イレーナ・ホフマン

国際連合食糧農業機関（FAO）
気候変動・生物多様性・環境局
生物多様性担当部長

Dr. Irene Hoffmann

Secretary of the Commission on Genetic Resources for Food and Agriculture

イレーナ・ホフマン博士は、2002年から2015年まで、FAOの動物遺伝資源課長および動物生産サービス課長を務め、動物遺伝資源に関する政府間技術作業部会の事務局を務めました。農業科学者であり、ホーエンハイム大学で博士号、ゲッティンゲン大学で修士号を取得しています。1994年から2002年までギーセン大学家畜生態学研究所の助教授を務め、国際的かつ学際的な研究プログラムをまとめました。それ以前は、開発分野（アフリカのGIZ）で、科学編集者として、また開発NGOsのために働いていました。彼女は、国際的な政策・技術的な会議を開催してきたとともに、科学的・政策的なテーマで幅広く発表しているほか、様々な諮問委員会や審査委員会で活躍しています。

Between 2002 and 2015, Ms. Irene Hoffmann was Chief of the Animal Genetic Resources Branch and Chief of the Animal Production Service in FAO, and acted as Secretary of the Intergovernmental Technical Working Group on Animal Genetic Resources. Irene is an agricultural scientist with a Ph.D. from Hohenheim University and an MSc from Göttingen University. Between 1994 and 2002 she was assistant professor at the Institute of Livestock Ecology, Giessen University, where she coordinated international and interdisciplinary research programmes. Earlier in her career she worked in development (GIZ, Africa), as scientific editor, and for development NGOs. She has organized international policy and technical conferences and published extensively on scientific and policy topics, and she has served in various advisory committees and review panels.

持続可能な農業 ～生物多様性と気候危機とのつながり～

概要

膨れ上がる世界の人口、持続不可能な管理方法による天然資源の劣化、生物多様性の喪失、そして気候変動は、根本的な懸念を呼び起こします。即ち、今日の食糧及び農業システムは、現在および将来の世代のニーズを満たすことができるのかということです。どのようにしたら、差し迫った地球規模の問題に取り組みながら、社会はより持続可能な食料システムに移行できるのでしょうか？世界の食料システムの要である食料と農業のための生物多様性は脅威にさらされ、侵食されつつあります。しかし、何千もの種とその遺伝的多様性は、食料安全保障と気候変動を含む新しい状況に適応するために必要不可欠なものです。私たちの農業食糧システムの未来は、いくつかの持続可能な開発目標（SDGs）の達成の中心となるでしょう。たとえば、飢餓の撲滅、責任ある生産と消費、そして陸域・水域の生態系と生物多様性の保全と持続可能な利用を含む「環境に対する責務（environmental stewardship）」の促進などが挙げられます。今回の発表では、現在の地球規模の課題と持続可能な農業へのアプローチに光を当てますが、どこにでも通用する万能の解決策は存在しないのだということを強調しています。日本における実例を示すとともに、国際的な協力と、共同して政策を作り対応することの必要性を強調しています。イレーナ・ホフマン博士は、国連食糧農業機関（FAO）の「食糧と農業のための遺伝資源委員会(CGRFA)」の事務局長を務めています。この委員会は、食糧と農業のための生物多様性について専門的に取り組んでいる唯一の政府間組織です。また、食糧と農業のための生物多様性の保全と持続可能な利用を支援するための共同行動と地球規模の政策について各国が合意するためのフォーラムを提供しています。

Sustainable Agriculture
– linkages with biodiversity and climate change

Abstract

An expanding world population, natural resource degradation from unsustainable management practices, biodiversity loss and climate change give rise to fundamental concerns: Are today's food and agricultural systems capable of meeting the needs of present and future generations? How can societies transition to more sustainable food systems while addressing pressing global issues? The backbone of the world food systems -biodiversity for food and agriculture- is under threat and eroding. Yet the thousands of species and their genetic variability are indispensable to food security and to adapt to new conditions, including climate change. The future of our agri-food systems will be central to the achievement of several Sustainable Development Goals (SDGs), such as, the elimination of hunger, responsible production and consumption, and the promotion of environmental stewardship, including the conservation and sustainable use of our terrestrial and aquatic ecosystems and biodiversity. The presentation sheds light on current global challenges, and on approaches to sustainable agriculture, highlighting that there is no one-size fits all solution. It provides illustrative examples of Japan and emphasizes the need for international collaboration and joint policy responses. Dr. Irene Hoffmann serves as the Secretary of the Commission on Genetic Resources for Food and Agriculture (Commission) of the Food and Agriculture Organization of the United Nations. The Commission is the only intergovernmental body that specifically addresses biodiversity for food and agriculture. It offers countries a forum to agree on joint actions and global policies to support the conservation and sustainable use of biodiversity for food and agriculture.

