E-LEARNING: MODULE 2 OUTLINE AND CONTENT

THE STRUCTURE OF THE BLENDED LEARNING PROGRAMME ON MAINSTREAMING BIODIVERSITY ACROSS AGRICULTURAL SECTORS

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MODULE OUTLINE: AN INTRODUCTION

A module outline describes all the course elements included in your learning content. It includes asynchronous content and synchronous content.

Here you can find a breakdown of the topics, as well as any asynchronous work and reading suggested.

The content of each topic within a learning objective will follow the outline of each learning objective.

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MODULE BLUEPRINT

KEY QUESTIONS:

- What are the interdependencies between agriculture, biodiversity and ecological functions?
- How does a healthy ecosystem and its correct functioning safeguard biodiversity?
- How to determine food production practices which are friendly or harmful towards biodiversity?
- How to integrate these principles and practices across scales?

INTEGRATING BIODIVERSITY IN AGRICULTURE

Learning Objective Title	Learning Objective	Key Topics
The ecology of agriculture	**LO 2.1:** Understand the ecological processes and ecosystem integrity (the healthy functioning of an agroecosystem) necessary for agriculture.	**2.1.1:** Agriculture as domesticated human managed ecosystems. **2.1.2:** Managing biodiversity in agriculture.
Sustainable and biodiversity-friendly agriculture	**LO 2.2:** Identify and analyze sustainable and biodiversity-friendly agricultural practices and approaches.	**2.2.1:** From uniformity to diversity. **2.2.2:** Sustainable and biodiversity-friendly practices and approaches
An integrated approach to agriculture	**LO 2.3:** Recognize and apply an integrated approach to agriculture across landscapes	**2.3.1:** Managing for multi-functionality **2.3.2:** Integrated approaches for a healthy planet

LEARNING OBJECTIVE 1 - TOPIC 1

THE ECOLOGY OF AGRICULTURE

2.1: Understand the ecological processes and ecosystem integrity (the healthy functioning of an agroecosystem necessary for agriculture.

SYNCHRONOUS CONTENT

TOPIC BREAKDOWN:

1. Defining ecosystems
2. The soil food web
3. The nutrient cycle
4. Agrobiodiversity

ASYNCHRONOUS CONTENT

VIDEOS:

- Pre-Session: Six actions to keep soil alive
- Pre-Session: Keep soil alive, protect soil biodiversity
- Pre-Session: Understanding our soil: the nitrogen cycle

ASYNCHRONOUS READING:

- Soils and biodiversity: Soils host a quarter of the our planet's biodiversity
- Genetic Diversity: The Hidden Secret of Life

IMAGES:

- The Soil Food Web (from: FAO, 2015: pg. 3)

2.1.1: Agriculture as domesticated human managed ecosystems

- The nutrient cycle (from Gassner and Dobie., 2022: pg. 54)

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THE ECOLOGY OF AGRICULTURE

2.1: Understand the ecological processes and ecosystem integrity (the healthy functioning of an agroecosystem necessary for agriculture.

2.1.1: Agriculture as domesticated human managed ecosystems

Defining ecosystems - (Education National Geographic, 2022; FAO, 2015)

- An ecosystem is a geographic area where plants, animals, and other organisms, as well as weather and landscape, work together to form a bubble of life. Ecosystems contain biotic or living parts, as well as abiotic factors, or nonliving parts. Biotic factors include plants, animals, and other organisms. Abiotic factors include rocks & sediments, gasses, temperature, and humidity.
- Every factor in an ecosystem relates to every other factor, either directly or indirectly. A change in the temperature of an ecosystem will often affect what plants will grow there, for instance. Animals that depend on plants for food and shelter will have to adapt to the changes, move to another ecosystem, or perish.
- A food web is a detailed description of the species within a community and their relationships with each other; it shows how energy is transferred up food chains that are interlinked with other food chains. These types of interactions occur between producers- organisms on the food chain that can produce its own energy and nutrients- and consumers - organisms on the food chain that depend on others for food, nutrition, and energy and between predator and prey.

The soil food web - (FAO, 2015)

- Soil is one of nature's most complex ecosystems and one of the most diverse habitats on earth: it contains a myriad of different organisms, which interact and contribute to the global cycles that make all life possible. Nowhere in nature are species so densely packed as in soil communities; however, this biodiversity is little known as it is underground and largely invisible to the human eye.
- In both natural and agro-ecosystems, soil organisms are responsible for performing vital functions in the soil ecosystem which have direct interactions with the biological, atmospheric and hydrological systems.
- Soil organisms act as the primary agents of nutrient cycling, regulating the dynamics of soil organic matter, soil carbon sequestration and greenhouse gas emissions, modifying soil physical structure and water regimes, enhancing the amount and efficiency of nutrient acquisition by the vegetation through mutualistic relationships, and enhancing plant health.

The nutrient cycle - (Gassner et al., 2022)

- Plant nutrients are the chemical elements that make up the food that plants need to grow and thrive. These nutrients are found in the soil, and come principally from the decay of dead leaves, twigs, stems and animal material; the very slow breakdown of minerals in the soil; and fertilizers applied by farmers. Soils that have low levels of nutrients are referred to as having low fertility and are not very productive
- Most soil nutrient sources are found in the upper soil layers. If the soil is in good health – with sufficient air, water and organic matter – it retains the

nutrients, which can then be gradually absorbed by growing plants. If the soil is exposed, its upper layers – and the nutrients in them – can be washed away in water runoff. In poor quality soils, particularly those that are sandy textured and free draining, nutrients can also be washed rapidly into deeper soil layers, below the level of crop roots. This is called 'leaching'.

- Trees can play an important role in keeping nutrients available by preventing runoff of water and improving its retention in the soil. Their deep roots can also pull up water and nutrients from far down in the ground. Nutrients make up the 'building blocks' of stems and leaves, or are used by the trees in other ways. After the old leaves, stems, twigs and branches fall as litter, they rot and provide more nutrients needed by plants. Trees are therefore important nutrient- recycling 'pumps' that maintain good soil conditions for plant growth.
- Nitrogen and phosphorus are two of the most important minerals for plant growth. Lack of both is one of the main reasons for resorting to artificial fertilizers, which is why effective nutrient recycling is so important.
  - Nitrogen-fixing trees, which come mostly from the very large legume (pea) family, can substantially improve the fertility of soils, and can be used in several ways in agroforestry systems. One approach is to grow them in rows, with crops planted in between, so that the falling leaf litter directly fertilizes the soil. Young tree branches can also be cut and mixed into the soil. Sometimes 'tired' soils are left in fallow – that is, without crops– to allow trees and bushes to grow back naturally.
  - Fallowing allows soils to recover from overuse, and nitrogen-fixing shrubs and trees, such as some leguminous species amongst others, can be grown on the fallows to speed up that process. Efficient fixation of nitrogen requires a minimum level of phosphorus in the soil; fixation can be insignificant in soils that are low in phosphorus, and this is often the limiting growth factor. Animal manure is a good source of phosphorus, which is one reason why livestock are an important part of numerous agroforestry systems. Many trees provide shoots and leaves that can be fed to animals; the resulting nutrient-rich manure can then be applied to crops in the system, including by carrying manure to fields from animal pens.

