NITI Aayog

सत्यमेव जयते
Ministry of Agriculture & Farmers Welfare
Government of India

Food and Agriculture Organization of the United Nations

NATIONAL DIALOGUE

INDIAN AGRICULTURE TOWARDS 2030

Pathways for Enhancing Farmers' Income, Nutritional Security and Sustainable Food Systems

19 - 22 January 2021

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Natural Farming, Agro-ecological and Biodiverse Futures: the foundations

January 20, 2021

Dr Ravi Prabhu

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My main points

- **Agriculture consumes too much!** most fresh water, much of the fertile soil, is the occupation of most people and generates a huge amount of GHG and toxicity: *We can't 'simply' focus on food production any longer*
- **Need to 're-imagine' agriculture.** It is possible – using agroecological principles and new technologies – to develop an agriculture that satisfies multiple objectives well
- **Farmers must be equal partners.** All those involved in the value chains must be actively included in this process of transformation and reinvention
- **Science must contribute evidence to be transformative.** It is the role and duty of academics to explore how a new agriculture can be delivered, soon. Perpetuating the status-quo is not an option

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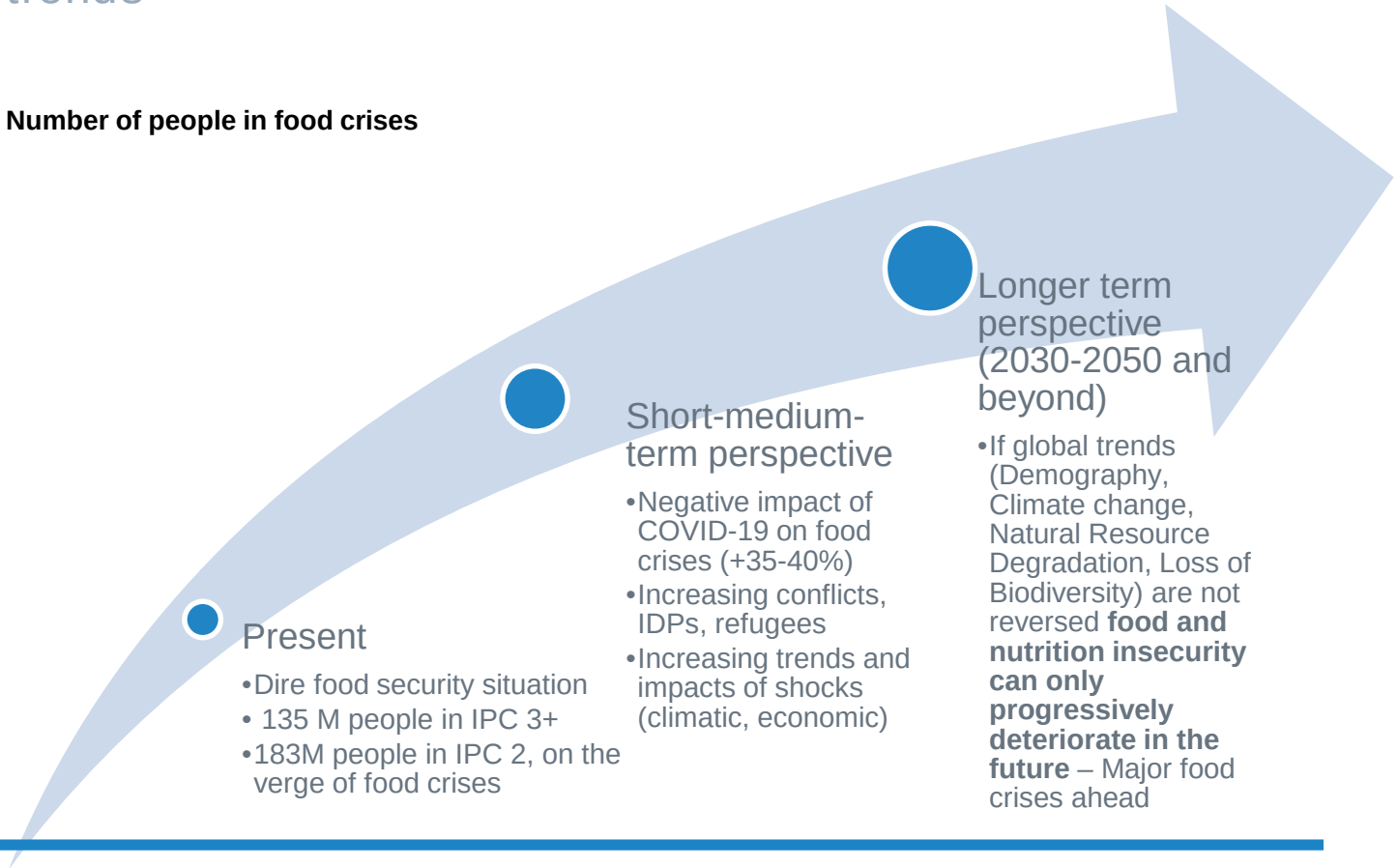
1.

Our challenges (briefly)

Contents here……

Global Food and Nutrition Crises - figures and trends

Number of people in food crises



Source: EC presentation, Crabbe

Looking ahead: worsening trends

Food systems at risk…

Number of undernourished people should exceed 840 million by 2030.