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Sustainable agriculture – linkages with biodiversity and climate change

Irene Hoffmann, Secretary, Commission on Genetic Resources for Food and Agriculture

Overseas Agricultural Science Seminar, February 22, 2022, Rakuno Gakuen University

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Structure

- Food & agriculture at the crossroads
- Approaches to sustainable agriculture
- Global responses & international cooperation
- Conclusion

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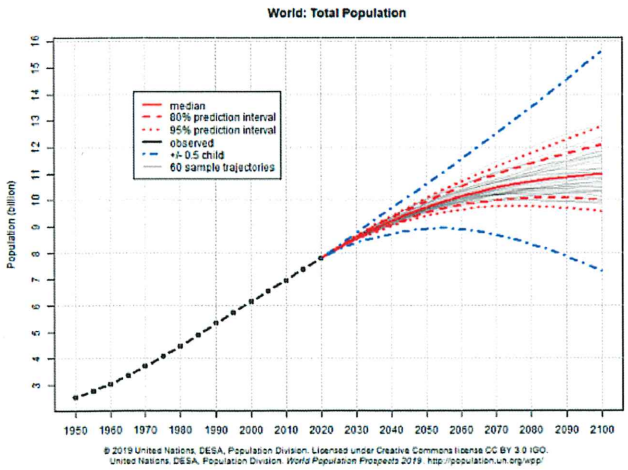
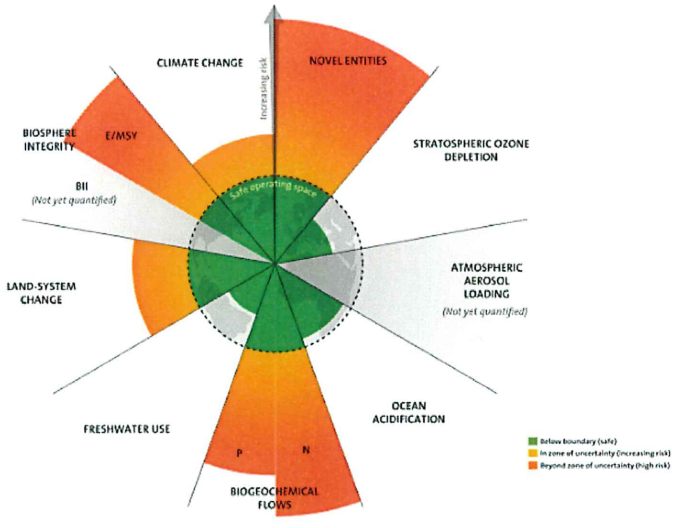
Planetary boundaries





Stockholm Resilience Centre, 2022

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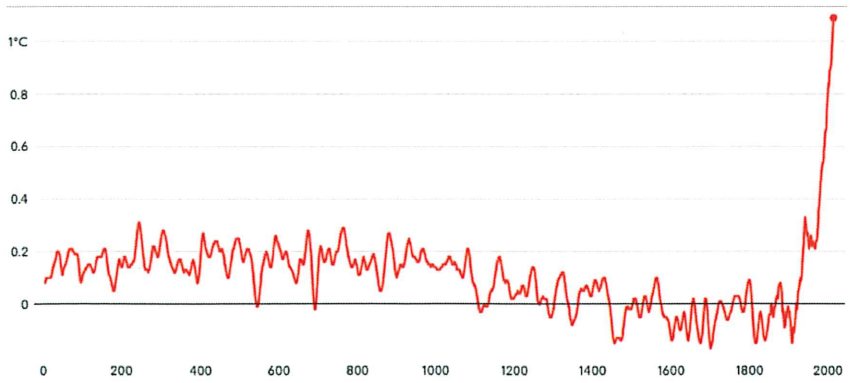
Climate change

Change in global surface temperature (decadal average) as reconstructed (1-1850) and observed (1850-2020)



Figures represent the central estimate for years 1-1850
Source: Intergovernmental Panel on Climate Change

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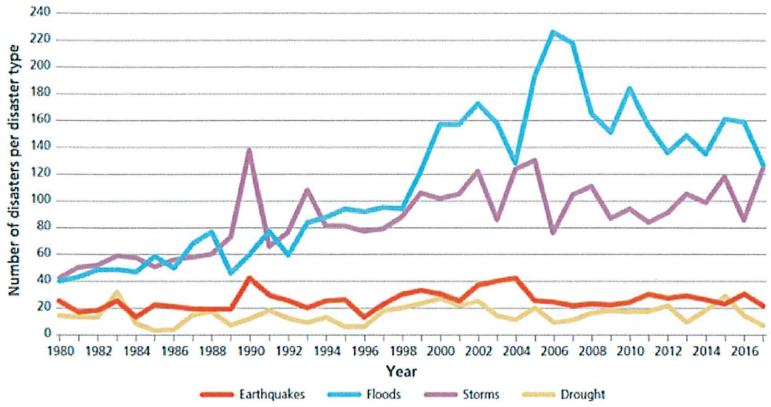
Climate change – Global trends in the occurrence of natural disasters



Source: EM-DAT, the OFDA/CRED International Disaster Database, www.emdat.be

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Example Japan: Effects of climate change & GRFA

Table 1: Main effects on paddy-field rice (nationwide)

Main effects	2008	2009	2010 *	2011	2012	2013	2014	2015	2016
Occurrence of white immature grains	33	21	46	28	29	27	17	20	27
Occurrence of cracked grains	7	7	...	10	10	8	5	3	5
Insufficient growth in grains	8	5	...	12	10	10	8	8	6
Frequent occurrence of insect damage	14	8	...	8	5	8	4	6	8

Source: "Fact-Finding Survey Concerning the Effects of Global Warming on Agricultural Production" The same unless otherwise stated.
Note: As a different type of survey was conducted in 2010, only the estimated occurrence of white immature grains is shown for the year.
As figures for other effects are unavailable, "..." is shown for them.

