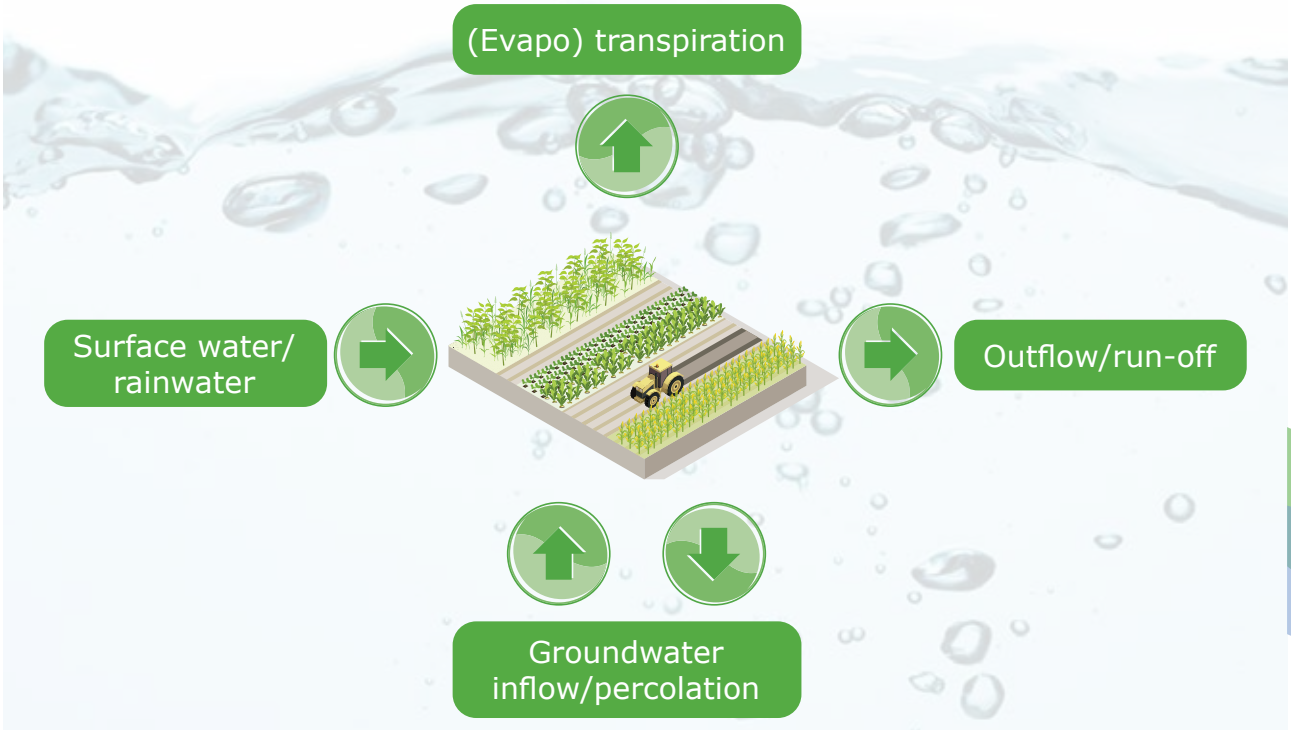
# Water assessment

1. Assess the current water balance of an agricultural system.
2. Assess how the water balance changes after implementation of nature-inclusive measures (e.g. cover crops).
3. Identify water-related innovations to enhance agricultural water productivity and efficiency and assess effects on the water balance as well.
4. Perform cost-benefit analysis to identify implementation potential and investment source.

The water balancing is a tool to assess the feasibility of investments in farm practices (including biodiversity enhancement practices) from a water perspective. The water balance shows the inflow, consumption and outflow of water in a system (farm level, sub basin, basin) (sub)basin. Comparing the baseline with the projected end situation shows the impact of the intervention on the water system.

# Menu of water-related interventions

- Use pressurized irrigation technologies (drip, micro-sprinkler, subsurface), including fertigation
- Improved surface irrigation, such as raised beds.
- Mulching
- Integrated use of water. (e.g., farm water storage in combination with fish production)
- Rainwater harvesting via basin or jars to provide additional water sources.
- Wastewater re-use (nutrient-rich water)
- Construction of pits and earthen banks (preserves substantial amounts of water and re-establishes the recharge rates that feed depleted aquifers)
- Construct wetlands to improve water quality.
- Canal lining (Local water savings)




When a water balance shows a negative impact (e.g. more consumption of water than inflow) it becomes necessary to consider mitigating measures. These measures include: organic mulching, modern irrigation techniques, water harvesting, waste water re-use, raised beds, et cetera. Water balancing combined with required mitigation measures should be evaluated economically. A cost benefit analysis on a farm level reveals the feasibility both for water and profitability effects.

# The field lab, in The Netherlands, creating diversity

Strip cropping with three cash crops and three supporting crops. Potato, Onion, Carrot, Wheat, Barley and Faba beans.

# The Farm of the Future, exploring the options for profitable and sustainable farming

BOERDERIJ van de Toekomst
Dichterbij dan je denkt

The design of the Farm of the Future in the central region of The Netherlands is based on strip cropping, fixed tracks for the tractors and machines to avoid soil compression, using advanced observation methods for decision support.

# Goals of the Farm of the Future

| | |
|---|---|
| Improved socio-economic position farmers | Energy-neutral - energy producing |
| Restoration and maintenance of natural resources; soil, water | Connected with nature: restoring and preserving biodiversity |
| Resilient cultivation system: almost no pesticides and artificial fertilizers | Climate-resilient production system |

The design of the farming systems combines societal requirements, technical feasibility and profitability objectives.

# Wide track potato harvester for strip cropping

Wide track mechanisation avoiding compaction compaction of the soil.

# Wide track tractor

Adaptation of tractors to wide track strips.

# Farm robot


Development of smart technolgies for the farm of the future.

# Developing farms of the future requires public and private partnerships

- Public benefit to protect biodiversity and production quality
- New research is required to develop solutions for new challenges
- Opportunity: water retention, carbon, appreciation, compensation
- Consumer demand: product quality, production quality, target markets
- Secondary business models, tourism, hospitality, services, local branding
- Creating a roadmap towards the future for transformation

The transition towards models for future farming is well underway and requires that farmers, policy makers, private sector and consumers embark on a journey with mutual interest to produce sufficient, affordable and responsible food to serve the growing world population.

Colofon

WAGENINGEN
UNIVERSITY & RESEARCH

Ministry of Agriculture,
Nature and Food Quality

Contact | Flip van Koesveld | ***flip.vankoesveld@wur.nl*** | T | +31 06 23 88 32 59