(State of Food Security and Nutrition in the World –SOFI – 2020)

a third more people in food crisis

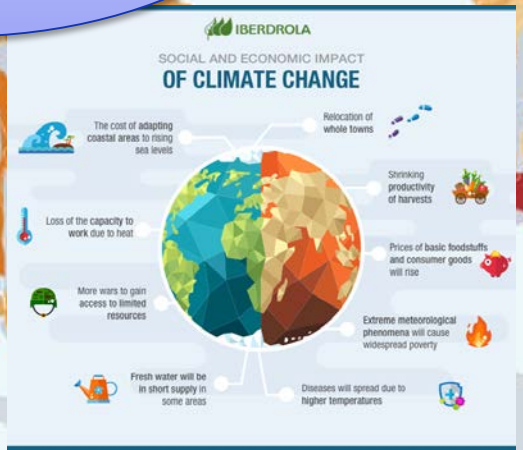
(Update Sep.2020 in 11 hotspots)

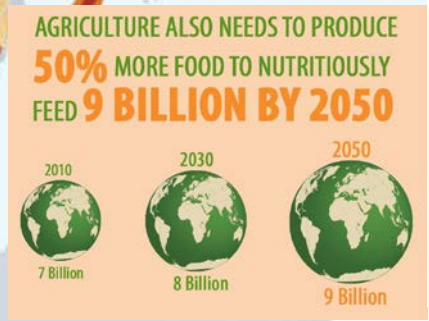
Pacific Ocean

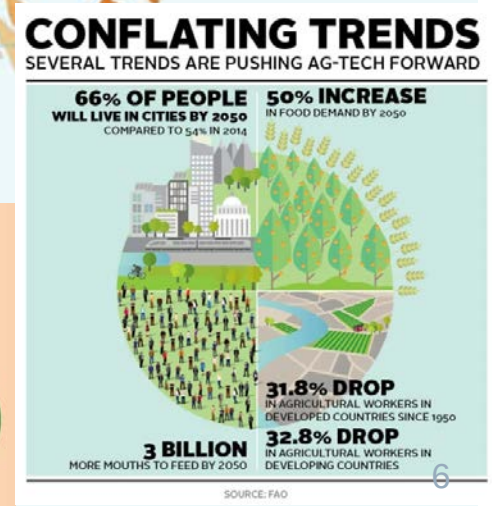
Indian Ocean

Soil degradation

- Very high severiry
- High severity
- Moderate severity
- Low severity
- Stable land, ice cap or non-used wasteland

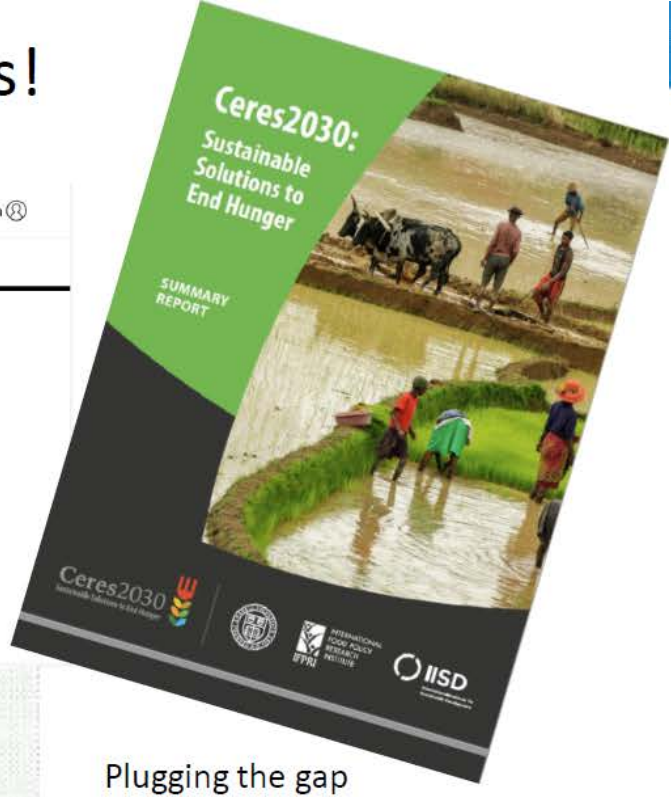






Source: EC presentation, Crabbe

Established science can re-inforce lock-ins!



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nature > editorials > article

EDITORIAL · 12 OCTOBER 2020

Ending hunger: science must stop neglecting smallholder farmers

Policymakers urgently need ideas on ways to end hunger. But a global review of the literature finds that most researchers have had the wrong priorities.

Plugging the gap between rhetoric calling for transformation and action to enbale it

Laborde, D., Murphy, S., Parent, M., Porciello, J. & Smaller C. (2020). *Ceres2030: Sustainable Solutions to End Hunger - Summary Report.* Cornell University, IFPRI and IISD.

Land degradation affects over 40% of the Earth's surface.

