



Seeds as vectors of agrobiodiversity and environmental sustainability



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Quality Seed Production for Resilient and Sustainable Agriculture: 5 July 2024

Collaborators

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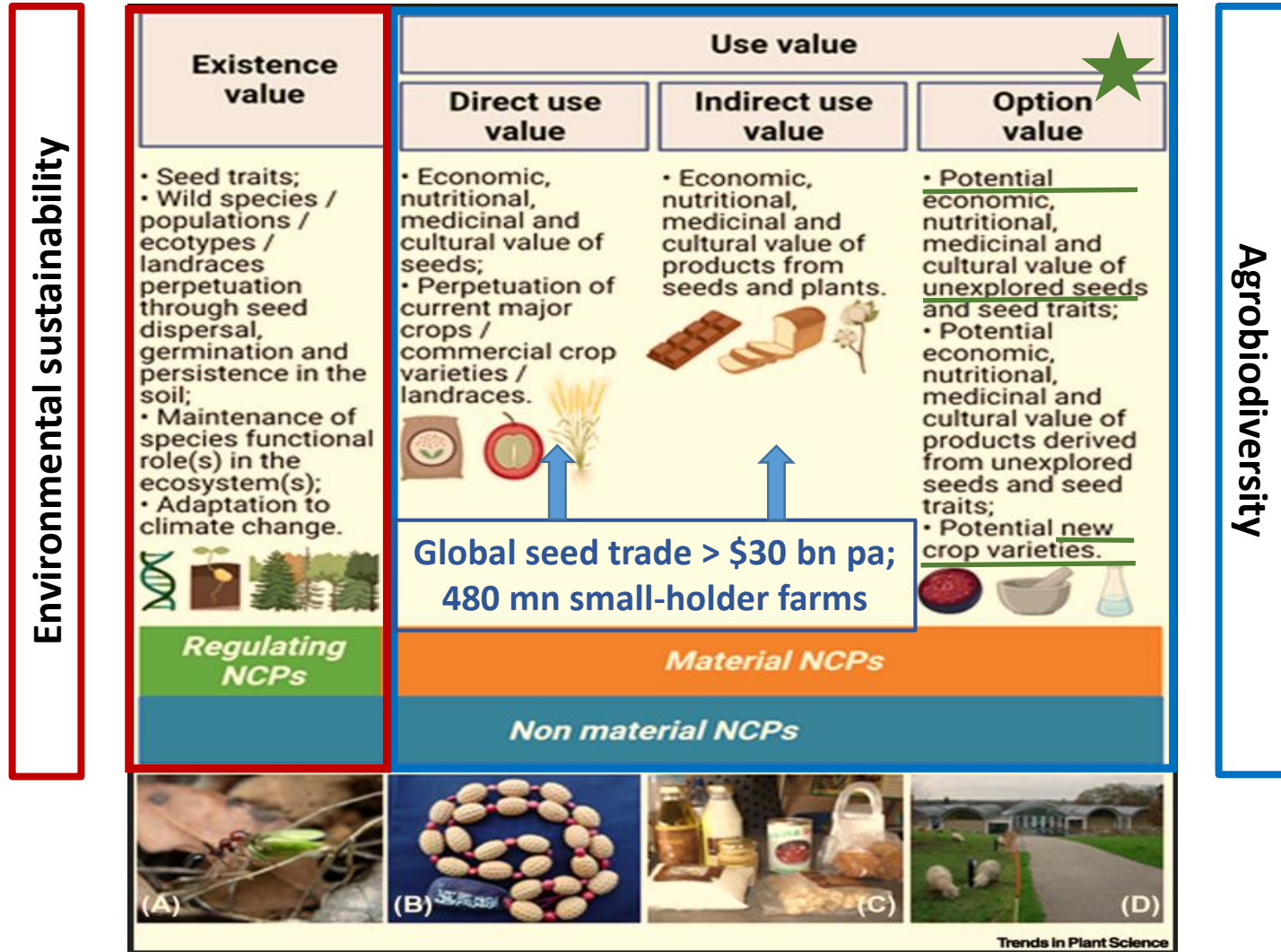
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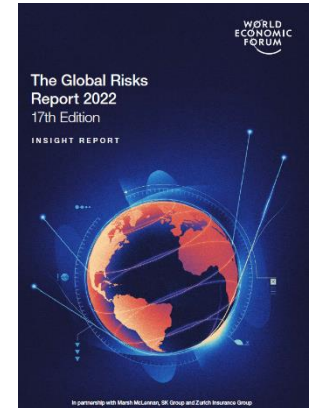
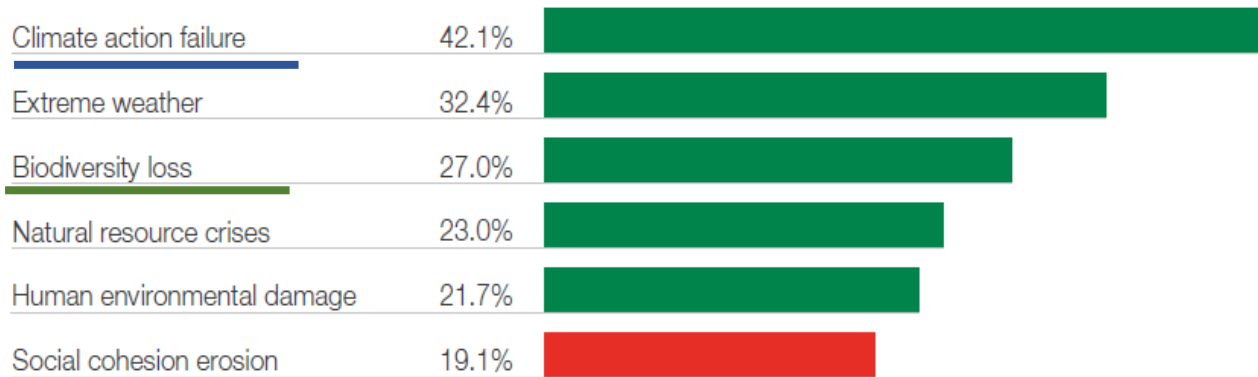