Agrobiodiversity **- (FAO, 2004)**

- Biological diversity or 'biodiversity' is described as "the variability among living organisms from all sources, whether terrestrial, aquatic or marine". It includes the diversity within species (genetic diversity), between species (organism diversity) and of ecosystems (ecological diversity).
- Agrobiodiversity is the result of natural selection processes and the careful selection and inventive developments of farmers, herders and fishers over millennia. Agrobiodiversity is a vital sub-set of biodiversity. Many people's food and livelihood security depend on the sustained management of various biological resources that are important for food and agriculture. Agricultural biodiversity, also known as agrobiodiversity or the genetic resources for food and agriculture, includes:
  - Harvested crop varieties, livestock breeds, fish species and non-domesticated (wild) resources within fields, forests, and rangelands including tree products, wild animals hunted for food and in aquatic ecosystems (e.g. wild fish);

    - Non-harvested species in production ecosystems that support food provision, including soil microbiota, pollinators and other insects such as bees, butterflies, earthworms, greenflies; and
    - Non-harvested species in the wider environment that support food production ecosystems (agricultural, pastoral, forest and aquatic ecosystems).
- There are several distinctive features of agrobiodiversity, compared to other components of biodiversity:
    - agrobiodiversity is actively managed by people; many components of agrobiodiversity would not survive without this human interference; local knowledge and culture are integral parts of agrobiodiversity management;
    - many economically important agricultural systems are based on non-native crop or livestock species introduced from elsewhere (for example, horticultural production systems or Friesian cows in Africa). This creates a high degree of interdependence between countries for the genetic resources on which our food systems are based;
    - as regards crop diversity, diversity within species is at least as important as diversity between species;
    - because of the degree of human management, conservation of agrobiodiversity in production systems is inherently linked to sustainable use - preservation through establishing protected areas is less relevant; and
    - In industrial-type agricultural systems, much crop diversity is now held ex situ in gene banks or breeders' materials rather than on-farm.
- Many farmers, especially those in environments where high-yield crop and livestock varieties do not prosper, rely on a wide range of crop and livestock types. This helps them maintain their livelihood in the face of pathogen infestation, uncertain rainfall and fluctuation in the price of cash crops, socio-political disruption and the unpredictable availability of agro-chemicals.
- "Water and food, climate regulation, even the interactions between human spirit and nature. These are all ecosystem services, and the secrets of how they work are hidden in genes." (CBD, 2021)

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LEARNING OBJECTIVE 1 - TOPIC 2

THE ECOLOGY OF AGRICULTURE

2.1: Understand the ecological processes and ecosystem integrity (the healthy functioning of an agroecosystem necessary for agriculture.

SYNCHRONOUS CONTENT

TOPIC BREAKDOWN:

1. Functional biodiversity in agroecosystems
2. Ecosystem Services
3. Wild biodiversity and natural habitats in agroecosystems
4. Managing functional biodiversity - two examples

ASYNCHRONOUS CONTENT

VIDEOS:

- Pre-Session: What is regenerative agriculture?
- Pre-Session: Genetic diversity

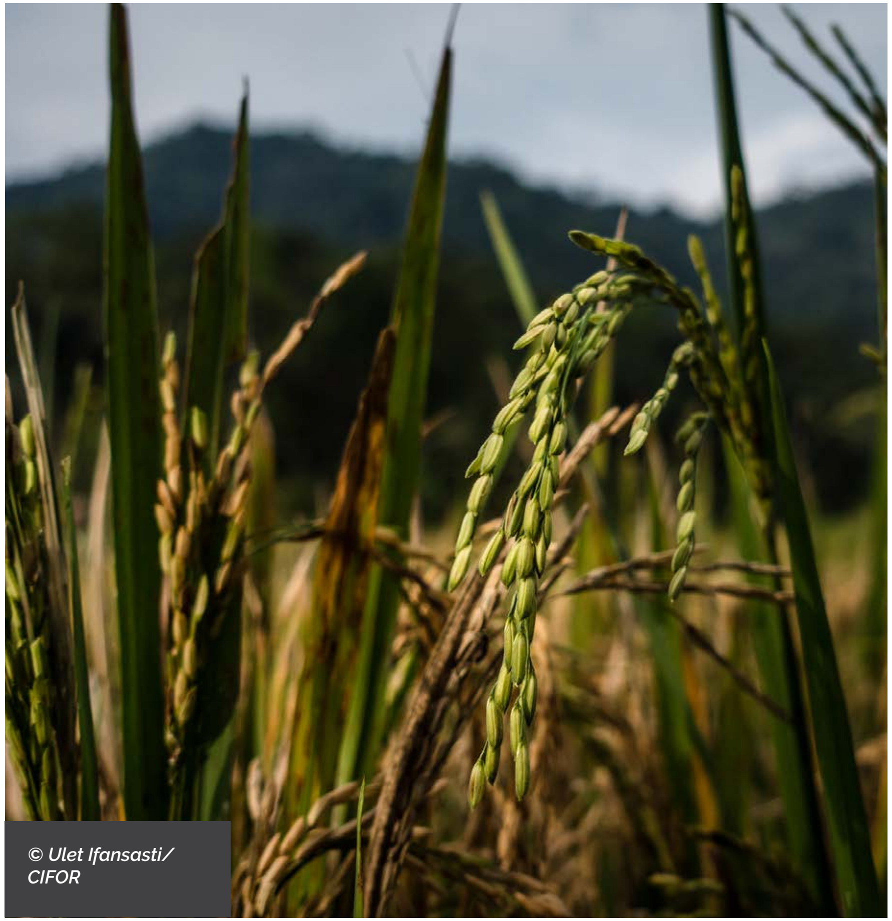
ASYNCHRONOUS READING:

- Functional Biodiversity: an agroecosystem approach

ASSIGNMENT

Identify case-studies and examples where biodiversity is managed in agriculture, defining the ecological functions that are managed.