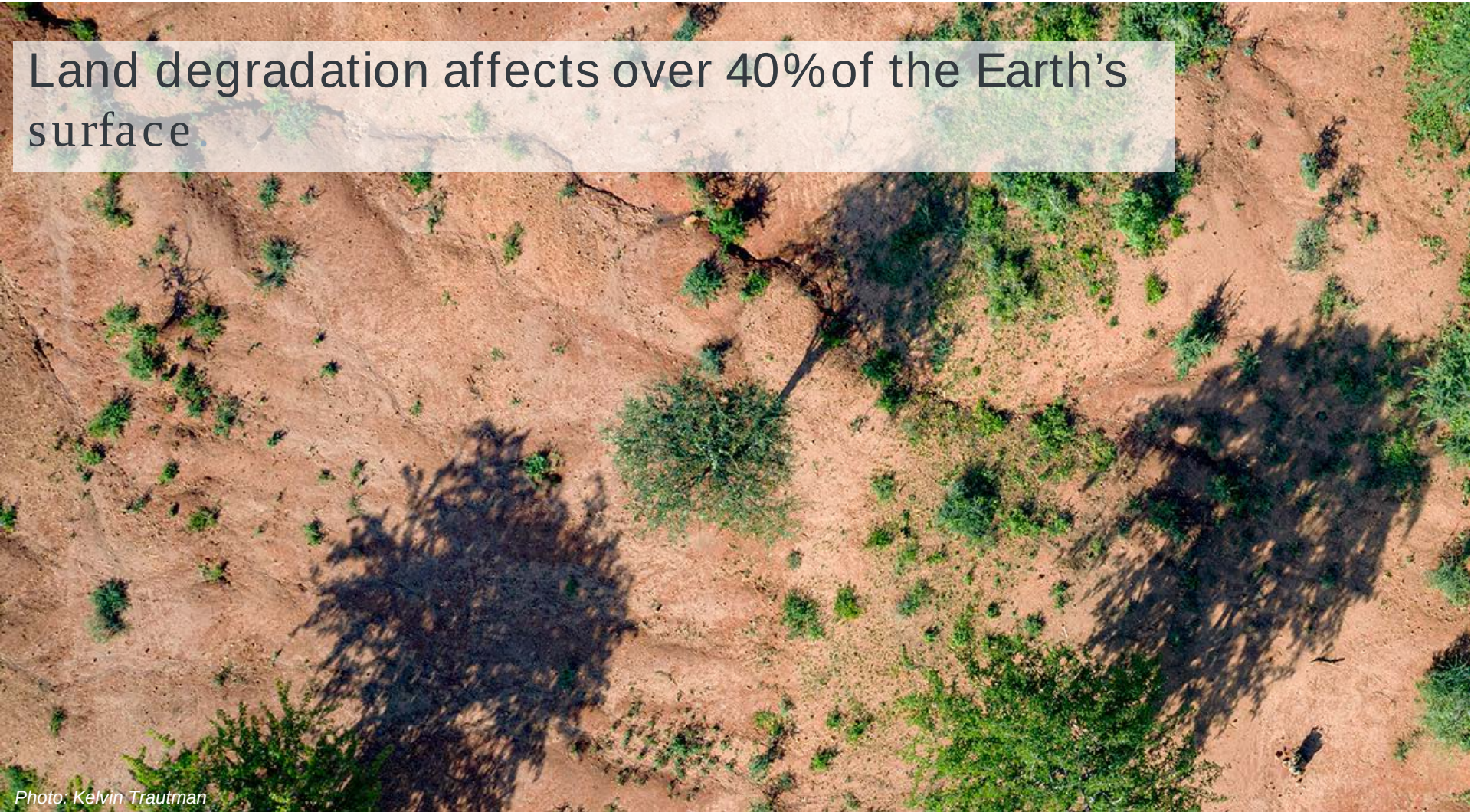
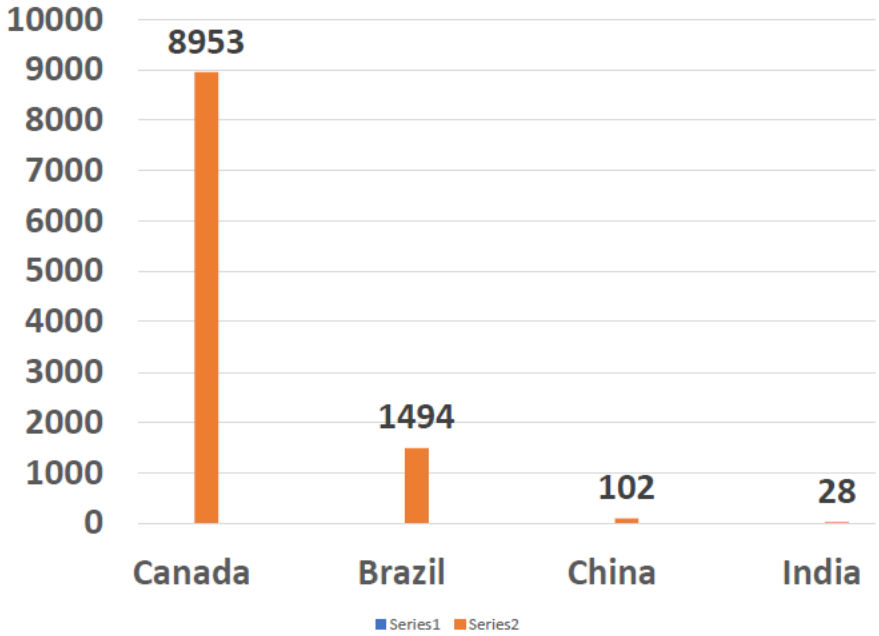


Photo: Kelvin Trautman

Average number of trees/ person (2015)



Sources of heavy metals in soil-crop systems

- Irrigation with waste-water or polluted water
- Pesticides or herbicides
- Synthetic fertilizers
- Sewage or sludge-based amendments
- Untreated livestock manure

(Hamiani et al., 2015;Bolan et al., 2017Kim et al.,2017a, 2017b; Kohzadi et al., 2018; Li et al.,2017a,2017b; Chary et al.,2008; Cai et al.,2009; Luo et al.,2009; Mansour et al.,2009; Gall et al.,2015; Lv et al.,2015; Elgallal et al.,2016;Woldetsadik etal.,2017;El-Kady and Abdel-Wahhab,2018)