Theoretical framework – seeds as natural capital



Threats to potential of (agro)biodiversity

5-10 years



Reduced environmental sustainability!

Conservation of (agro)biodiverse seeds (option value)



Independent
Advisory and
Evaluation
Service



\$149 mn over 5 years OR \$40 per accession a year
(banking, maintenance, equipment upgrade, research, policy support,
quality management system, etc)

Holdings: > 750,000 accessions (mostly seeds)

NBPGR, Delhi



USDA, Fort Collins



Svalbard GSV



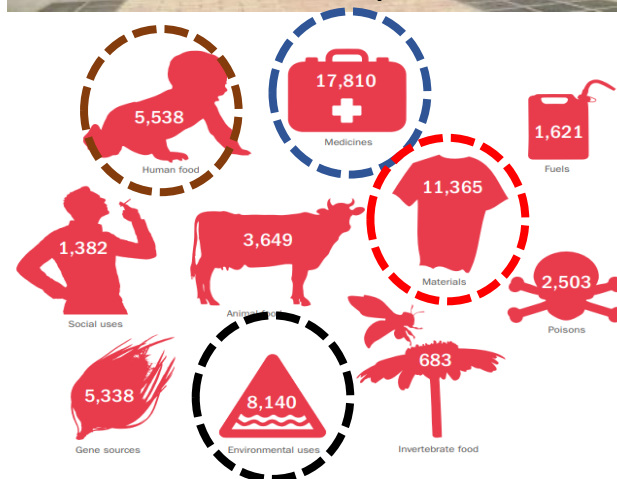
Conservation of diverse species (option value)



MSB Collection:

13,598 species (34%) with known uses;
14 biomes, and 175 countries;
Most common beneficial use:
medicinal > **environmental** >
material and **human food value**.
8% are identified as globally threatened.