Figure 2: Cross-section surface of white immature grain (left) and normal grain (right)

Figure 3: Cracked grains

Source: MAFF, 2018

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Example Japan: Effects of climate change & GRFA

Table 5: Effects on unshu mikan

Main effects	Citrus fruits (Note)		Unshu mikan					
	2008	2009	2011	2012	2013	2014	2015	2016
Occurrence of peel puffing	7	9	12	6	5	8	11	14
Defective coloring or delayed coloring	10	7	5	4	7	1	2	6
Occurrence of tanning	9	6	5	5	6	4	2	5

Note: Figures for 2008 and 2009 are reference data on the number of prefectures where effects on citrus fruits (including unshu mikan) occurred.
Reference: Fact-Finding Survey Concerning the Effects of Global Warming on Agricultural Production

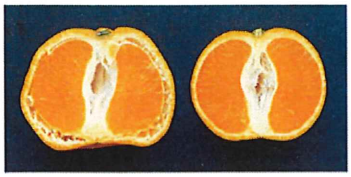

Table 6: Effects on apples

Main effects	2008	2009	2011	2012	2013	2014	2015	2016
Defective coloring or delayed coloring	6	4	4	11	8	4	4	8
Occurrence of tanning	4	1	3	7	6	6	6	6
Occurrence of freeze or frost damage	2	1	-	-	-	-	2	2
Frequent occurrence of insect damage (by spider mites, etc.)	2	1	-	2	1	1	1	2

Source: MAFF, 2018

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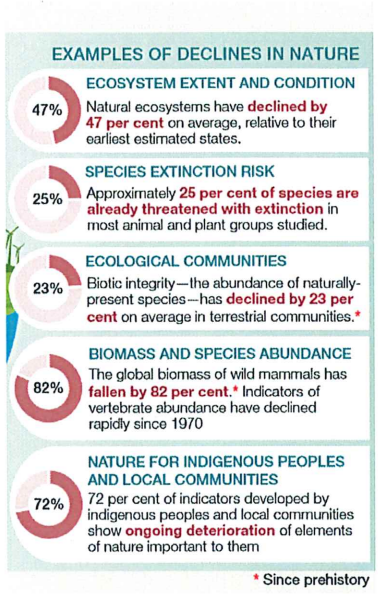
Biodiversity crisis



- Direct and indirect drivers of change have accelerated during the past 50 years
- Biodiversity and ecosystem functions and services are deteriorating worldwide
- Biodiversity can be conserved, restored and used sustainably while simultaneously meeting other global societal goals through urgent and concerted efforts fostering transformative change.

Source, IPBES, 2019

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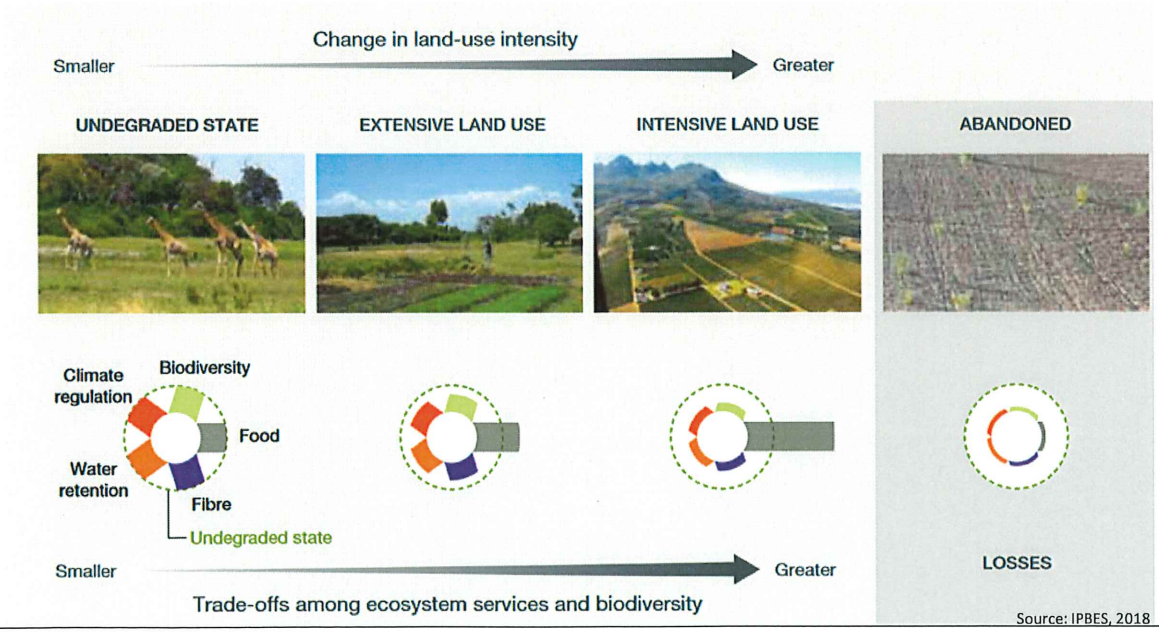

Source: IPBES, 2018

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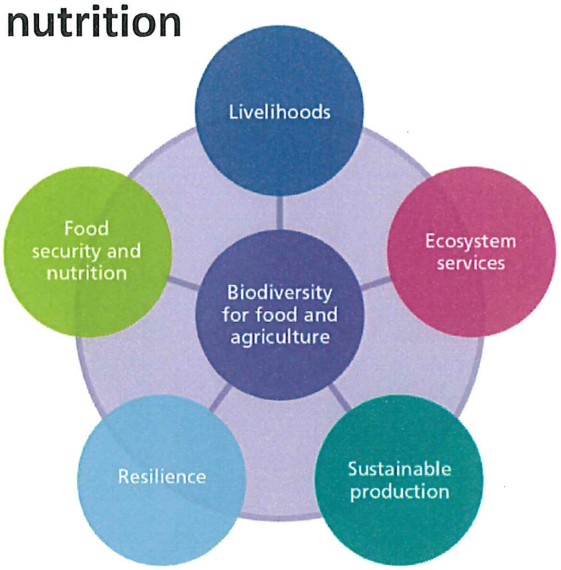
Biodiversity and healthy ecosystem are key to food security and nutrition



Biodiversity for food and agriculture is the variety of life at genetic, species and ecosystem levels that contributes to agriculture and food production.