Source: Zakir Hussain/Vijay Kumar

Arsenic menace in India

- Seven states namely- West Bengal, Jharkhand, Bihar, Uttar Pradesh in the flood plain of the Ganga River; Assam and Manipur in the flood plain of the Brahamaputra and Imphal rivers and Rajnandgaon village in Chhattisgarh state have so far been reported affected by Arsenic contamination in groundwater above the permissible limit of 10 µg/L. (Ghosh e al.2018)
- (http://cgwb.gov.in/documents/papers/incidpapers/Paper%208%20-%20Ghosh.pdf

Source: Zakir Hussain/Vijay Kumar

Majority of the Rivers in India are highly polluted (CWC Study)

Number of rivers polluted with unacceptable levels of heavy metals

Contaminant	Permissible limit	No of rivers
Lead	10 µg/L	**69**
Nickel	20 µg/L	**25**
Iron	300 µg/L	**137**
Copper	50 µg/L	**10**
Chromium	50 µg/L	**21**
Cadmium	3 µg/L	**25**

- The Central Water Commission (CWC) collected a total of 442 surface water samples from 62 rivers in India of which 287 were polluted by heavy metals.
- The most common heavy metal found was iron, and above safe limits in 156 samples. Lead, nickel, chromium, cadmium and copper were the other metals.
- The Paddy and other vegetables grown in the catchment areas are highly polluted (Kiran Pandel et al. (2018)
- Ganga, the national river, was found to be polluted with five heavy metals—chromium, copper, nickel, lead and iron—six rivers–Arkavathi, Orsang, Rapti, Sabarmati, Saryu and Vaitarna—had unacceptably high concentration of four pollutants.

Source: Zakir Hussain/Vijay Kumar

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2.

Agroecology and its promise

Contents here……

Some insights from FAO Agroecology Conference 2014

- Addressing global challenges in achieving food and nutrition security through Agroecology by **re-introducing biological complexity**

- Agroecological systems are complex and knowledge intensive

- Caring for the environment should be a means to achieve other goals (not an afterthought). There are win-win opportunities to close yield gaps and environmental gaps.

CFS 46
COMMITTEE ON WORLD FOOD SECURITY

Fundamentals of Agroecology

Dynamic concept,
from field and farm to whole food system:

- Science: transdisciplinary
  - Focused on real world problems; solution orientated
  - Involves stakeholders
  - Reflexive method development
- Set of practices:
  - harness ecological processes (biodiversity) rather than forcing agricultural and food systems with external inputs
  - generic principles, applied locally - no prescribed se ➡ diversity
- Social movements: political, assert collective rights, advocate diversity in agriculture and food systems, transformation at scale

https://www.bondproject.eu/outstanding-practices-in-agroecology-2019-announced/

Source: Fergus Sinclair

Principles and transition levels

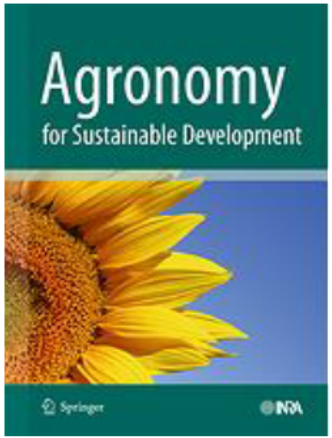
Agronomy for Sustainable Development (2020) 40:40
https://doi.org/10.1007/s13593-020-00646-z

REVIEW ARTICLE

Agroecological principles and elements and their implications for transitioning to sustainable food systems. A review

Alexander Wezel[1] · Barbara Gemmill Herren[2] · Rachel Bezner Kerr[3] · Edmundo Barrios[4] · André Luiz Rodrigues Gonçalves[5] · Fergus Sinclair[6,7]

Accepted: 8 October 2020



Transformational

LEVEL 5
Build a new global food system based on participation, localness, fairness and justice

LEVEL 4
Reconnect consumers and producers through the development of alternative food networks

