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Herb Power for Animal Health: From Tradition to Legislation

Sustainable practices in medicinal plants production and use

Module 4

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Session objectives

1. Define sustainability in the context of medicinal plants use.
2. Differentiate between production systems (*e.g.*, organic farming vs. conventional farming).
3. Outline the key aspects of sustainable medicinal plant production.
4. Define key terms related to sustainability (*e.g.*, biodiversity, ecosystem, cultural heritage, etc.)
5. List and explain methodologies to assess HVMP sustainability (*e.g.*, LCA, biodiversity assessment, etc.).

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Sustainability -

MP4V Training Course _ Module 4 | Present mode

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Eco friendly
Long term mindset
Natural
Wasteless
Responsible
Use of resources efficiently
Future
Organic
effective
Ecology
Yes "waste" can be applied
Horizon
Environmental
Fair
Efficacy
Long term
Rationalization
Durability
Multidisciplinary

Sustainability

- In 1987, the United Nations Brundtland Commission defined sustainability as “meeting the needs of the present without compromising the ability of future generations to meet their own needs”.
- In 2015, UN Member States translated their vision of sustainable development into a blueprint for achieving it: the 2030 Agenda for Sustainable Development

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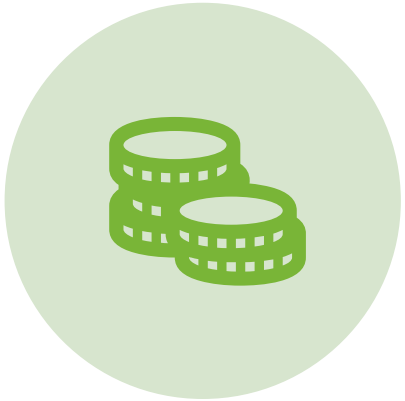
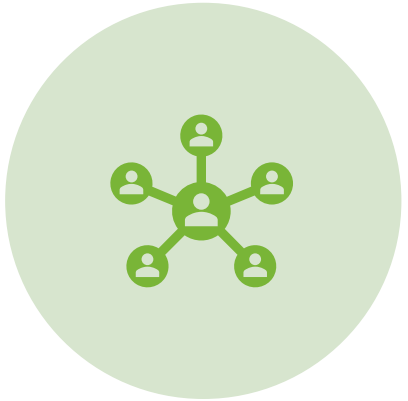
Sustainability



ECONOMIC

ENVIRONMENTAL



SOCIAL

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Sustainability – SDG 2030

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Sustainability – in HVMP

- Increasing interest and risk of overexploitation.
- Climate change, threats and endangered species.
- Endemic species.
- Link between bioactive compounds, bioactivities and abiotic factos.
- Possible health benefits and ecosystem services.