- Genetic resources for food and agriculture
- Wild foods from non-domesticated species
- Associated biodiversity
  - Micro-organisms, fungi, invertebrates
  - Vertebrates, including wild relatives
  - Wild and cultivated terrestrial and aquatic plants other than crops and crop wild relatives

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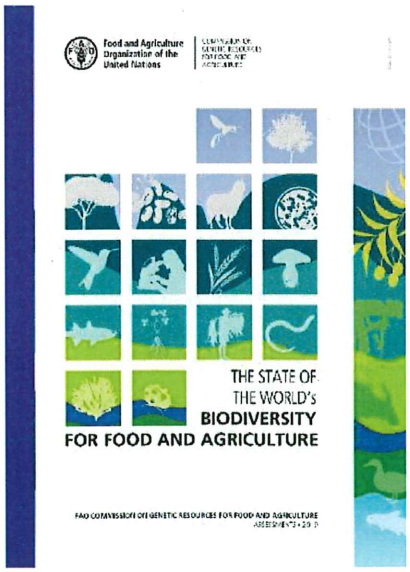
Biodiversity for food and agriculture is declining



FAO, 2019 SOW-BFA

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Multiple interacting drivers of change

Drivers of change		Reported effect on biodiversity for food and agriculture
Economic and social	Population growth and urbanization	- -
	Markets and trade	-
	Changing economic, sociopolitical and cultural factors	+ / -
Environmental drivers	Climate change	- -
	Natural disasters	- -
	Pests, diseases, invasive alien species	- -
	Changes in land and water use and management	- -
Drivers at production system level	Pollution and external inputs	- -
	Overexploitation and overharvesting	- -
Other	Advances and innovations in science and technology	+
	Policies	+ +

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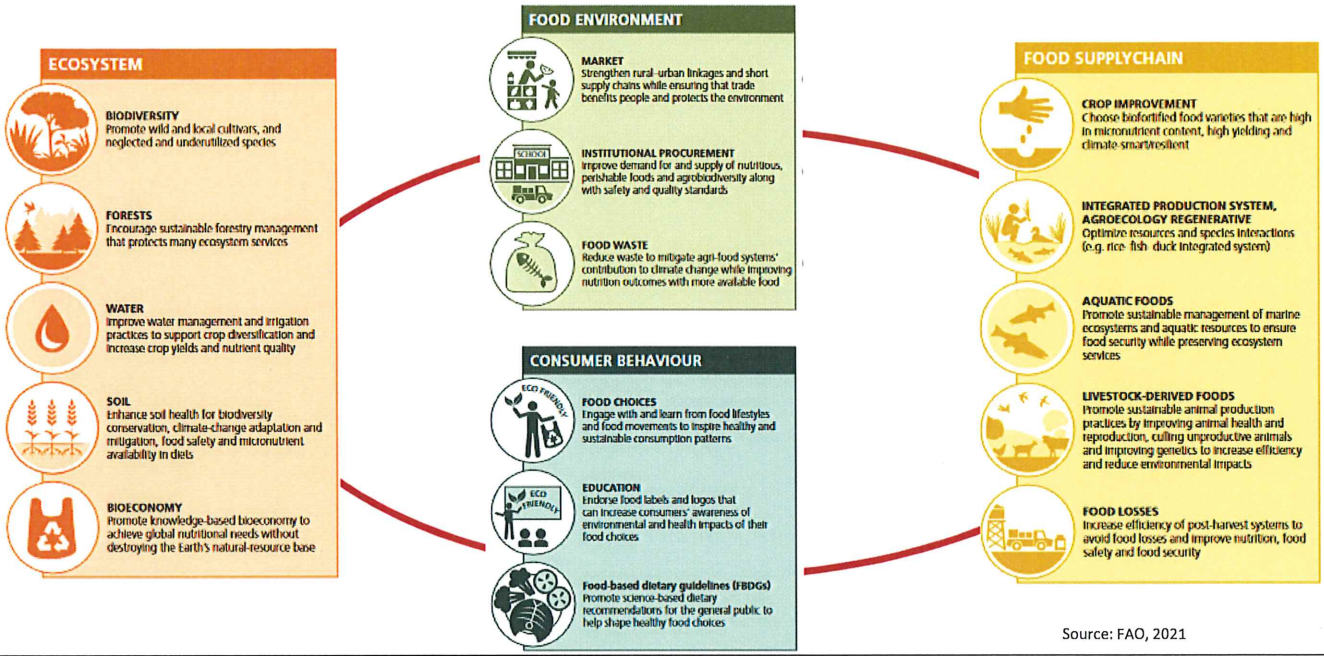
Key entry points in agri-food systems