Liu et al. (2023) *Biodiversity & Conservation*



>40,000 species on
World Checklist of Useful Plants
(Diazgranados et al., 2020), RBG Kew

From option to use value: Hessian fly and *Aegilops tauschii*

- **~10% yield reduction**
- Rising temperatures worsened losses from Hessian fly in the US Midwest
- *Aegilops tauschii*, wild grass native to the Fertile Crescent, is resistant



Syrian seeds could save US wheat from climate menace

Ancient Syrian grass rescued from Aleppo is resistant to pests devastating American farms

- [This article was originally published by the Yale school of forestry](#)



A seed accession from ICARDA, Syria

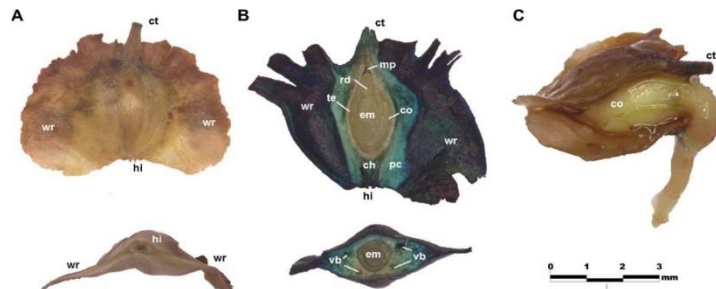
Option value of underutilised species – *Anogeissus leiocarpa*



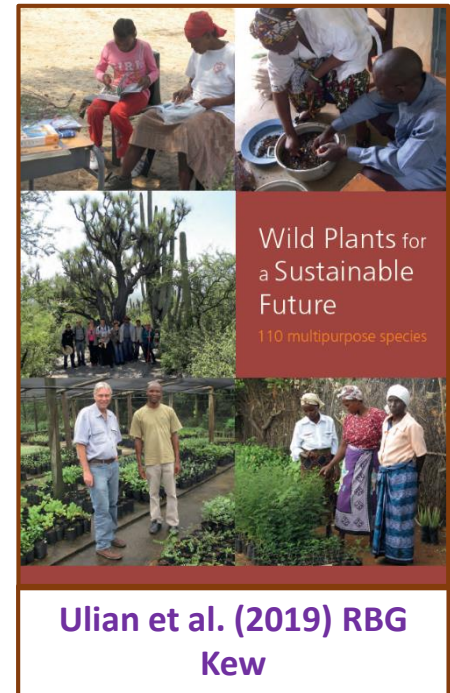
Yellow dye
on cotton

Tree – shade, wood ; Stem bark and leaves – antioxidants (e.g. flavonoids); Bark gum – food; Leaves – dye; etc.

- Low propagation by seed.
- X-rays to identify filled fruits.
- Understanding barriers to (fruit or seed) germination.



Mattana et al. (2018) Plant Biology

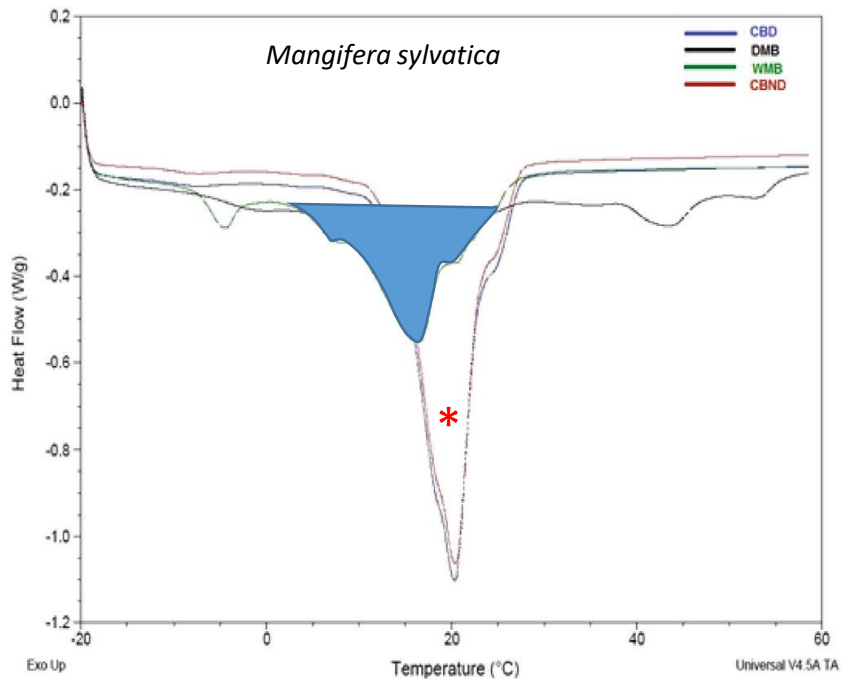


Oromia, Ethiopia: home garden agrobiodiversity is rich, e.g., 78 species
from 35 plant families