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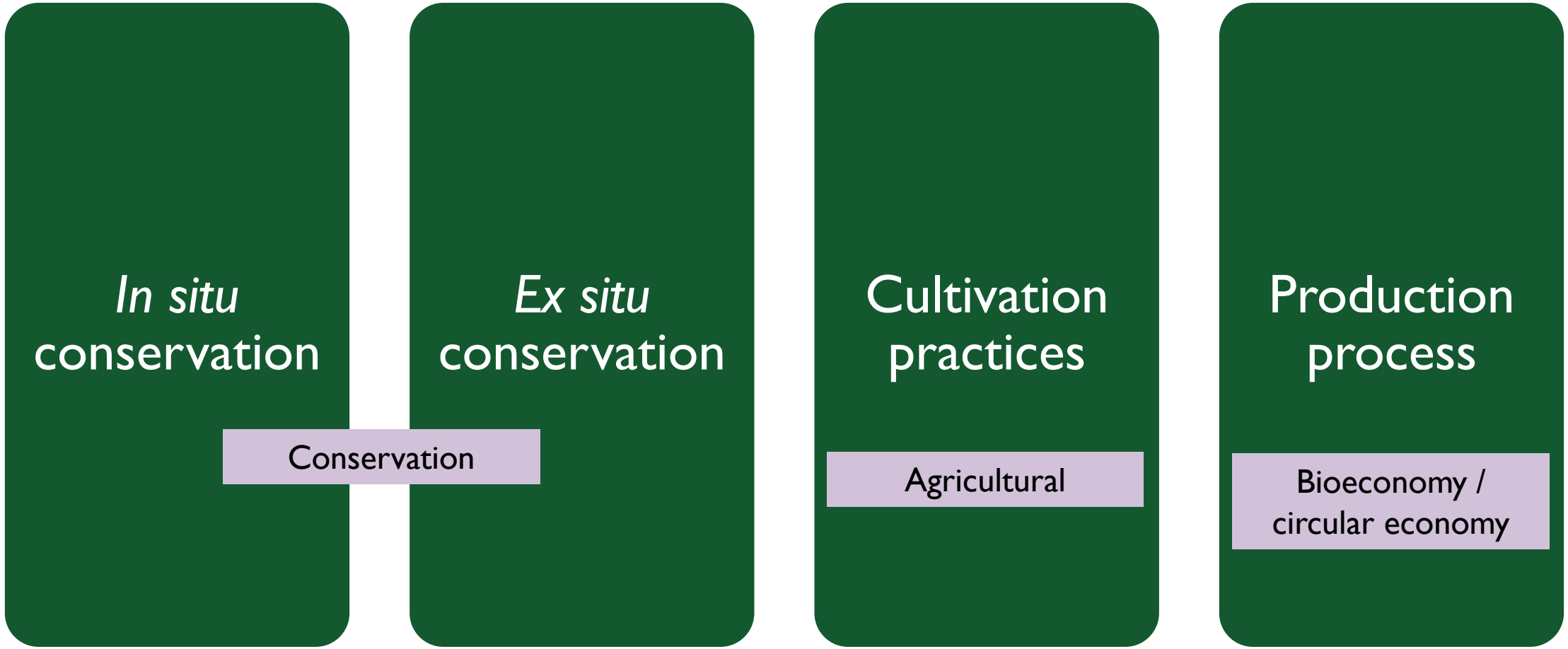
Sustainability – in HVMP



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Conservation

- Wild resources
- Ecosystem services
- More efficient
- Botanic gardens, seeds bank, wild nurseries, natural reserves

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Agricultural practices: Organic farming *vs*. Conventional agriculture

- Soil health and fertilisation
- Pollinators and ecosystem services
- Energy consumption
- Ecological and social impact
- Land use
- Genetic modification

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Group discussion – If we were launching our start-up

15 min

1. Discuss the benefits and limitations of organic vs conventional production.
2. The trainees divided into 2 groups, each of them needed to focus on 1 production system.

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Subjects	Characteristics and advantages of organic farming
Medicinal plants	To produce material in optimal quality and sufficient quantity
	To increase growth rate and biomass yield of medicinal plants
	To enhance the biosynthesis of efficacious substances
	To maintain the genetic diversity of medicinal plants
	To protect medicinal plants against pests and disease
Environmental effects	To prohibit the use of synthetic pesticides and fertilizers
	To promote sustainable use and proper care of production systems
	To enhance plant diversity and biotype conservation
	To protect wildlife habitats (e.g. micro-organisms, soil fora and fauna)
	To enhance soil rich in macro and microelements
	To conserve soil properties, fertility, productivity and system stability
	To use organic fertilizers and renewable resources to minimize all forms of pollution
Economic prospects	To increase market opportunity
	To maintain high market price
	To achieve optimal quality and economic returns
	To secure economic growth and social stability

Information from Rigby and Cáceres [59], Macilwain [60] and Suresh [61]

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Chen et al., 2016

Group discussion – If we were policymakers

15 min

1. Discuss the benefits and limitations of using medicinal plants to promote sustainability – the importance of legislation.
2. With focus on differences between organic vs conventional production.
3. Taking into consideration difference in legislation between countries and trade fluxes.

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Social importance – cultural heritage

- Medicinal plants are deeply rooted in cultural heritage, carrying centuries of traditional knowledge and healing practices.
- Ethical and sustainable medicinal plant use supports rural economies, traditional knowledge and equitable access to natural healthcare.
- Different traditional medicine systems (e.g., Ayurveda, Traditional Chinese Medicine).
- Indigenous communities hold vast ethnobotanical knowledge of plant-based remedies

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Ecosystem

- An ecosystem is a dynamic community of living organisms interacting with their physical environment (soil, water, air, and climate).
- Ecosystems provide essential services such as air purification, water regulation and soil fertility, supporting all life forms.
- Medicinal plants play a crucial role in ecosystems by contributing to biodiversity and offering health benefits.