Food system

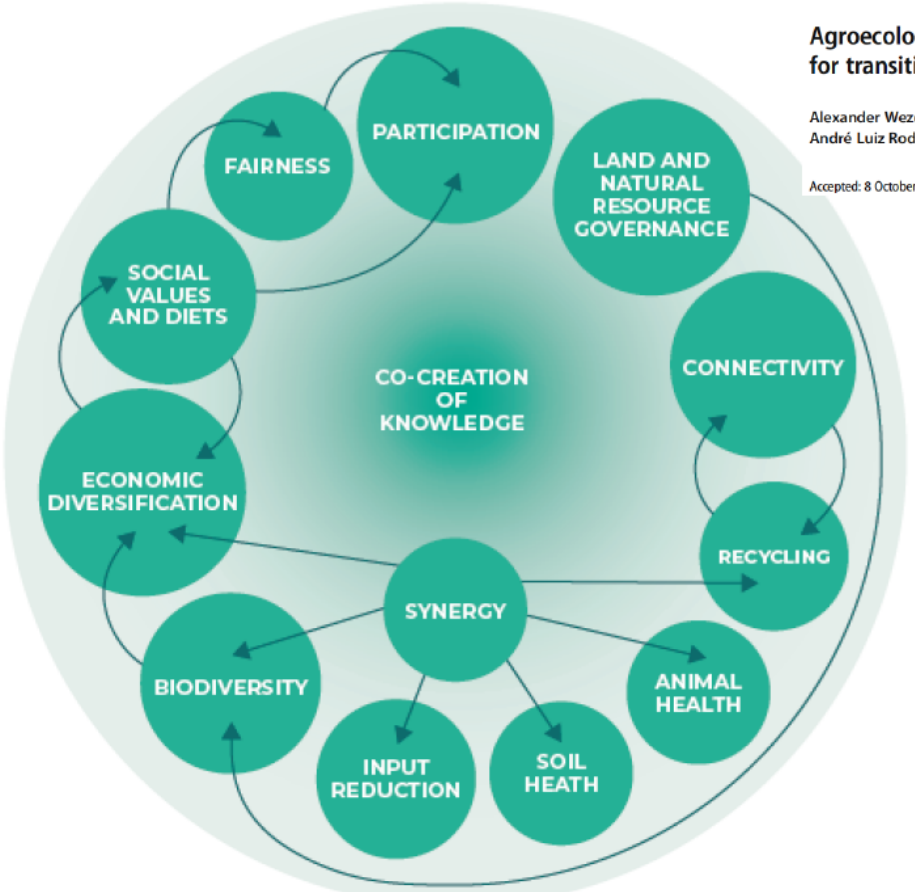
LEVEL 3
Redesign agroecosystems

Incremental

LEVEL 2
Substitute conventional inputs and practices with agroecological alternatives

LEVEL 1
Increase efficiency of input use and reduce use of costly, scarce or environmentally damaging inputs

Agroecosystem



FAO Elements – entry points

HLPE Principles – characterisation and analysis

Wezel A, Gemmill Herren B, Bezner Kerr R, Barrios E, Gonçalves ALR and Sinclair F (2020). Agroecological principles and elements and their implications for transitioning to sustainable food systems. A review. *Agronomy for Sustainable Development* **40:** 40 13pp.

Source: Fergus Sinclair

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Innovation for Transformation

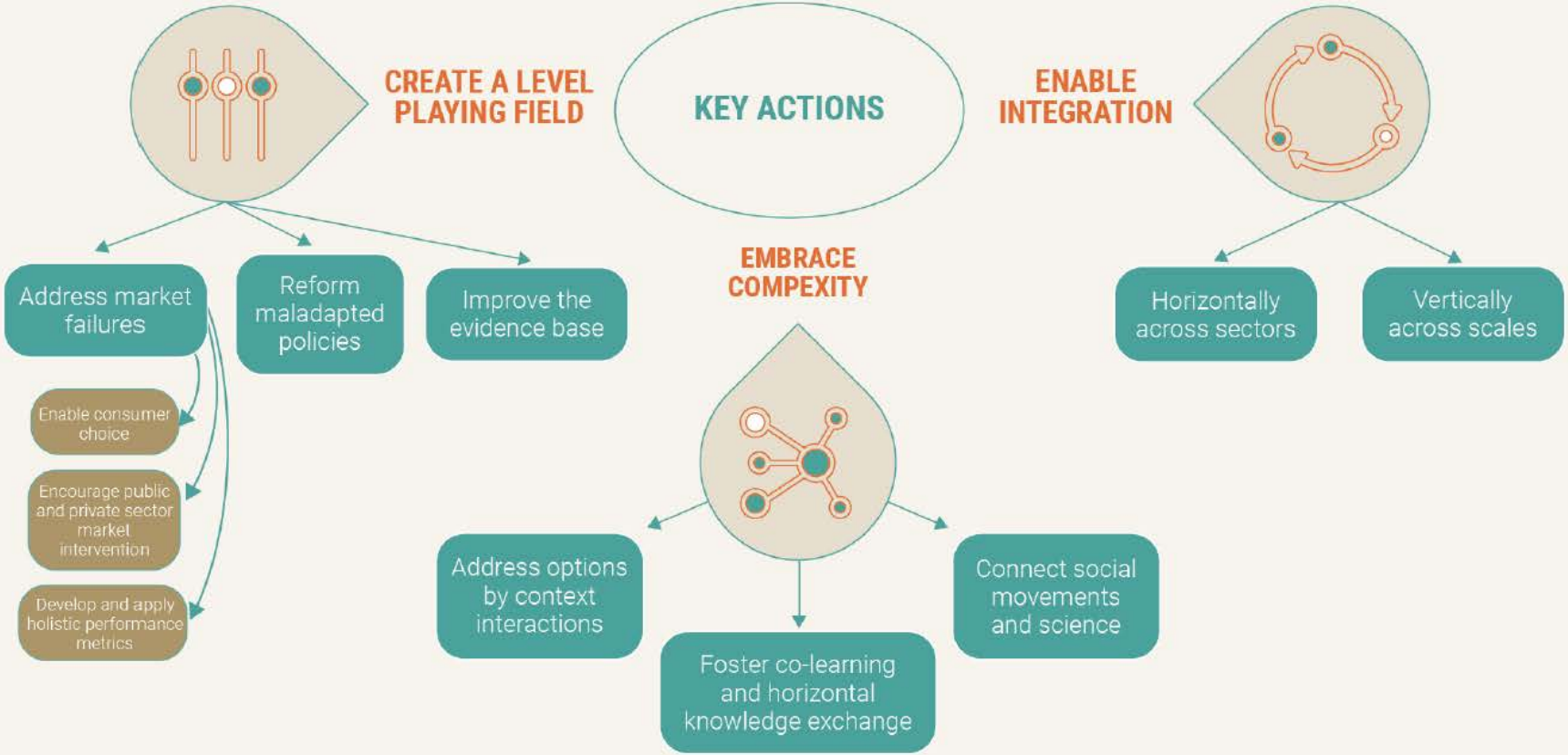
Involves challenging the *status quo* (rules, institutions, practices).