2.1.2: Managing biodiversity in agroecosystems



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Introduction

2.1.2 Content

Learning Objective 2

Learning Objective 3

Functional biodiversity in agroecosystems - (CBD, 2001)

- Agroecosystems have a clear purpose for producing food, feed, goods such as timber, fibers and other natural products for own use and/or for the market. Farmers, herders and fishers sometimes add components, other species, to provide agroecosystem services.
- Agroecosystem services are positive contributions of one component of the agroecosystem to the growth, productivity or sustainability of other components (for example, shade, nitrogen-fixation, organic matter formation, water regulation).
- Apart from agroecosystem services that directly benefit biomass (fish, crop, timber) production, other ones that pests, disease, insects and weeds and those that support gene flow, such as pollination, also contribute positively to the wider food web.
- Organisms within the ecosystem that provide the same agroecosystem services are often grouped into "functional groups". Functional biodiversity is the role these groups have in influencing the agroecosystem processes (biomass, nutrients and water cycles).
- A well functioning and efficient agroecosystem is thus one with minimal dependence on agrochemical and energy inputs, in which ecological interactions and synergy among biological components provide the mechanisms for the systems to drive their own nutrient and water cycling and biomass production functions
- The mix of functional groups partially determines agroecosystem resilience, the desirable ability of a given ecosystem to recover its functions after a disturbance such as harvest fire, flood; compaction and tillage and diseases in aquaculture.
- The importance of diversity for the "health" of the ecosystem is apparent when organisms within a functional group are complementary and contribute to different phases of a process, e.g. decomposition of different components of soil organic matter, or they perform under diverse environmental conditions.
- This means that an effective management of the agroecosystem requires a deep knowledge of the ecological processes, the functions and roles of individual organisms and their synergies and potential antagonistic effects.

Ecosystem Services - (Millennium Ecosystem Assessment Program, 2005; FAO, 2016)

- Ecosystem services are "the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfill human life".
- The most common categories of ecosystem services include:
  - regulating services: benefits obtained from the regulation of ecosystem processes (climate regulation, water purification, pollination, pest control, etc)
  - supporting services: services that support the deliver of other services allowing them to continue the supply of regulating and provisioning services (soil formation, habitat provision)
  - provisioning services: goods and physical products from an ecosystem (food, fuel, fiber, wood, genetic resources, medicines, etc)
  - cultural services: non-material benefits that people derive from ecosystems (spiritual enrichment, recreational values, etc.)

Wild biodiversity and natural habitats in agroecosystems - (FAO, 2019; Thrupp, 2000; Tscharntke et al., 2005; Donald and Evans, 2006; Gardner et al., 2009; Stoate et al., 2009; Heller and Zavaleta, 2009)

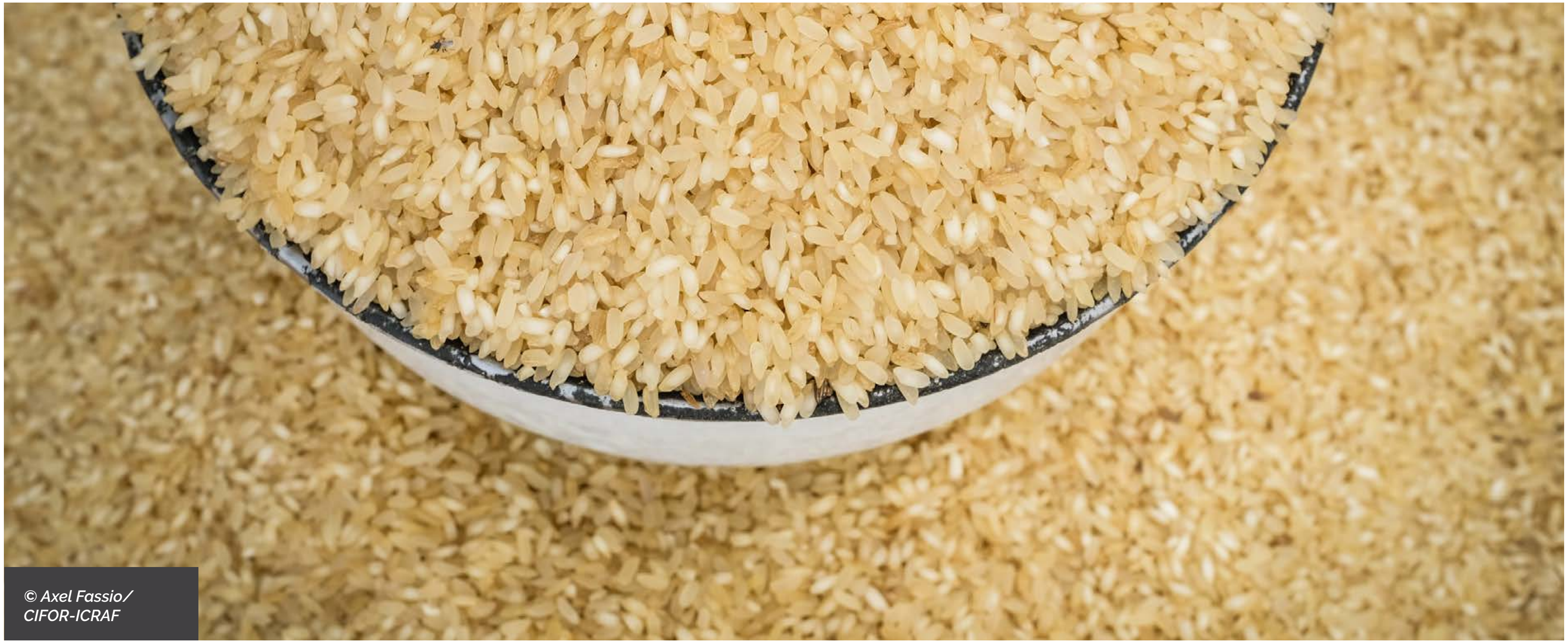
- Agricultural lands are a habitat for species and varieties, cultivated or otherwise, used by humans (agrobiodiversity, including agricultural species and beneficial species), to support food production
- A number of plants within or around traditional cropping systems are wild or weedy relatives of crop plants. The ecological amplitudes of wild relatives may exceed those of the crops derived from or otherwise related to them, a feature exploited by plant breeders to enhance the resistance or adaptive range of crops. Keeping wild relatives within the farm allows for gene flow between both the wild relatives and the crop.
- Agricultural land may also act as habitat for wild biodiversity for those species that use agricultural landscapes to fulfill all or part of their niche requirements, as well as strictly forest-dwelling species that use the agricultural matrix to disperse between forest fragments .
- There are two kinds of connectivity: structural and functional. Structurally connected ecosystems flow naturally into one another with no gaps between them, while functionally connected ecosystems are tactically used by flora and fauna to survive, often documented by GPS tagging and satellite mapping.
- Well-managed productive agricultural landscapes that include developed, semi-natural and natural land, such as woodlots, wetlands and forest fragments are "permeable" to the widespread movement of species; these islands of natural habitat and refuges provide the stepping-stones between natural ecosystems. In agricultural landscapes, flying insects and birds are the most adept at getting from one habitat to another, followed by mammals and reptiles that can move long distances quickly. Slow-moving crawling animals will not easily cross large areas of cropland. Some plants have seeds that travel or are carried long-distance, but many plants including many trees are likely to be stuck.
- Some species, especially large animals and slow-spreading plants need properly designed and managed "linkage zones" that allow movement between areas of high conservation value. Linkage zones that cross agricultural landscapes require careful habitat protection and planned land use to prevent conflict between land users and animals. For example, elephant movement in East Africa requires connectivity across large areas of land, and as ancient migration routes become increasingly fenced and cultivated, human-wildlife conflict is increasing.
- "Wildlife corridors" support animal migration, and consist of protected pathways and remaining habitat patches. They are often set up to facilitate the movement of specific species between protected areas, but best practice suggests that corridors should not be established for single species (and not only "charismatic megafauna"). Wildlife corridors usually have to cross agricultural landscapes and careful planning and management are needed to prevent competition between humans and wildlife.