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Ecosystems & medicinal plants

Medicinal plants depend on ecosystems – Soil quality, climate, and biodiversity influence the bioactive compound composition in plants.

Ecosystem services sustain medicinal plant growth – Pollination, nutrient cycling, and water availability ensure healthy plant development.

Ecosystem degradation threatens medicinal plants – Deforestation, pollution, and climate change lead to habitat loss and species extinction.

Conserving ecosystems ensures sustainable use – Protecting forests, wetlands, and grasslands preserves wild medicinal plant resources.

Medicinal plants contribute to ecosystem stability – Some species prevent soil erosion, support pollinators, and promote biodiversity restoration.

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Biodiversity

- The Convention on Biological Diversity (CBD) defines biodiversity as “The variability among living organisms from all sources, including, inter alia, terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems.”

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Biodiversity – in medicinal plants

- **Source of Medicinal Compounds**
  - Biodiversity ensures the continuous discovery of new phytochemicals with potential therapeutic properties.
- **Ecosystem Services & Sustainable Harvesting**
  - Medicinal plants contribute to pollination, soil health, and water regulation.
  - Sustainable wild harvesting and cultivation practices help preserve plant populations and prevent overexploitation.

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Biodiversity – medicinal plants

- Biodiversity is the foundation of medicinal plant resources, which supports global health, traditional knowledge conservation and ecological stability.
- Sustainable management of medicinal plant biodiversity is of utmost importance for drug development in the future and for ecosystem resilience.

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Biodiversity assessment

- The process of evaluating the variety, distribution, and abundance of species in an ecosystem. It helps track ecosystem health and guides conservation efforts.
- Biodiversity assessment is essential for sustainable harvesting of medicinal plants by ensuring that species are not overexploited, allowing for their regeneration. It helps identify and protect endangered species and supports the preservation of ecosystems. The assessment also highlights priority areas for conservation and provides data to adapt harvesting practices to environmental changes like climate change.
- By supporting evidence-based policies, biodiversity assessments promote responsible plant use and protect ecosystems.

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Biodiversity assessment - quantitative

- **Biodiversity indices:** Used to quantify the diversity of medicinal plant species in a defined area, helping assess the balance and sustainability of plant populations.
- **Field sampling:** Provides numerical data on the abundance and distribution of medicinal plants, helping determine their population sizes and trends over time.
- **Species richness**: Counts the total number of medicinal plant species in a region, aiding in understanding the richness of medicinal plant diversity.
- **Remote sensing & GIS:** Maps the distribution of medicinal plant species across large areas, especially useful in tracking habitat changes and the effects of environmental factors.

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Biodiversity assessment - qualitative

- **Interviews & local knowledge:** ethnobotanical surveys, gathering traditional knowledge from local communities about the use, cultivation and conservation of medicinal plants.
- **Ecological modeling:** Descriptive modeling to predict the future status of medicinal plant populations based on environmental changes and human impacts.
- **Citizen science:** Public participation (e.g. European Citizen Science Platform) in monitoring medicinal plant species providing qualitative insights into species distribution and trends.