How change happens (the process of innovation) is as important as the specific changes (innovations) that result:

- New technology, markets and institutions: emphasis now on democratizing and responsible innovation hence co-creation of knowledge.
- Innovation in agriculture is inherently localized.
- Approaches = widely practiced sets of principles and methods that foster the transition towards SFS for FSN, within an overarching philosophy and strategic vision for the future.
- Principles = statements which form a basis for a system of belief or reasoning which guide decisions and behaviour.
  - Either normative or causative
  - Need to be fully explicit

Source: Fergus Sinclair

FIGURE 7 Key Actions Required to Enable Adoption of Agroecological Practices at Scale to Build Resilience of Farming and Food Systems



Source: Fergus Sinclair

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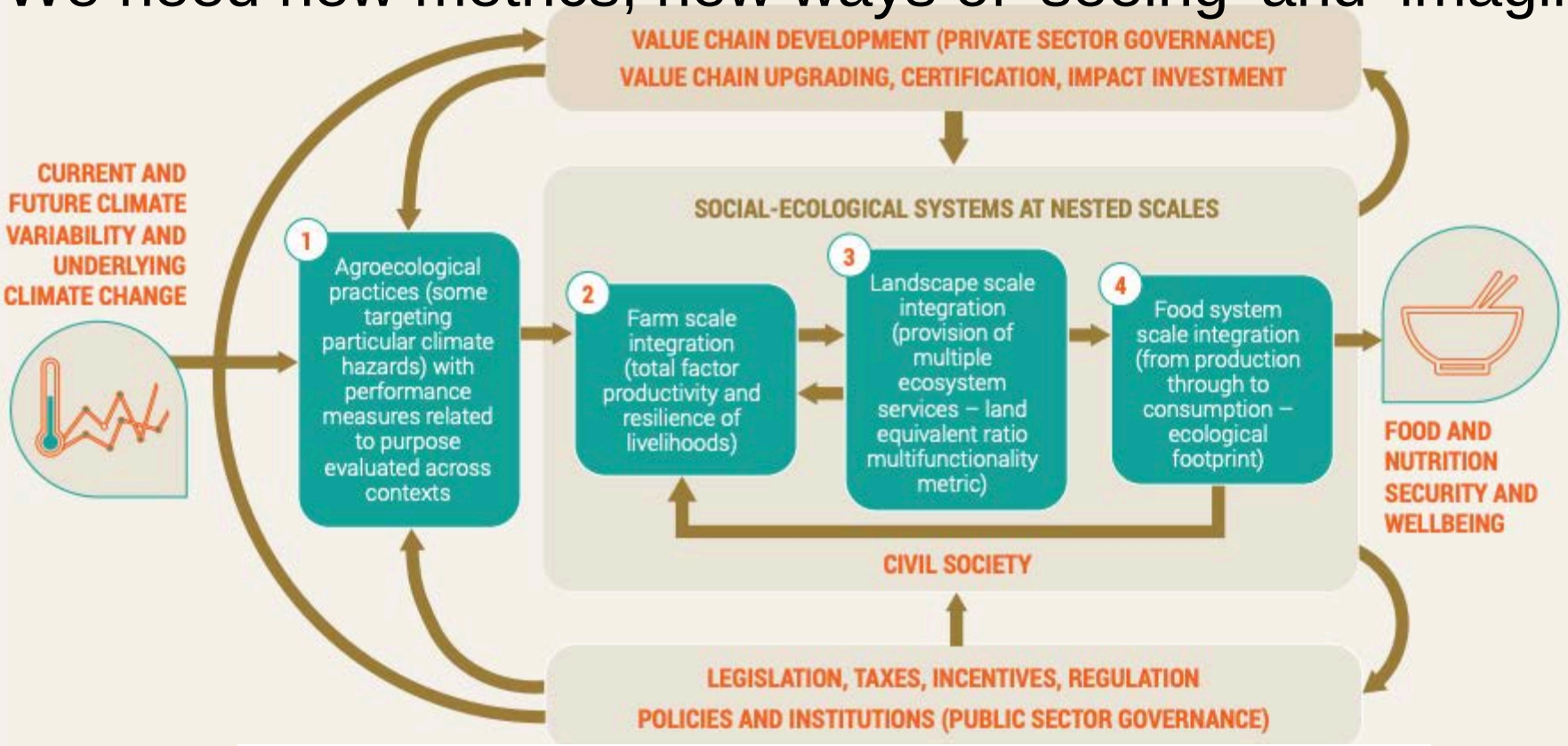
What was learnt from analyzing diverging perspectives

- Divergence more around **how** technology is accessed, **used and controlled** rather than the fundamental nature of technologies themselves
- **Moralization** of food
  increases motivation of policy makers to act
  but makes it more difficult for this to be done on the basis of evidence
- There is **need for clarity** on asserting *normative starting points* for transitioning to SFS for FSN *and then causative mechanisms* to **achieve transitions in different contexts**
- **Understanding the basis and nature of controversies** helps **get beyond divisions**
- **Agroecology is** not anti-technology, anti-science, or anti-private sector but **a modern response to today's challenges – being considered by national governments**

NITI-Aayog (2020). Agroecology and Natural Farming Could Accelerate Inclusive Economic Growth in India. https://pib.gov.in/PressReleasePage.aspx?PRID=16[illegible]