Source: FAO, 2021

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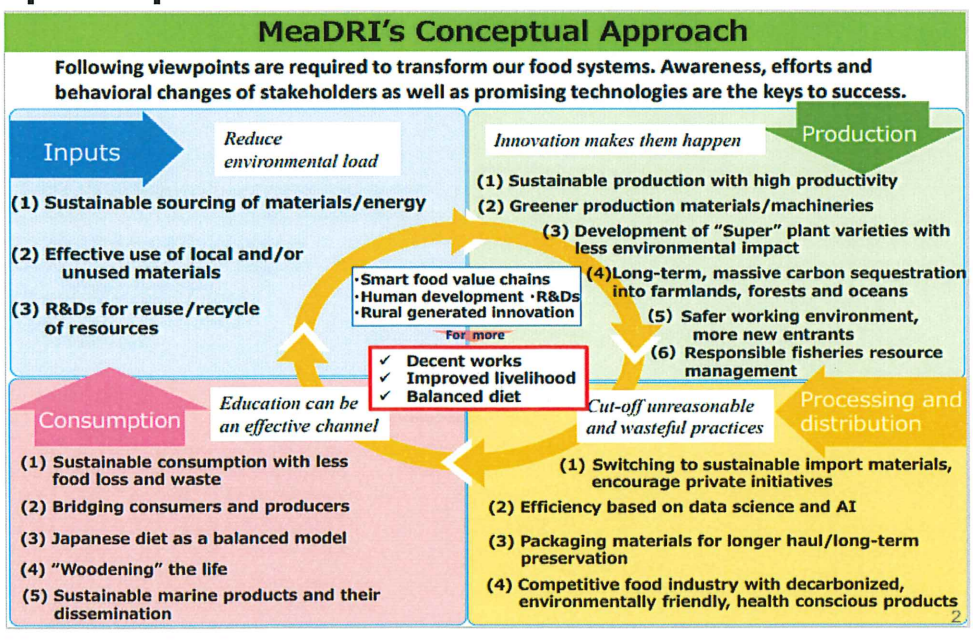
Example Japan



Source: MAFF, 2021

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Example Japan

Measures for achievement of Decarbonization and Resilience with Innovation (MeaDRI)

Abstract

~ Innovation will enhance potentials and ensure sustainability in a compatible manner~ MAFF Japan

"MeaDRI," the medium-long term strategy will pave the way for the future.

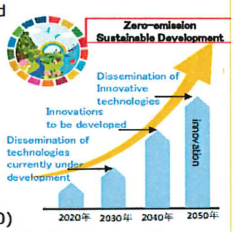
- **Enhancing engagement of stakeholders at each stage of food supply chains**
- **Promoting innovation to reduce environmental load**

Challenges

- Depopulation and aging of producers
- Stagnant rural communities
- Climate change and increasing natural disasters
- Disrupted supply chains due to the COVID-19
- Achievement of SDGs

By 2050, MAFF aims to achieve;

- **Zero CO2 emission** from the agriculture, forestry and fisheries sectors
- **50% reduction in risk-weighted use of chemical pesticides** by dissemination of the Integrated Pest Management and newly-developed alternatives
- **30% reduction in chemical fertilizer use**
- **Increase in organic farming to 1Mha** (equivalent to 25% of farmland)
- **At least 30% enhancement in productivity of food manufacturers** (by 2030)
- **Sustainable sourcing for import materials** (by2030)
- **90% and more superior varieties and F1 plus trees** in forestry seedling
- **100% of artificial seedling rates** in aquaculture of **Japanese eel, Pacific bluefin tuna,** etc.



which will be enabled through:
- development and dissemination of innovative technologies
- greening of MAFF's policy tools

MAFF endeavors to accomplish the triple win of;

Economic sustainability	Social sustainability	Environmental sustainability
Ensure robust and resilient food industry	Improve livelihood, promote balanced diet	Save global environment for the future generation

Source: MAFF, 2021

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The use of many biodiversity-friendly practices is reported to be increasing

Management practices and approaches	Production systems (PS)											
	Livestock grassland-based systems	Livestock landless systems	Naturally regenerated forests	Planted forests	Self-recruiting capture fisheries	Culture-based fisheries	Fed aquaculture	Non-fed aquaculture	Irrigated crop systems (rice)	Irrigated crop systems (other)	Rainfed crop systems	Mixed systems
Landscape management	↗	↗	↗	↗					↗	↗	↗	↗
Ecosystem approach to fisheries					↗	↗	↗					
Restoration	↗		↗	↗	↗				↗	↗	↗	↗
Diversification	↗	↗	↗	↗	↗	↗	↗		↗	↗	↗	↗
Home gardens	↗	↔	↗	↗					↗	↗	↗	↗
Agroforestry	↗	↗	↗	↗					↗	↗	↗	↗
Polyculture/aquaponics							↗					↗
Organic agriculture	↗	↗	↗	↗					↔	↗	↗	↗
Low external input agriculture	↗↙	↗	↗	↗					↗	↗	↗↙	↗
Sustainable soil management	↗	↗	↗	↗					↗	↗	↗	↗
Management of micro organisms	↗		↗	↗	↗				↗	↗	↗	↗
Conservation agriculture	↗	↗	↗	↗					↗	↗	↗	↗
Integrated plant nutrient management	↗	↗	↗	↗					↗	↗	↗	↗
Integrated pest management	↗	↗	↗	↗	↗				↗	↗	↗	↗
Pollination management	↗	↗	↗	↗						↗	↗	↗
Enrichment planting			↗	↗								↗
Reduced-impact logging			↗	↗								
Domestication	↗	↔	↗↙	↗			↗		↗	↗	↗	↗
Base broadening	↗	↗	↗↙	↗					↗	↗	↗	↗

Notes: Analysis based on 91 country reports. See main report for details of the methodology.