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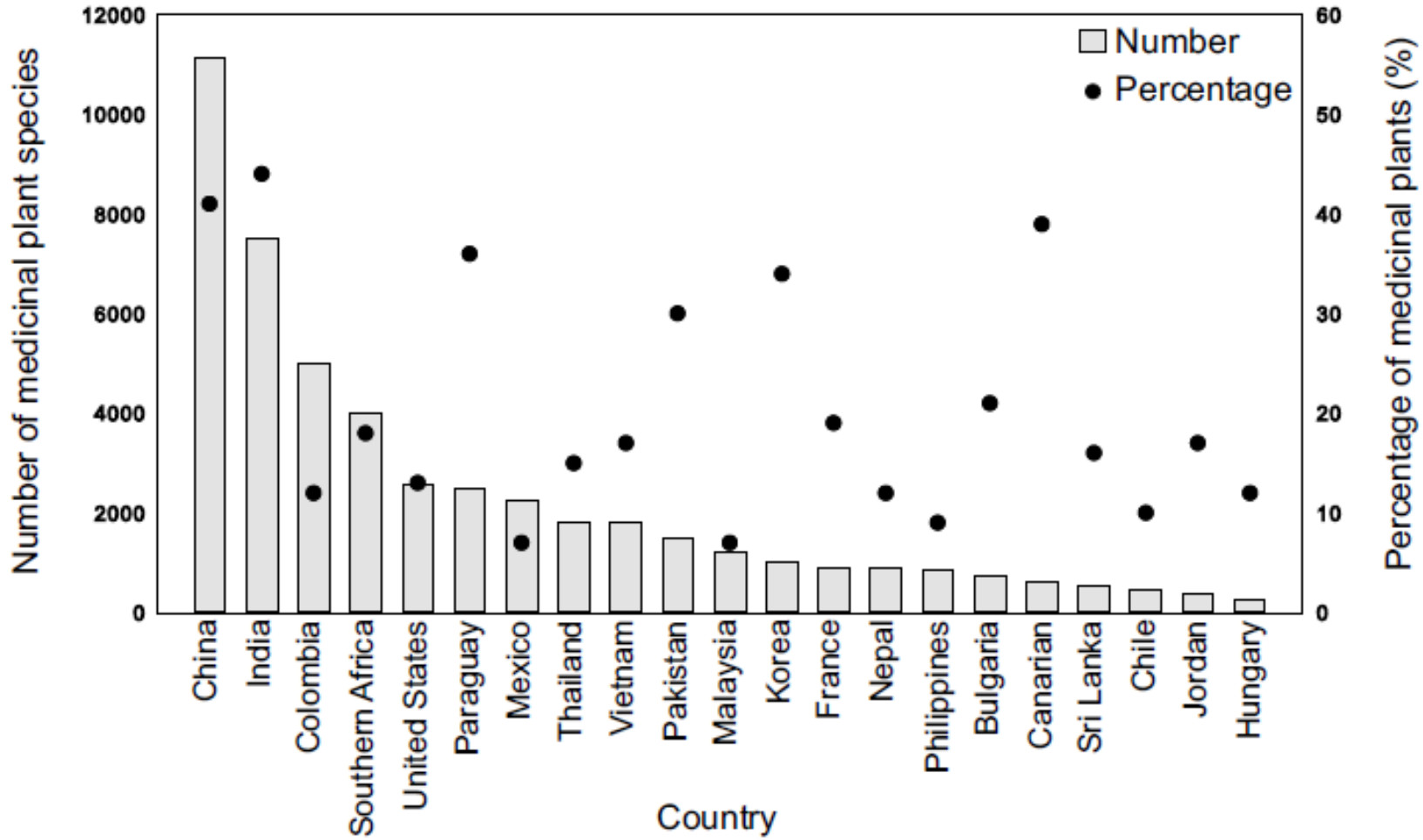

Fig. 2 Number and percentage of medicinal plant species in different countries. The *light bars* indicate the number of medicinal plant species, and the *dark dots* indicate the percentage of medicinal plants compared with the total number of plant species. Data sources from Rafieian-Kopaei [16], Hamilton [17], Marcy et al. [18], and Srujana et al. [19]