Managing Functional Biodiversity - two examples - (Khan et al., 1998; Altieri, 2004)

- Push and pull systems:
  - Push and pull systems are a great example of how adding functional groups can be used for biological pest control. Cereals, which include maize, sorghum, millet and rice, are the main staple and cash crops for millions of small-scale farmers in most of sub Saharan Africa (SSA). However, their production is hugely constrained by insect pests, notably stem borers, the parasitic weed known as striga and poor soil fertility. Insect communities can be stabilized by re-introducing plants that either support natural enemies and/or directly inhibit pest attack. An example is the push–pull system developed at the International Center of Insect Physiology and Ecology to control lepidopteran stem borers in Africa. This system uses Napier grass (Penisetum purpureum) and Sudan grass (Sorghum vulgare) along the borders of maize fields to attract stem borers

away (the "pull"), as well molasses grass (Melinis minutiflora) and silverleaf (Desmodium uncinatum) intercropped with the maize to repel them (the "push") (Khan et al. 1998). Border grasses also increase the parasitization of stemborers by the wasp Cotesia semamiae, and are important fodder plants. The leguminous silverleaf (Desmodium uncinatum) suppresses parasitic witchweed (Striga sp) by a factor of 40 when compared to a maize monocrop. Desmodium's nitrogen-fixing ability increases soil fertility, and it is also an excellent forage (Altieri, 2004).

- Multi-trophic aquaculture:
  - Multi-trophic aquaculture, or IMTA, where two or more organisms are farmed together. In IMTA, multiple aquatic species from different trophic levels are farmed in an integrated fashion to improve efficiency, reduce waste, and provide ecosystem services, such as bio-remediation. Species at the lower trophic level (usually plants or invertebrates) use waste products such as feces and uneaten feed from the higher trophic species (typically finfish), as nutrients. The lower trophic species can then be harvested in addition to the fish to give the farmer more revenue, or even to be fed back to the fish (Chopin et al., 2012).



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LEARNING OBJECTIVE 2 - TOPIC 1

Introduction
Learning Objective 1
Learning Objective 2
Learning Objective 3

SUSTAINABLE AND BIODIVERSITY-FRIENDLY AGRICULTURE

2.2: Identify and analyze sustainable and biodiversity-friendly agricultural practices and approaches

2.2.1: From uniformity to diversity

SYNCHRONOUS CONTENT

TOPIC BREAKDOWN:

1. From uniform to diverse production systems
2. Key messages from IPES

ASYNCHRONOUS CONTENT

ASYNCHRONOUS READING:

- From uniformity to diversity
- Building a common vision for sustainable food and agriculture

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From Uniform to Diverse production systems - (IPES-Food, 2016)

- Agriculture around the world is the result of multifaceted interactions between ecology, weather and management systems and practices used by culturally diverse peoples. As a result land and water resources are used for production in multiple ways and interdependent with local knowledge and culture.
- Identifying and analyzing biodiversity-friendly and resilient agricultural approaches and practices can be done by understanding the agricultural system in terms of productivity, environmental, socio-economic, and nutrition and health outcomes.
- Productivity outcomes include: yield; agro-ecosystem resilience; pest management through biodiversity.
- Environmental outcomes include: greenhouse gas emissions and resource efficiency; water efficiency and usage; wild biodiversity; bundles of ecosystem services; landscape heterogeneity
- Socio-economic outcomes include: income and livelihoods; knowledge, autonomy and capacity to adapt; employment
- Nutrition and health outcomes include: dietary diversity; toxicity, nutrients and beneficial compounds

Key Messages from IPES - (IPES-Food, 2016)

- "What is required is a fundamentally different model of agriculture based on diversifying farms and farming [production] landscapes, replacing chemical inputs, optimizing biodiversity and stimulating interactions between different species, as part of holistic strategies to build long-term fertility, healthy agro-ecosystems and secure livelihoods, i.e. 'diversified agroecological systems'.
- There is growing evidence that these systems keep carbon in the ground, support bio-
- diversity, rebuild soil fertility and sustain yields over time, providing a basis for secure farm livelihoods.
- Data shows that these systems can compete with industrial agriculture in terms of total
- outputs, performing particularly strongly under environmental stress, and delivering production increases in the places where additional food is desperately needed. Diversified agroecological systems can also pave the way for diverse diets and improved health.
- Change is already happening. Industrial food systems are being challenged on multiple
- fronts, from new forms of cooperation and knowledge-creation to the development of
- new market relationships that bypass conventional retail circuits.
- Political incentives must be shifted in order for these alternatives to emerge beyond the margins. A series of modest steps can collectively shift the center of gravity in food systems."

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LEARNING OBJECTIVE 2 - TOPIC 2

CHALLENGES AND OPPORTUNITIES FOR SUSTAINABLE FOOD AND AGRICULTURE

2.2: Identify and analyze sustainable and biodiversity-friendly agricultural practices and approaches

SYNCHRONOUS CONTENT

TOPIC BREAKDOWN:

1. Sustainable Agriculture - A Recap
2. Biodiversity-friendly practices and appraoches
3. Sustainable Forest Management
4. Ecosystem approach to fisheries and aquaculture
5. Diversified agroecological system
6. The 10 elements of agroecology
7. Agroforestry systems

ASYNCHRONOUS CONTENT

VIDEOS:

- Pre-Session: The 10 elements of agroecology

ASYNCHRONOUS READING:

- Mainstreaming Biodiversity in Forestry
- The 10 Elements of Agroecology

2.2.2: Sustainable and biodiversity-friendly practices and approaches.

- Agroforestry: A Primer - Design and management principles for people and the environment
- Ecosystem approach to fisheries and aquaculture: Implementing the FAO code of coduct for responsible fisheries

IMAGES:

- The tree of sustainable development (from Staples and Funge-Smith pg. 7)

ASSIGNMENT

Beginning in groups, learners should develop their own framework for analyzing agricultural systems. The framework should consider the evidence needed, the context and production systems, the systems performance, and participatory approaches for interpretation.