Source: Fergus Sinc

We need new metrics, new ways of ‘seeing’ and ‘imagining



[a] With performance measures related to their purpose, evaluated across contexts

[b] Total factor productivity and resilience of livelihoods

[c] Provision of multiple ecosystem services – land equivalent ratio multifunctionality

[d] From production through to consumption – ecological footprint

Source: Fergus Sinclair

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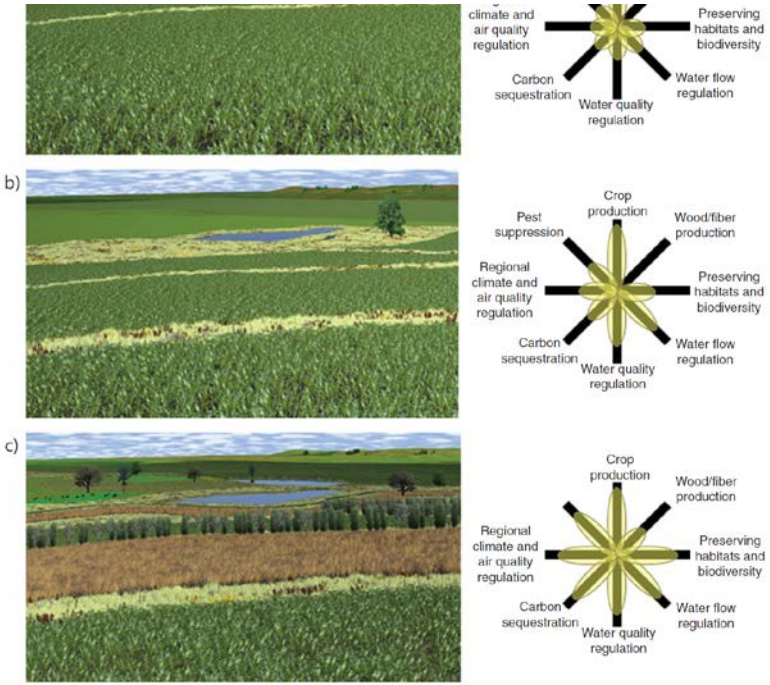
3.

Towards evidence-based adoption

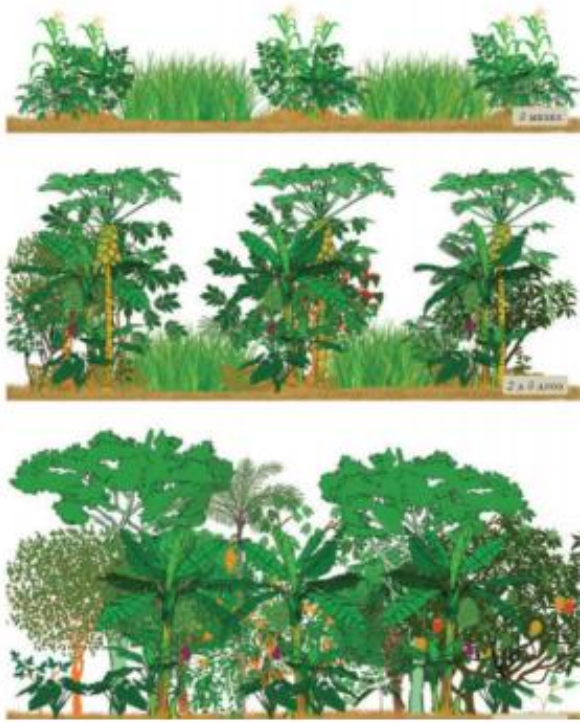
Contents here……

We understand how to get the best from trees and ecosystem services in agricultural landscapes, for people



From Guidebook ‘Restoration through Agroforestry:
Reconciling Conservation and Production in Practice’
and its complementary tool PLANTSAFS