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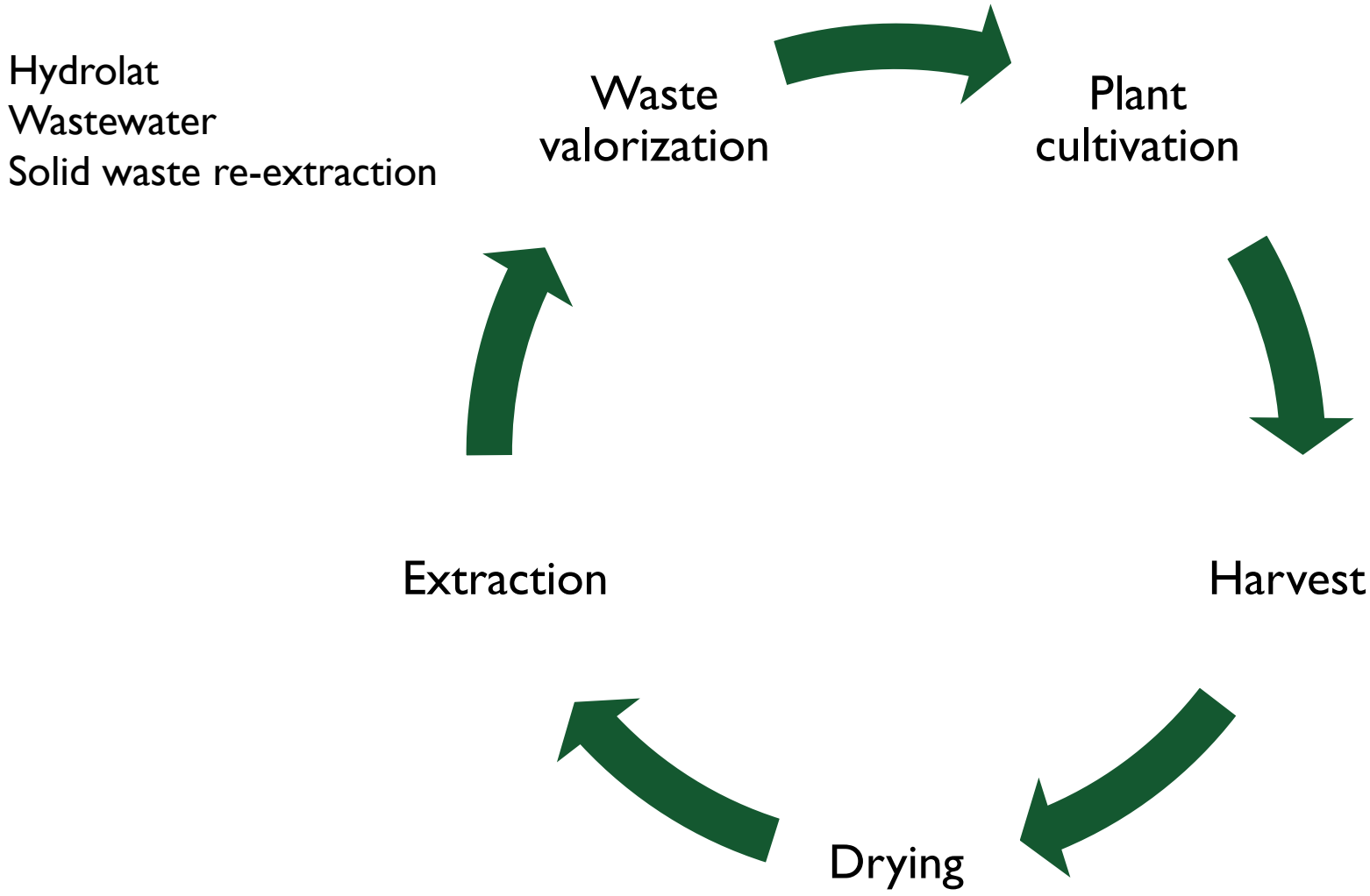
Chen et al., 2016

Production process - Methodologies to assess sustainability



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Methodologies to assess sustainability – LCA

1. **Cultivation Phase**
    1. **Land Use & Soil Health**: to assess the impact of farming methods on soil fertility, erosion and biodiversity.
    2. **Water Consumption**: Some medicinal plants require irrigation, and LCA evaluates water footprint and efficiency.
    3. **Fertilizers & Pesticides**: The assessment can compare synthetic inputs vs. organic/natural alternatives and their environmental effects.
2. **Harvesting & Processing**
    1. **Energy Consumption**: Drying, extraction, and processing often require significant energy. LCA helps compare traditional sun-drying vs. industrial drying methods.
    2. **Waste Management**: Residues from extraction (e.g., spent plant material, hydrolat) can be reused and LCA can evaluate their potential for circular economy applications.

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Methodologies to assess sustainability – LCA

3. **Transportation & Distribution**
    1. **Carbon Footprint**: LCA calculates emissions from transporting raw or processed medicinal plants, comparing local vs. global supply chains.
    2. **Packaging Impact**: Sustainable packaging (e.g., biodegradable materials) is analyzed to reduce environmental burdens.
4. **End-Use & Disposal**
    1. **Biodegradability & Pharmaceutical Waste**: Some plant-based medicinal products have better biodegradability than synthetic drugs, reducing pollution.
    2. **Post-consumer Waste**: LCA looks at the environmental fate of unused or expired medicinal products.

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Take-home messages

Sustainability is key – Medicinal plant production must balance environmental, economic, and social aspects.

Biodiversity matters – Protecting medicinal plant diversity ensures long-term availability of natural bioactive compounds and ecosystem health.

Farming choices impact sustainability – Organic supports biodiversity; conventional may have higher yields but environmental trade-offs.

Assessing sustainability is essential – Tools like LCA, biodiversity assessments and carbon credits help guide responsible production.

Policy & innovation drive change – Regulations, eco-friendly practices, multidisciplinary approaches and collaboration ensure a sustainable future for medicinal plants.