Proportion of countries reporting the PS that report any trends (%)

0–9
10–19
20–29
30–39

FAO, 2019 SOW-BFA

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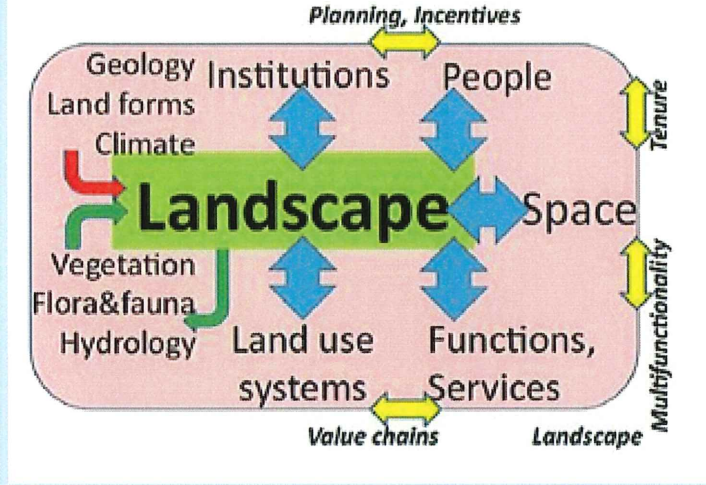
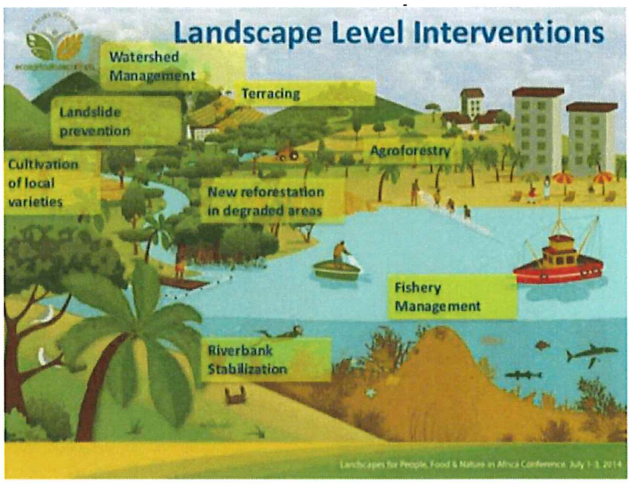
The Landscape approach





Source: Scherr, 2013

Landscape as interaction between human actions, ecosystems and the abiotic factors that shape the physical environment (Minang et al., 2015; Scherr, 2013)

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Globally Important Agricultural Heritage Systems (GIAHS)

Combining agricultural diversity, resilient ecosystems, traditional farming practices and cultural identity

Revitalization of Regional Communities Utilizing Globally Important Agricultural Heritage Systems (GIAHS)

GIAHS is an initiative under which the Food and Agriculture Organization of the United Nations (FAO) designates remarkable agricultural land use systems (including forestry and fisheries) and landscapes which are rich in globally significant biological diversity evolving from the co-adaptation of the community with its environment and its needs and aspirations for sustainable development. They have an intricate relationship with their territory, cultural or agricultural landscape or biophysical and wider social environment. In Japan's designated regions, efforts are being made to revitalize rural areas by promoting the branding of agricultural products that utilize regional characteristics and promoting green tourism.

Crested ibis feeding in paddy field (Sado Region)

Terraced paddy fields connecting Satoumi and Satoyama

Designated Regions in Japan (As of October 2015)

Region	Agricultural System
Sado region, Niigata Prefecture	Sado's Satoyama in harmony with crested ibis
Noto region, Ishikawa Prefecture	Noto's Satoyama and Satoumi
Kakegawa peripheral region, Shizuoka Prefecture	Traditional tea-grass integrated system in Shizuoka (local name: Chagusaba)
Aso region, Kumamoto Prefecture	Managing Aso Grasslands for Sustainable Agriculture
Kunisaki Peninsula Usa region, Oita Prefecture	Kunisaki Peninsula Usa Integrated Forestry, Agriculture and Fisheries System

Source: https://www.maff.go.jp/e/data/publish/attach/pdf/maff_2016-2.pdf

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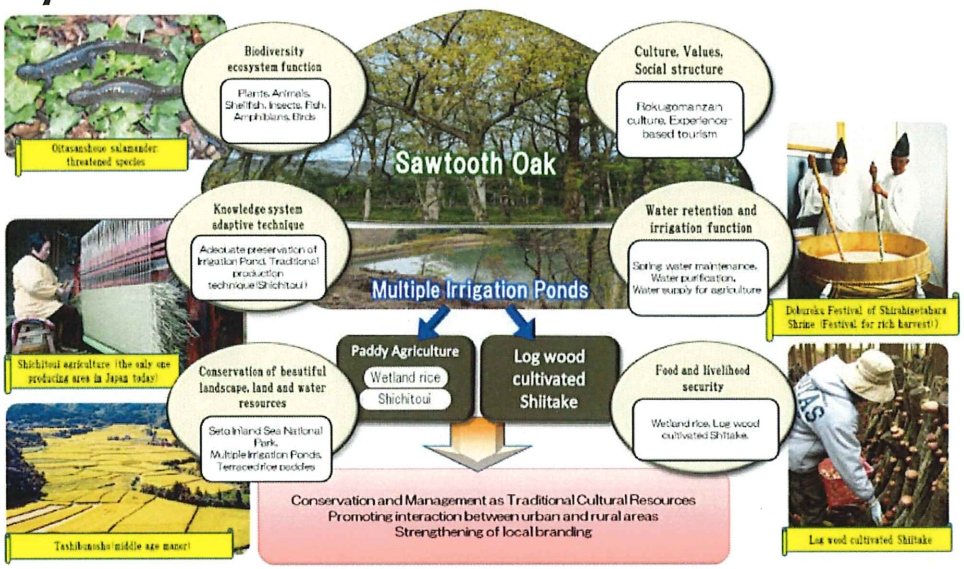
Kunisaki Peninsula Usa - Integrated Forestry, Agriculture and Fisheries Systems