Semu (2018) Open Journal of Forestry

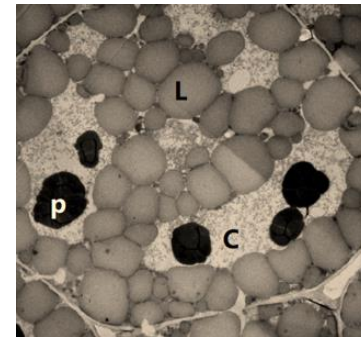
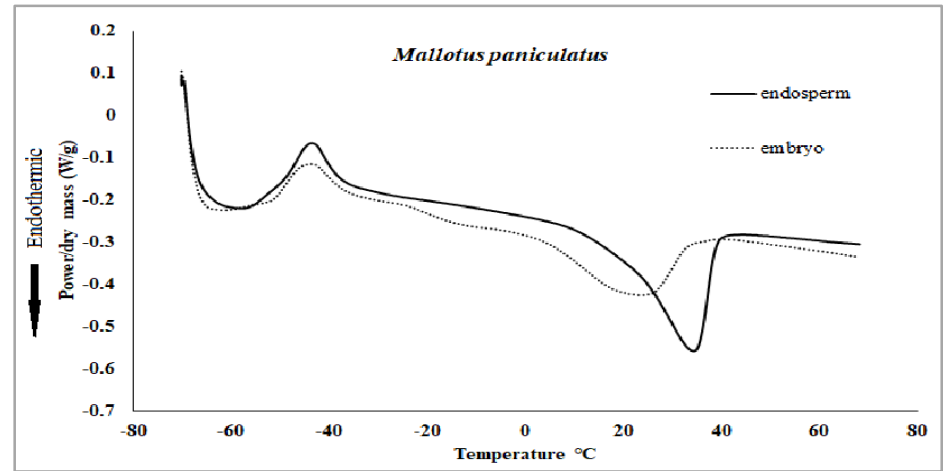
Option value: seeds as chemical factories

Wild mango vs cocoa* butter



Akter et al. (2016) Scientific Reports

Unusual hydroxylated fatty acids



HU et al., in preparation

Melting profiles of seed lipids / oils

Existence value – seed dispersal



Wind (anemochory)



Water (hydrochory)

From the parent plant or diaspore (autochory)



Unassisted (barochory)

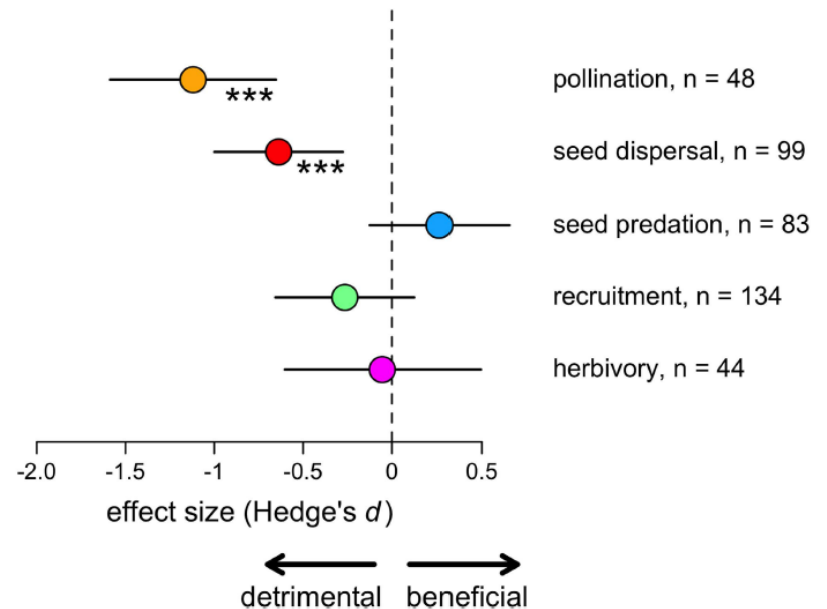
Dispersal prevented (atelochoy, antitelochory)