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A suggested planetary health perspective

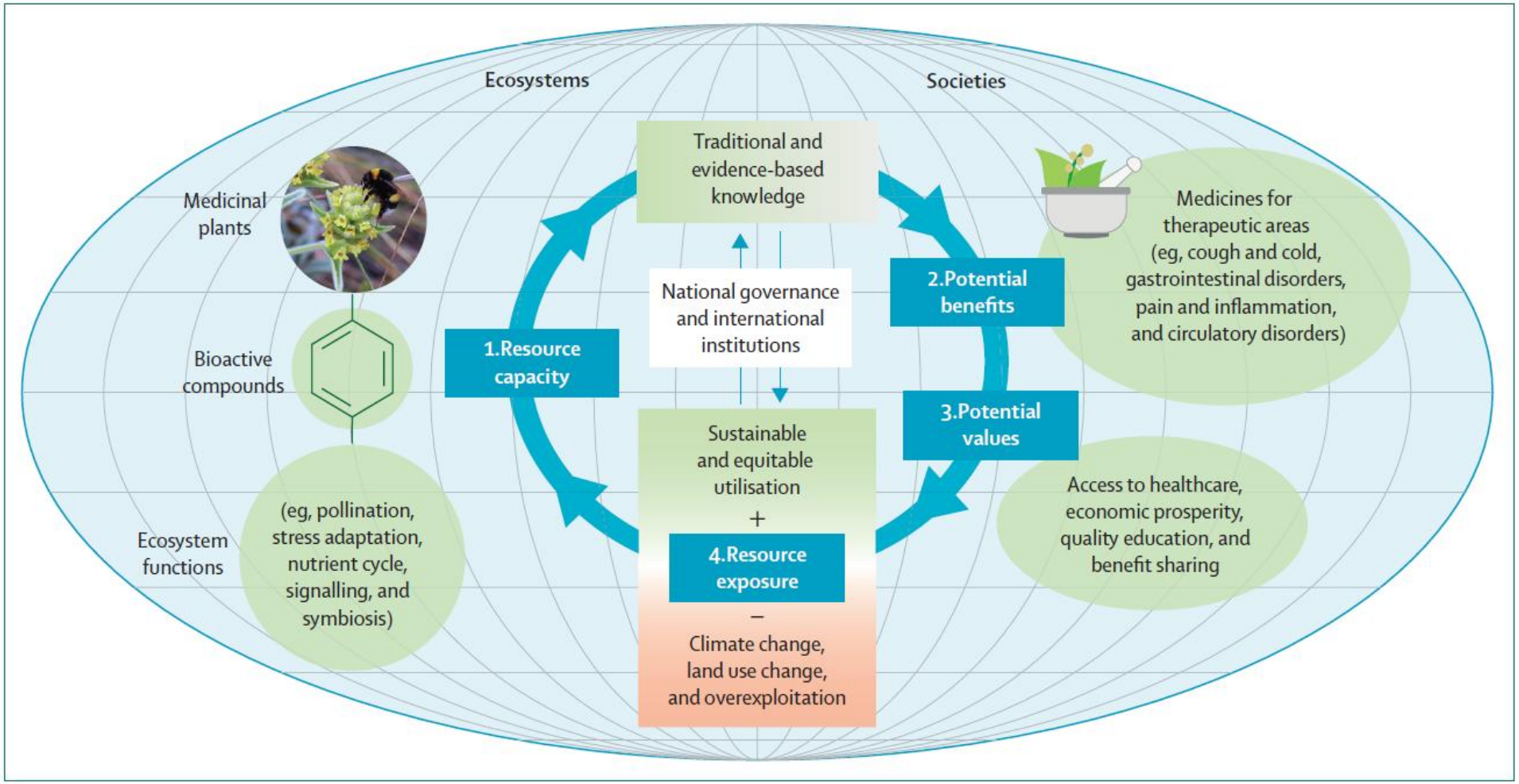

Figure 1: **A planetary health perspective of natural medicinal resources**
The proposed conceptual framework that links ecosystems and human societies via the interaction between traditional and evidence-based knowledge and the sustainable and equitable use of medicinal plants. Resource capacity, potential benefits, potential values, and resource exposure are the four elements that can be approximated by the proposed spatial indicators.

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Theodiris et al., 2023

Q&A

5 min

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