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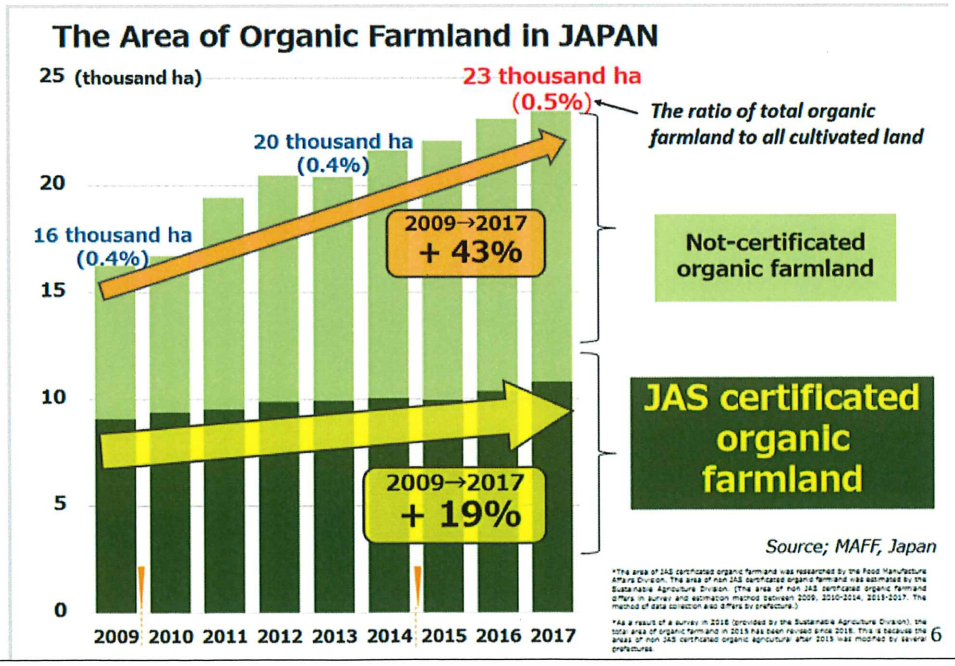

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Source: MAFF

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Sustainable use of biodiversity / genetic resources for food and agriculture

- Breeding of GRFA for multiple objectives
- Maintain local genetic diversity on farm / in situ
- Promote sustainable use of BFA / GRFA and integrated approaches to its management at production system, ecosystem, landscape and seascape levels
- Improve landscape structure and connectivity to provide habitats for associated biodiversity and wild food species
- Reduce impacts on BFA from the inappropriate use of chemical pesticides, veterinary medicines and fertilizers
- Manage soil biodiversity to ensure soil health and soil fertility

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Example Japan: Adaptation

Table 8: Adaptation measures for unshu mikan

Purpose	Measures taken	2012	2013	2014	2015	2016
Curb peel puffing	Use of plant growth regulators	2	3	4	3	5
Curb peel puffing Address defective coloring	Use of multi-sheets	3	7	3	6	10
Curb tanning	Thinning (thinning of tree crowns and focused thinning at late stage)	1	1	1	1	1
Address defective coloring	Cooling (facilities and greenhouse-raised mikan)	-	-	-	-	1

Table 9: Adaptation measures for apples

Purpose	Measures taken	2012	2013	2014	2015	2016
Address defective coloring	Shift to breeds of excellent coloring or yellow breeds	-	1	1	1	1
Address defective coloring Curb tanning	Thorough technological management such as brine water and multi-sheet	-	1	1	1	1
Curb tanning	Curb leaf thinning	-	-	2	1	1
	Use light-shielding materials	1	1	1	1	1

Table 3: Ratio of planted area of rice breeds resistant to high temperature to planted area of paddy-field rice for staple diet

	Cropped in 2010	Cropped in 2016	Difference
Planted area of rice breeds resistant to high temperature	37,700ha	91,400ha	–
Planted area of paddy-field rice breeds for staple diet	1,580,000ha	1,381,000ha	–
Ratio of planting	2.4%	6.6%	Up 4.2 points

Source: "2010 Paddy Field Rice Yields" and "2016 Paddy Field Rice Yields," Statistics Department, Ministry of Agriculture, Forestry and Fisheries

Table 4: Number of prefectures where planting of rice breeds resistant to high temperature was reported and the number of breeds

	2010	2011	2012	2013	2014	2015	2016
Reported number of breeds	13	16	20	24	26	27	27
Reported number of prefectures	19	20	25	30	33	33	33

Source: MAFF, 2018

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Conservation of GRFA

In Situ Conservation

- **wild species/relatives in natural habitats and ecosystems**
- **on-farm conservation of domesticated GRFA in traditional farming systems**
- Supporting on-farm management and improvement

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Ex Situ Conservation

- **Maintenance of genetic material outside of the natural environment where the species have evolved**
- **Gene banks, botanical gardens, zoos etc**
- Supporting targeted collecting of genetic resources for food and agriculture
- Sustaining and expanding ex situ conservation of germplasm
- Regenerating and multiplying ex situ accessions