Animal (zoochory)

Negative effect of human forest disturbance on plant regeneration

(Neuschulz et al. 2016, Scientific Reports)



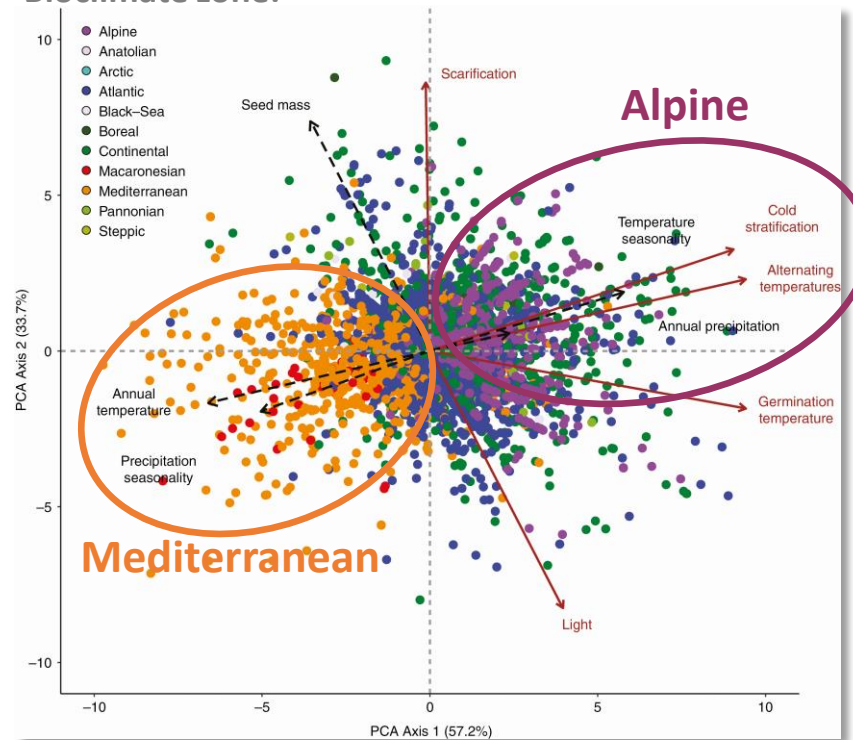
Loss of large frugivores could reduce standing carbon sequestration (of *Cryptocarya* sp. in Brazilian Atlantic Forest) by 2.5% (Bello et al. 2021, Ecosystem Services)

Existence value – seed germination (niche)

Appropriate conditions:



Bioclimate zone:

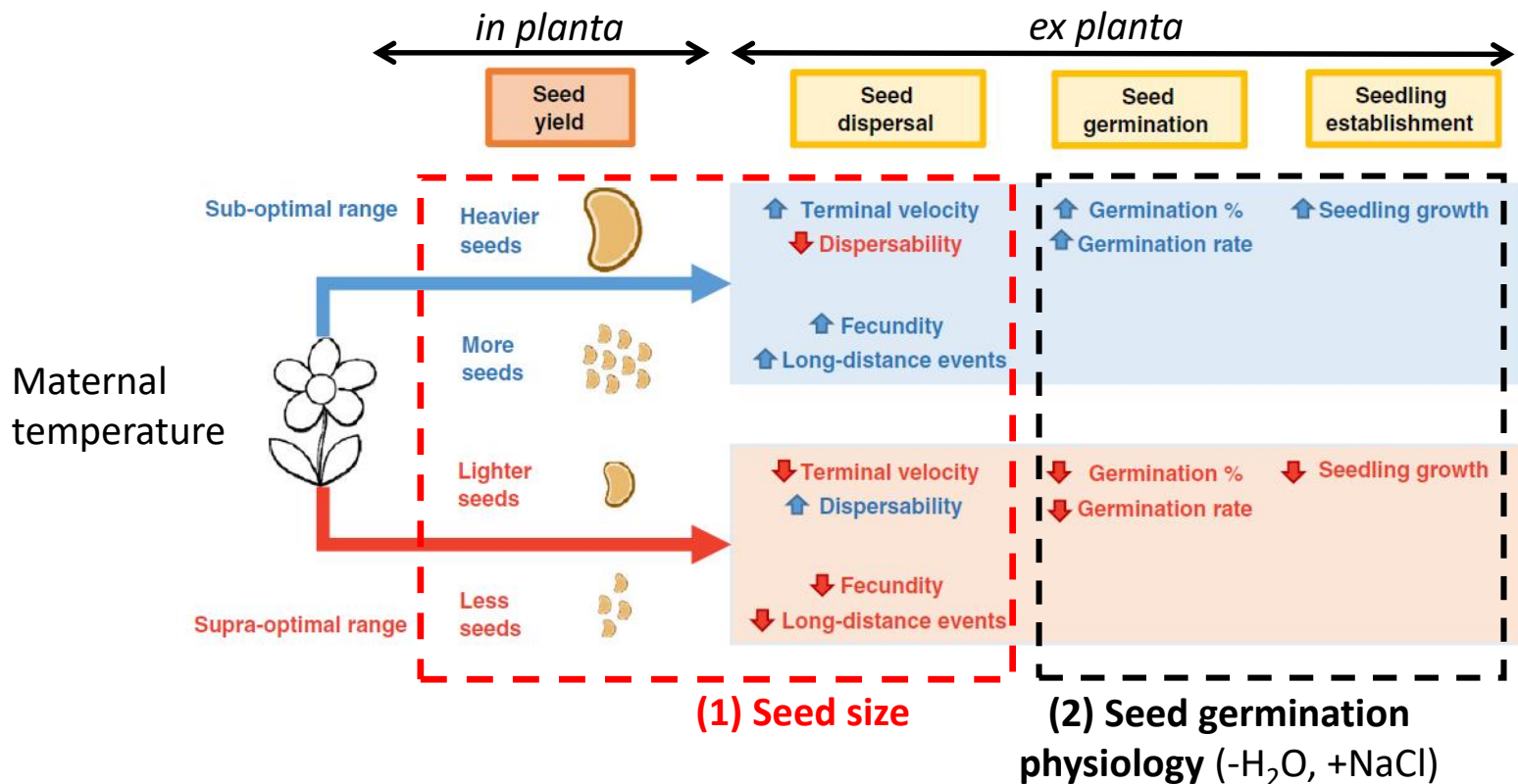


2418 species of European temperate plants:
Carta et al. (2022) - Annals of Botany

Existence value – germination & climate change



Meta-analysis reveals **two regulatory hubs** influencing **seed thermal memory**



Conclusions: seeds as vectors of...

....agrobiodiversity

- Potential / **options value** of seeds will only be realised if species are not lost (i.e., seeds conserved);
- Underutilised species, so valued by communities, will only progress towards domestication (**direct & indirect use**) with better understanding of seed biology;
- (biodiverse) Seeds as chemical factories (**direct & indirect use**) have huge potential for use by industry.