SUSTAINABLE AND BIODIVERSITY-FRIENDLY AGRICULTURE

2.2: Identify and analyze sustainable and biodiversity-friendly agricultural practices and approaches

2.2.2: Sustainable and biodiversity-friendly practices and approaches.

Sustainable Agriculture: A Recap - (FAO 1988; FAO 2017; FAO 2016; CBD, 2022)

- FAO defines sustainable agriculture as "the management and conservation of the natural resource base, and the orientation of technological change in such a manner as to ensure the attainment of continued satisfaction of human needs for present and future generations. Sustainable agriculture conserves land, water, and plant and animal genetic resources, and is environmentally non-degrading, technically appropriate, economically viable and socially acceptable.
- There are five elements of sustainability in food and agriculture:
  - Improving efficiency in the use of resources;
  - Conserving, protecting and enhancing natural ecosystems;
  - Protecting and improving rural livelihoods, equity and social well-being;
  - Enhancing the resilience of people, communities and ecosystems; and
  - Promoting responsible and effective governance mechanisms across natural and human systems.
- Transitioning to sustainable agriculture should recognize the role of biodiversity, including pollinators, pest and disease control organisms, soil biodiversity and genetic diversity, as well as diversity in the landscape, for productive and resilient agriculture that makes efficient use of land, water and other resources.

Biodiversity-friendly Practices and Approaches - (FAO, 2019)

- Biodiversity-friendly practices "refer to production and to practices and approaches that promote the conservation and sustainable use of biodiversity"
- The adoption of biodiversity friendly practices and approaches in crop and livestock production, forestry, fisheries and aquaculture include examples implemented at ecosystem and landscapes scales; farm levels; genetic level; terrestrial and aquatic ecosystems; food processing and agro-industrial processes. Examples of such practices and approaches include ecosystem approach to fisheries and aquaculture, landscape or seascape approaches, sustainable forest management, agroecology, restoration practices, diversification approaches, polyculture, aquaponics, home gardens, agroforestry, agroecology, organic agriculture, sustainable soil management, integrated pest management, pollination management, domestication.

Sustainable Forest Management - (FAO, 2022; FAO, 2020; Shono and Jonsson, 2022; Harrison et al., 2022)

- The results of Global Forest Resources Assessment 2020 of FAO indicate that considerable progress has been made towards enabling and implementing SFM globally
- Sustainable forest management is gaining traction globally and considerable progress has been made towards enabling and implementing it.
- "Sustainable forest management seeks to balance ecological, sociocultural and economic interests, and thereby manage forests according to the principles of sustainable development" (FAO, 2022)
- "It recognizes that forests provide multiple uses and that different benefits accrue to different stakeholders" (Sabogal et al., 2013). Hence, under SFM, forest management plans are developed through broad 8 Mainstreaming biodiversity in forestry stakeholder consultation to address potential trade-offs, especially between economic values, local livelihood needs and long-term ecological sustainability.

Introduction

Learning Objective 1

2.2.2 Content

Learning Objective 3

- Since the Rio de Janeiro Earth Summit (1992) Forest Principles, the Non-legally Binding Instrument on All Types of Forest is the main strong international commitment to sustainable forest management. However, sustainable forest management may be guided by national laws and regulations, or forest management certification standards. There are several international guiding criteria and indicator frameworks (Montreal Process and International Timber Trade Organization) as well as national and local frameworks.
- In 2004 the CBD recognised sustainable forest management as an ecosystem approach to forest ecosystems, with parallels with landscape approaches. "It is a vehicle for defining stakeholder objectives and negotiating conflicting use rights, including by way of fiscal transfers (e.g. PES schemes). It emphasizes the management of biodiversity for long-term sustainability and recognizes the importance of maintaining ecosystem functions and interactions across a range of spatial scales." (Harrison et al., 2022).
- The High Conservation Value approach is often used for biodiversity management in some forest certification schemes.
- Adaptive management and monitoring are important to track outcomes, identify problems and iteratively implement remedial measures.

Ecosystem Approach to Fisheries and Aquaculture - (Chopin et al., 2012; Staples and Funge-Smith, 2009)

- "An Ecosystem Approach to Fisheries (or Aquaculture) strives to balance diverse societal objectives, by taking account of the knowledge and uncertainties about biotic, abiotic and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecologically meaningful boundaries. (FAO, 2003)."
- Ecosystem approaches to fisheries therefore adopt a social-ecological system framework where humans are a part of the ecosystem, and interventions target both human and ecological well-being. The image further divides these targets into related policy objectives and issues.
- There are several approaches to guide fisheries and aquaculture management. They differ in terms of the balance between ecological well-being and human well-being, and the sectoral approach. Examples include: ecosystem approach to fisheries, and ecosystem-based fisheries management; ecosystem approach to aquaculture, and ecosystem-based aquaculture management; integrated coastal management; sustainable livelihoods approach; wealth-based fisheries management; large marine ecosystem.
- The ecosystem-approach to fisheries aims to promote sustainable development within ecological boundaries, considering the socio-economic benefits. The challenge lies in reaching a balance between conservation and the sustainable use of fishery resources, and across socio-economic and ecological objectives in management. Co-management and stakeholder engagement and the scale of interventions are therefore important aspects to implementing ecosystem-approaches to fisheries.
- Ecosystem approaches to aquaculture are similar, and should be guided by three key principles:
  - "Aquaculture should be developed in the context of ecosystem functions and services with no degradation of these beyond their resilience capacity.
  - Aquaculture should improve human-well being and equity for all relevant stakeholders.
  - Aquaculture should be developed in the context of (and integrated with) other relevant sectors. Three scales/levels of EAA application have been identified, namely the farm, the water body and its watershed/aquaculture zone, and the global, market-trade scale." (Staples and Funge-Smith, 2009).

SUSTAINABLE AND BIODIVERSITY-FRIENDLY AGRICULTURE

2.2: Identify and analyze sustainable and biodiversity-friendly agricultural practices and approaches

2.2.2: Sustainable and biodiversity-friendly practices and approaches.

Diversified Agroecological Systems - (FAO, 2018; IPES-Food, 2016)

- "Agroecology is an integrated approach that simultaneously applies ecological and social concepts and principles to the design and management of food and agricultural systems. It seeks to optimize the interactions between plants, animals, humans and the environment while taking into consideration the social aspects that need to be addressed for a sustainable and fair food system"
- Diversification means that there are multiple sources of production maintained at any one time. It also means that there is variety in the produce across landscapes over any given period of time.
- Some of the key characteristics of a truly diverse system could look like this:
    - Temporal and spatial diversification - for example, crop rotation, and intercropping, respectively. These should be carried out at all levels up to the overall landscape level.
    - The use of less uniform species, including those which are locally-adapted. The use of these species should be based on any number of uses and criteria, encompassing traditional use-cases, culture, taste, productivity, etc.
    - Low external inputs - which suggests that waste should be recycled, and concepts of circular value regeneration can and should be applied.
- Because such systems are designed to create a stable agro-ecosystem over a long-term, the harm done by aiming to maximize short-term yields of a specific crop is negated.
- Furthermore, a biodiverse agro-ecosystem can bring resilience in a number of ways - such as in pest management, through the synergies that exist within different species.
- More important than this, diverse agroecosystems aim to sustain wild biodiversity in surrounding ecosystems, because these areas often provide complementary habitats.