Crop Trust FAO

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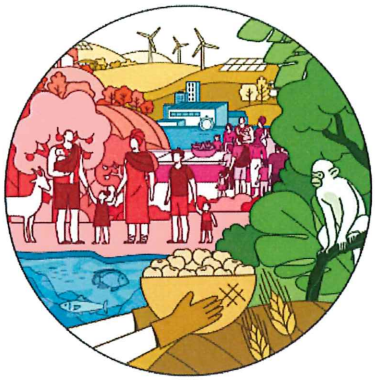
Global responses and international cooperation

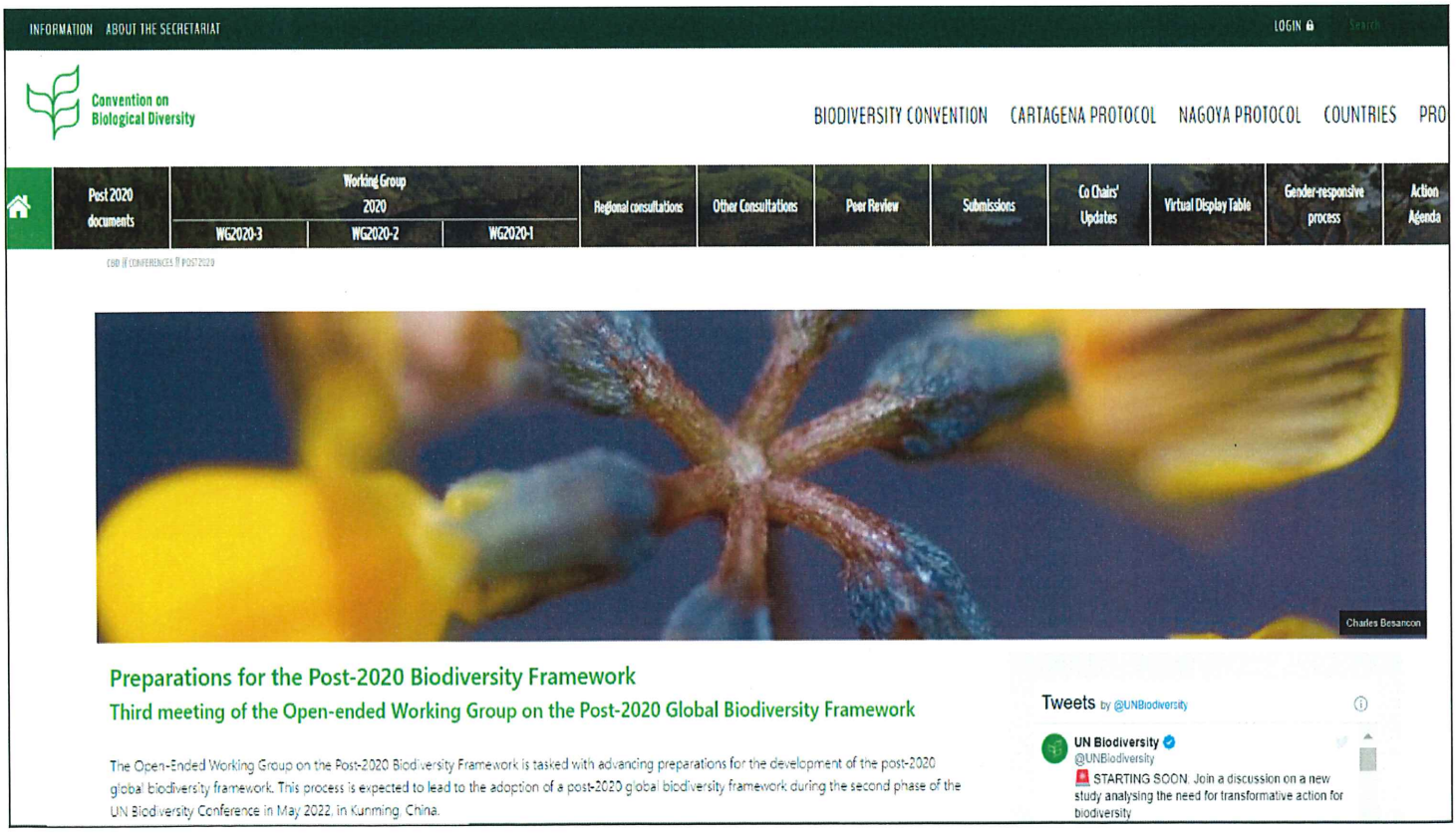
SUSTAINABLE DEVELOPMENT GOALS



SUSTAINABLE DEVELOPMENT GOAL 2

Zero Hunger

End hunger, achieve food security and improved nutrition and **promote sustainable agriculture**



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Key messages

- The global food system is under pressure, e.g. population growth, biodiversity loss and climate change negatively impact food security
- Good governance, enabling frameworks, and integrated system approaches are needed to facilitate sustainable agriculture
- Enhanced efforts to sustainably use and conserve BFA and to transform to more resilient and sustainable agriculture
- International policy responses and collaboration are essential
- There is no one-size fits all solution! Local-regional
- More data are needed on impacts of practices on biodiversity

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Thank you!

For more information:

Commission on Genetic Resources for Food and Agriculture: http://www.fao.org/cgrfa/

FAO Office of Climate Change, Biodiversity and Environment: https://www.fao.org/about/office-of-climate-change-biodiversity-environment/en/

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