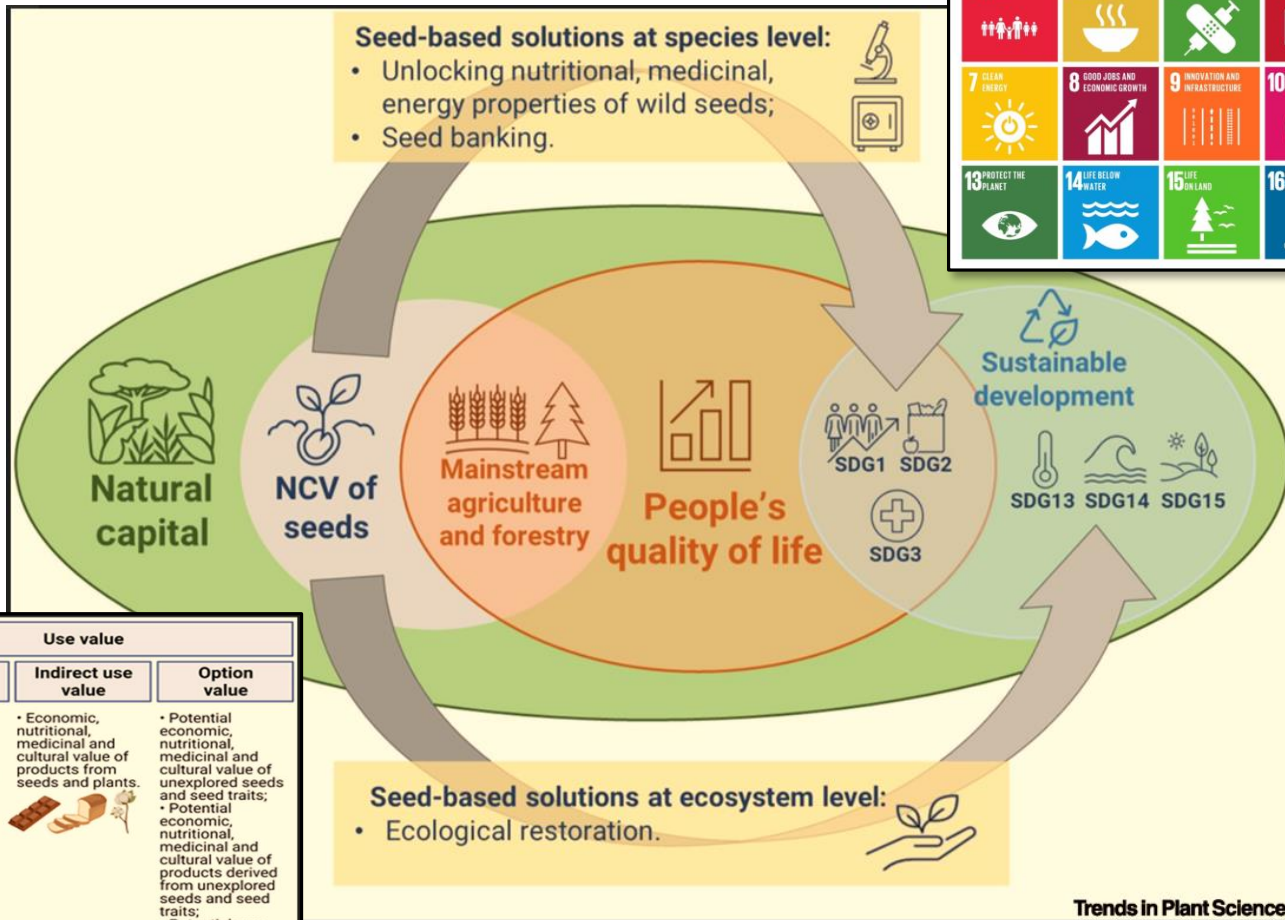
.....environmental sustainability

- Seed trait plasticity (germination / dormancy, persistence, survival) underpins habitat(s) regeneration, including under climate change and through restoration (**existence value**).



Seed-based solutions can improve Natural Capital, help delivery of the SDGs and thus improve People's Quality of Life.

Seed-based solutions



Existence value	Use value		
	Direct use value	Indirect use value	Option value
<ul style="list-style-type: none"> Seed traits; Wild species / populations / ecotypes / landraces perpetuation through seed dispersal, germination and persistence in the soil; Maintenance of species functional role(s) in the ecosystem(s); Adaptation to climate change. 	<ul style="list-style-type: none"> Economic, nutritional, medicinal and cultural value of seeds; Perpetuation of current major crops / commercial crop varieties / landraces. 	<ul style="list-style-type: none"> Economic, nutritional, medicinal and cultural value of products from seeds and plants. 	<ul style="list-style-type: none"> Potential economic, nutritional, medicinal and cultural value of unexplored seeds and seed traits; Potential economic, nutritional, medicinal and cultural value of products derived from unexplored seeds and seed traits; Potential new crop varieties.
Regulating NCPs	Material NCPs		
Non material NCPs			
(A)	(B)	(C)	(D)

Trends in Plant Science