The 10 elements of agroecology - (FAO, 2018)

- Diversity: "diversification is key to agroecological transitions to ensure food security and nutrition while conserving, protecting and enhancing natural resources"
- Co-creation and sharing of knowledge: "agricultural innovations respond better to local challenges when they are co-created through participatory processes"
- Synergies: "building synergies enhances key functions across food systems, supporting production and multiple ecosystem services"
- Efficiency: "innovative agroecological practices produce more using less external resources"
- Recycling: "more recycling means agricultural production with lower economic and environmental costs"
- Resilience: " enhanced resilience of people, communities and ecosystems is key to sustainable food and agricultural systems"
- Human and social values: "protecting and improving rural livelihoods, equity and social well-being is essential for sustainable food and agricultural systems"
- Culture and food traditions: "by supporting healthy, diversified and culturally appropriate diets, agroecology contributes to food security and nutrition while maintaining the health of ecosystems"
- Responsible governance: "sustainable food and agriculture requires responsible and effective governance mechanisms at different scales - from local

to nation to global"

- Circular and solidarity economy: "circular and solidarity economies that reconnect producers and consumers provide innovative solutions for living within our planetary boundaries while ensuring the social foundation for inclusive and sustainable development

Agroforestry Systems - (Gassner et al., 2022)

- Agroforestry systems are designed so that the components (crops, trees and livestock) work together in a complementary and synergistic way. Basic levels of synergy can be achieved even in simple agroforestry systems in which one crop or a few crops dominate, and trees and livestock are added to provide additional products for the household, income and ecosystem services. To achieve synergy, trees, crops and livestock are arranged to make the best use of nutrients, water and energy within systems, while managing the competition for them. Full synergy is achieved when the productivity from an agroforestry system is greater than it would be if the components were established in separate monocultures. These agroforestry systems are 'more than the sum of their parts'. This is usually achieved by arranging trees, crops and animals in such a way that they have maximum interaction.
- Competition in these systems is controlled by carefully selecting species that support each other. For example, in successional systems, resource sharing between different species is optimized by planting species with different life cycles, which succeed each other over time. These systems are designed to mimic the nutrient and water flows in natural ecosystems, such as forests, and minimize the need to bring fertilizer in from outside the system.

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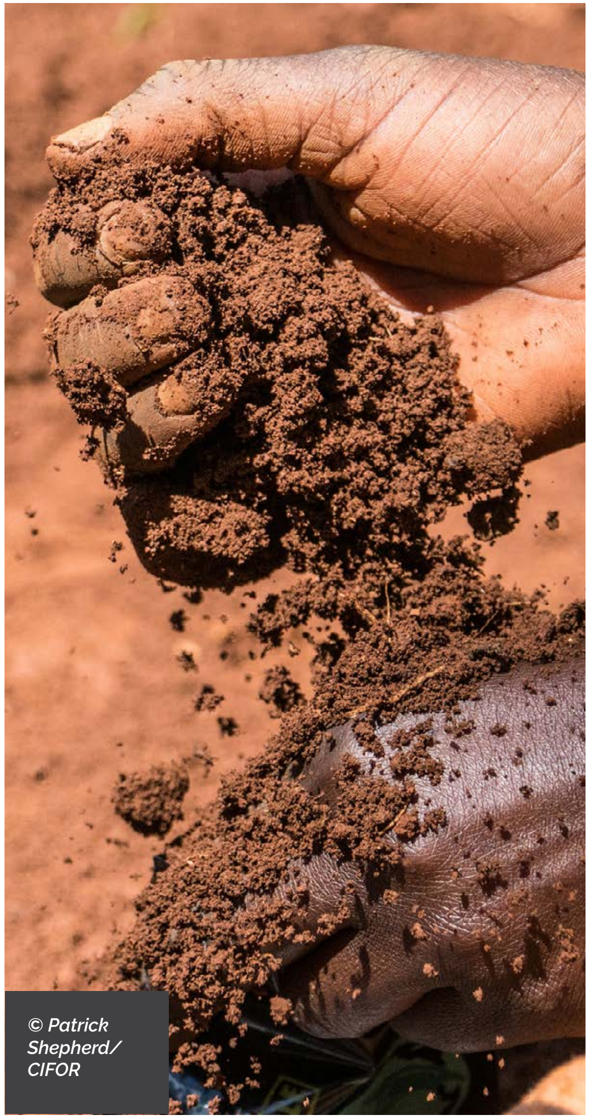

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LEARNING OBJECTIVE 3 - TOPIC 1

AN INTEGRATED APPROACH TO AGRICULTURE

2.3: Recognize and apply an integrated approach to agriculture across landscapes

SYNCHRONOUS CONTENT

TOPIC BREAKDOWN:

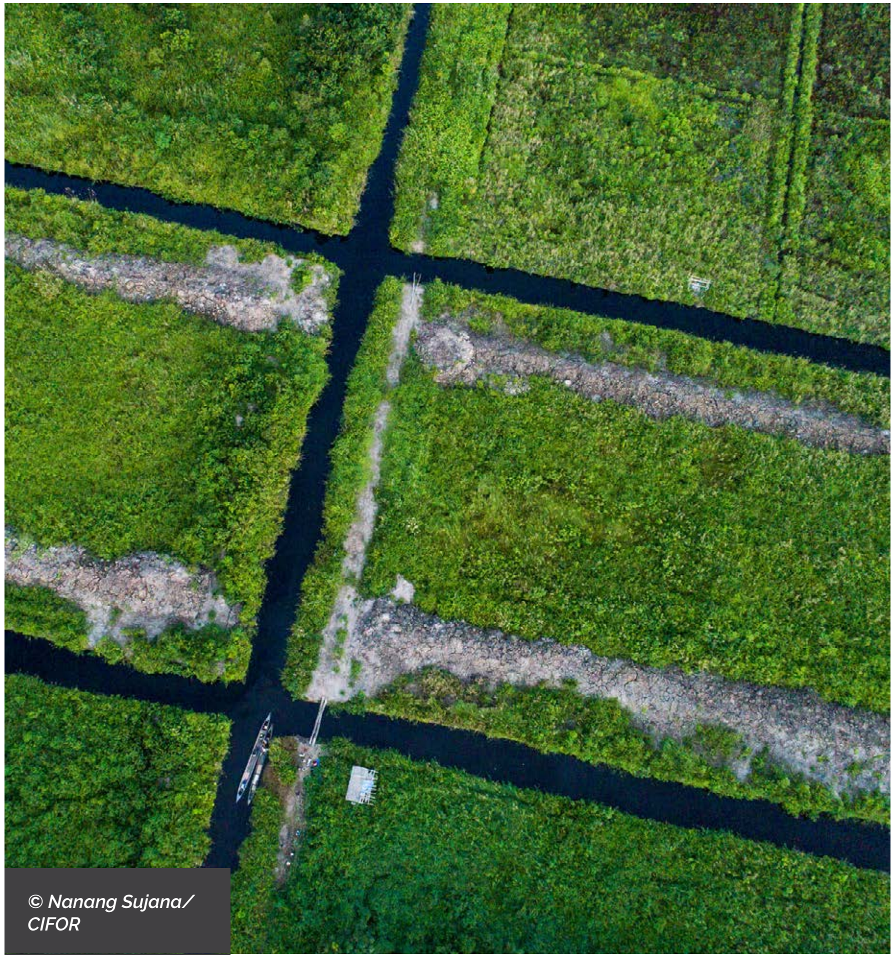
1. Integrated approaches in production landscapes
2. Agricultural landscapes and biodiversity
3. Mosaic of agriculture and protected areas in landscapes

ASYNCHRONOUS CONTENT

VIDEOS:

- Pre-Session: Revolutionlizing food systems in support of the post-2020 framework

2.3.1: Managing for multi-funcitonality



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Integrated approaches in production landscape

- Well-managed landscapes are able to provide multiple services that could contribute toward shaping regional and local identity, combine traditional knowledge with modern techniques of sustainable land-use, maintain or enhance natural values in the landscape, and provide the basis for the formation of future landscapes.
- Integrated approaches in production landscapes should build on and synergize the multi-functionality while recognizing that they are shaped by long term human interactions with nature. Therefore, they are initiated by bringing together diverse stakeholders for long-term collaboration and co-management. This results in the potential to achieve multiple objectives related to resource management and environmental goals while bringing about transformation over time, space and levels.
- There are several key considerations when implementing an integrated approach in production landscapes. These include: continuous assessment of trade-offs and synergies; building a common understanding of the landscape issues; multi-institutional cooperation; benefit-sharing and incentives; capacity building; broad stakeholder engagement.

Agricultural Landscapes and Biodiversity - (Borah et al., 2020; Reed et al., 2015; Gassner and Dobie, 2022; Garibaldi et al., 2020)

- Landscape approaches are an ideal framework to ensure equitable and sustainable land-use, and thus biodiversity conservation not only because they have roots in conservation and landscape ecology, but they focus strongly on reconciling tradeoffs between conservation and development by integrating policy and practice across landscapes.
- The CBD, which has traditionally seen agriculture as a major threat to biodiversity, must understand that food production systems must not be discarded, but instead harnessed as a tool for biodiversity conservation.
- The positive environmental, productivity, socio-economic, and nutrition and health benefits resulting from biodiverse agriculture on individual farms can be multiplied greatly when they are applied holistically across agricultural landscapes. Biodiversity must therefore be integrated into agricultural planning and management at landscape levels.
- Beyond our efforts to preserve natural areas, to restore them, and to design ways to combine them with agriculture sustainably, we will need to deploy additional strategies to achieve the greatest amount of biodiversity conservation possible.

Mosaic of agriculture and protected areas in landscapes - (Gassner and Dobie, 2022; Garibaldi et al., 2020; Hilty, 2020)

- Mosaics of adjoining and connected agriculture and protected areas may contribute positively to wildlife and biodiversity. Many wild species have adapted to agricultural landscapes, but even strictly forest-dwelling species use patches of natural forest or grassland in agricultural areas, which scientists call 'natural habitat in working landscapes'.
- Forest patches, grassland or natural habitat along streams and rivers allow wild species to move between protected areas. Flying insects and birds are the most adept at this movement, followed by mammals and reptiles that can travel long distances quickly. Animals that crawl slowly, however, are at a disadvantage. Similarly, some plants have seeds that travel or are carried long distances, but seeds of others, including many trees, disperse with greater difficulty in fragmented habitats.

- With thoughtful planning and management, however, farmland and areas of high conservation value can be connected through 'linkage zones', benefiting animals and plants. These corridors can allow large animals and slow-spreading plants to move across farmland from one protected area to another. Careful planning of land use and habitat protection can also reduce conflict between humans and animals in places like East Africa, where elephant migration routes are increasingly blocked by fences and farms.

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LEARNING OBJECTIVE 3 - TOPIC 2

AN INTEGRATED APPROACH TO AGRICULTURE

2.3: Recognize and apply an integrated approach to agriculture across landscapes

SYNCHRONOUS CONTENT

TOPIC BREAKDOWN:

1. Integrated approaches for a healthy planet
2. Land-sharing or Land-sparing

ASYNCHRONOUS CONTENT

ASYNCHRONOUS READING:

- Sharing vs sparing: the great debate over how to protect nature
- Linked sustainability challenges and trade-offs among fisheries, aquaculture and agriculture
- Half-earth or whole earth? Radical ideas for conservation, and their implications.

ASSIGNMENT

In the same groups as before, learners should identify spatial synergies between two to three sustainable and biodiversity-friendly practices and approaches, occurring within or between their landscapes.

2.3.2: Interated approaches for a healthy planet

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Integrated approach for a healthy planet - (Gassner & Dobie, 2022; CBD, 2021; Gassner et al., 2021; Dobie et al., 2021)

- Conservation scientists and experts who advise the CBD through its intergovernmental scientific advisory body stress that while “priority should be given to retaining existing natural ecosystems. … [t]he conservation and sustainable use of biodiversity is also important in areas beyond ‘natural’ ecosystems including in agricultural and urban environments. Such ‘managed’ ecosystems (those whose biotic composition is the result of deliberate manipulation by people) can provide important habitats, and contribute to habitat connectivity, for some species, as well as being essential for ecosystem functioning and services.”
- Global and regional framework’s need to take into account the large expanse of the planet and regions where people live and work the land.
- Agricultural ecosystems must be recognized, as the changes that are needed for agriculture to play its role in biodiversity conservation can only be achieved at a landscape level, where ecosystems can be managed for integrity, connectivity and the maintenance of ecosystem services.
- Reducing the management of biodiversity on farmland to a set of site-specific activities would eliminate countless opportunities for making agricultural landscapes biodiversity-friendly.
- Because of the amount of land dedicated to producing food, strategies to conserve biodiversity, such as protecting 30% of the planet’s surface, can only be achieved by incorporating agriculture into strategies and plans for protecting biodiversity. This will require the full participation of agricultural authorities, who are likely to continue to ignore biodiversity if agriculture is not included in global biodiversity policy.
- Global biodiversity policy matters. Governments set spending priorities on the basis of agreed policy, whether it is their own investment in biodiversity conservation or the aid budgets that rich donor countries set aside for supporting conservation in developing countries. Currently, agricultural ministries and authorities around the world focus their activities almost exclusively on increasing farming efficiency.
- Biodiversity conservation is often the remit solely of environment ministries and related authorities. Unless and until the importance of agricultural ecosystems to biodiversity conservation is recognized – and efforts are made to make agriculture part of the solution to the problem rather than the cause – we risk missing out on this vital element of biodiversity protection. The challenge of mainstreaming biodiversity into agriculture will remain beyond reach without full policy support, and that support must begin with the Convention of Biological Diversity and the new Global Biodiversity Framework.

Land-sharing or Land-sparing - (Kremen, 2015; Godfray et al., 2010; Godfray, 2015)

- “Conservation biologists are devoting an increasing amount of energy to debating whether land sparing (high-yielding agriculture on a small land footprint) or land sharing (low-yielding, wildlife-friendly agriculture on a larger land footprint) will promote better outcomes for local and global biodiversity. In turn, concerns are mounting about how to feed the world, given increasing demands for food … On the basis of my review, I suggest that the dichotomy of the land-sparing/land-sharing framework limits the realm of future possibilities to two, largely undesirable, options for conservation. Both large, protected regions and favorable surrounding matrices are needed to promote biodiversity conservation; they work synergistically and are not mutually exclusive. A "both-and" framing of large protected areas surrounded by a wildlife-friendly matrix suggests different research priorities from the "either-or" framing of sparing versus sharing. Furthermore, wildlife-friendly farming methods such as agroecology may be best adapted to provide food for the world's hungry people.” (Kremen, 2015)

- There has been much debate over the integration of sustainable intensification as a biodiversity-friendly and sustainable approach to agriculture. It is defined as "producing more from the same area of land while reducing negative environmental impacts and increasing contributions to natural capital and the flow of environmental services." (Godfray et al., 2010). However, major concerns have been raised, and some argue that it will only justify intensification, high-input and hi-tech agriculture, while being easily co-opted by industrial agriculture.

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December 2022

Global Landscapes Forum

The Global Landscapes Forum (GLF) is the world's largest knowledge-led platform on integrated land use, dedicated to achieving the Sustainable Development Goals and Paris Climate Agreement. The Forum takes a holistic approach to create sustainable landscapes that are productive, prosperous, equitable and resilient and considers five cohesive themes of food and livelihoods, landscape restoration, rights, finance and measuring progress. It is led by the Center for International Forestry Research and World Agroforestry (CIFOR-ICRAF), in collaboration with its co-founders UNEP and the World Bank and Charter Members.

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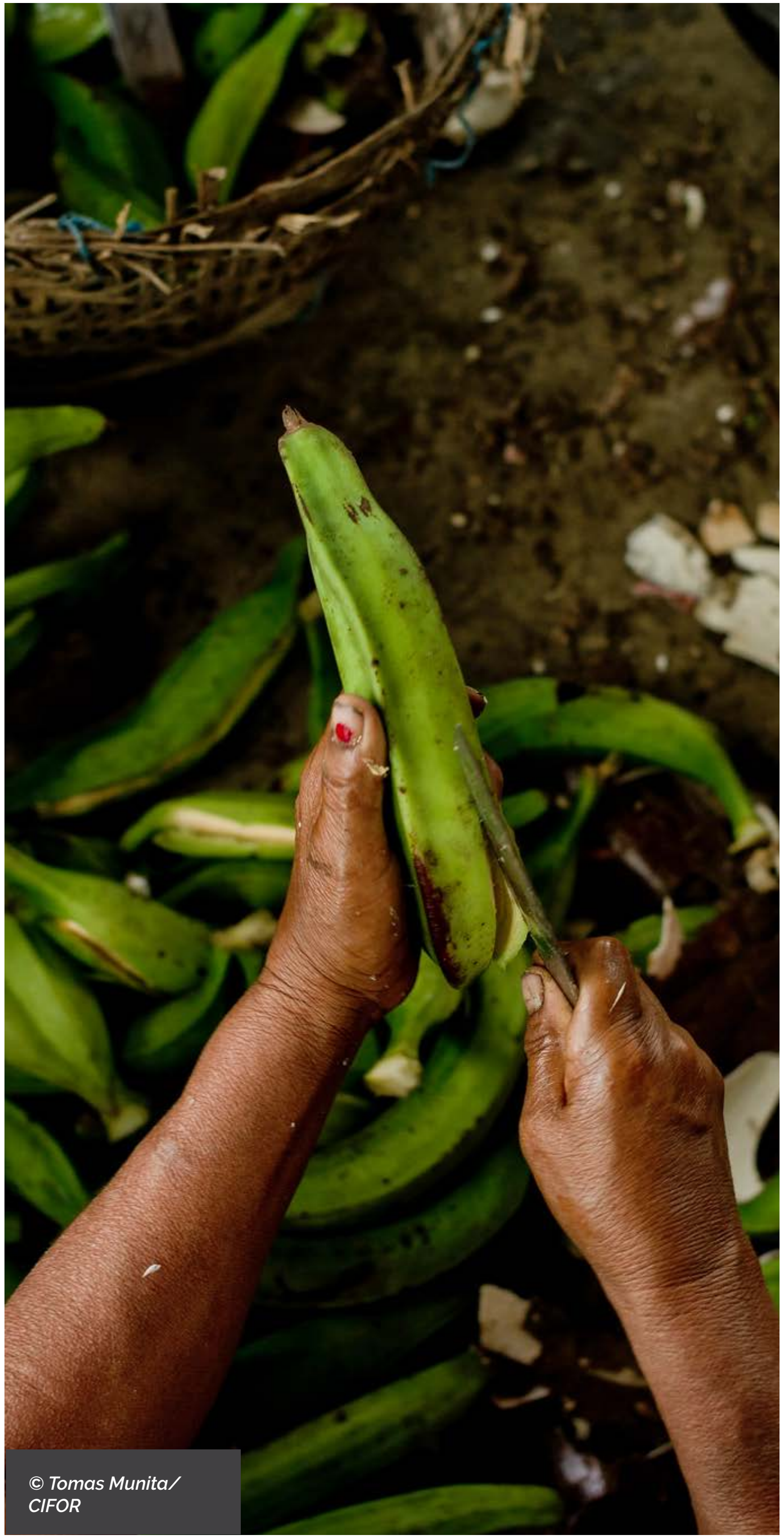

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