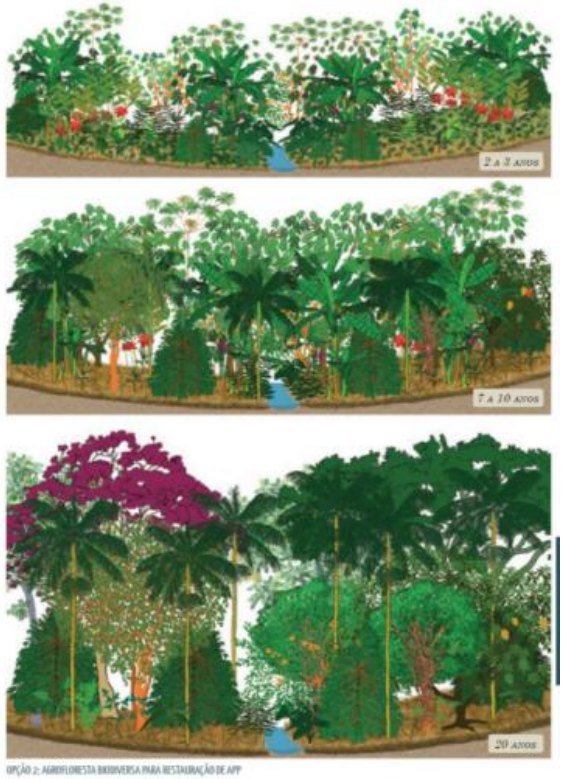
..building resilience over time



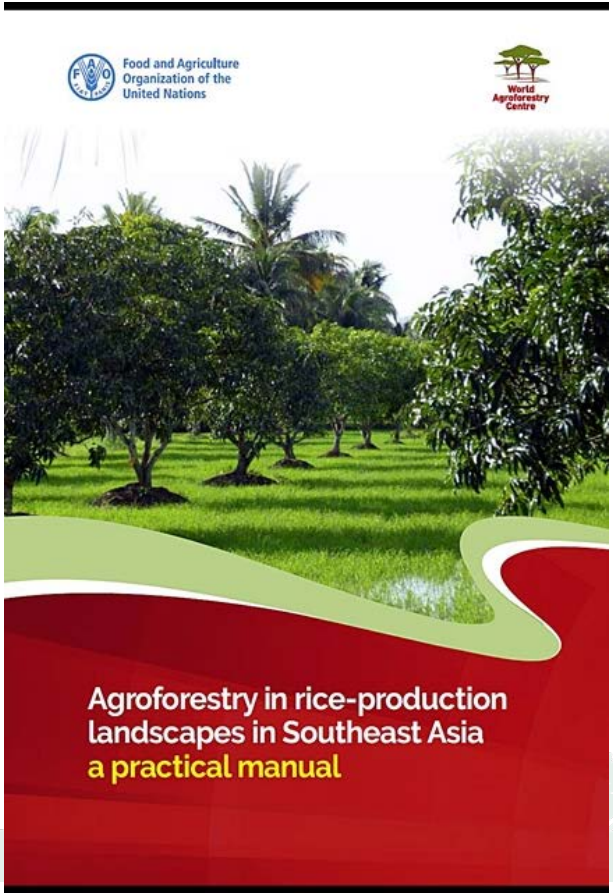
2-3 years

7-10+ years

20+ years



Role of agroforestry trees in climate adaptation and mitigation



Impacts of trees on crop temperatures, yield, flowering, pest and disease incidence to adapt to a changing climate

Opportunities to store more carbon in soils, vegetation and grow sustainable fuelwood on farms

For key staple and commodity crops:

- rice, wheat, teff
- coffee, cocoa

Diversification as a resilience strategy

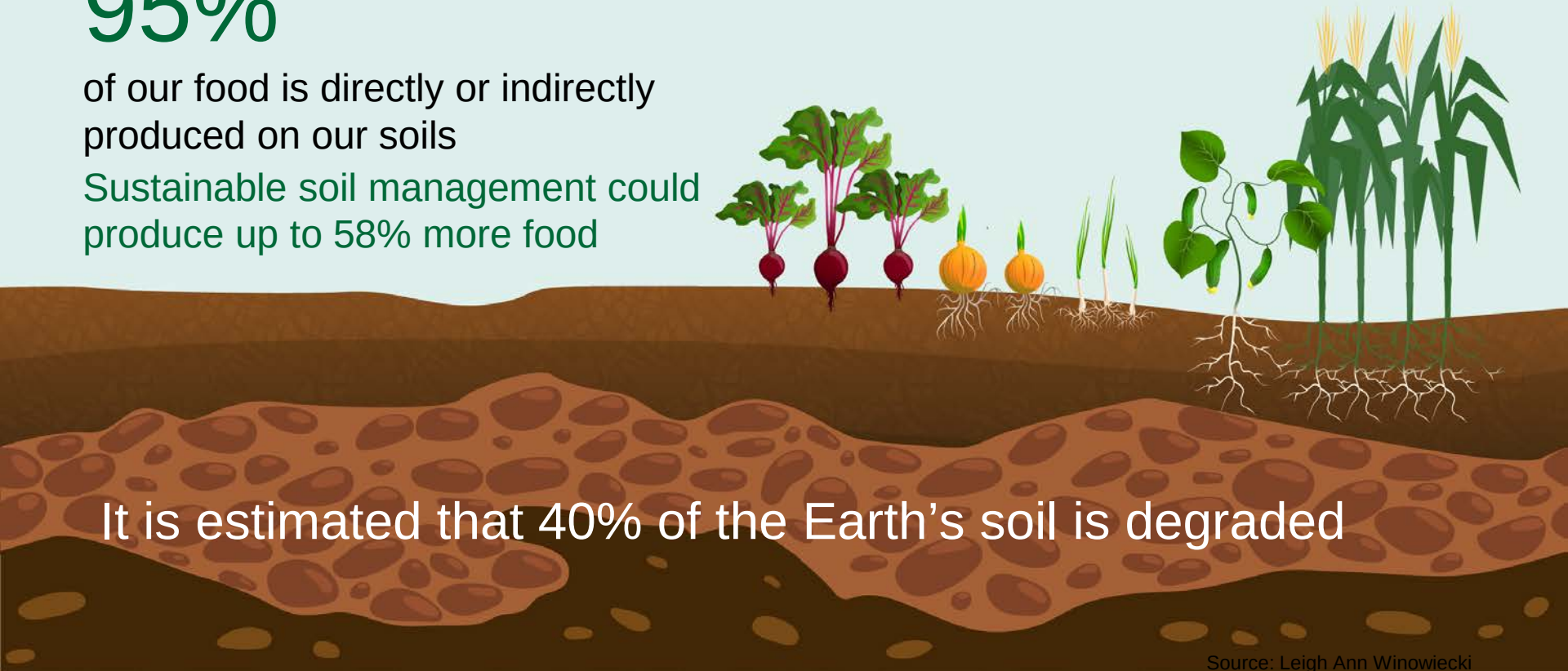
Fergus Sinclair: f.sinclair@cgiar.org

The Global Relevance of Soil

95%

of our food is directly or indirectly produced on our soils

Sustainable soil management could produce up to 58% more food

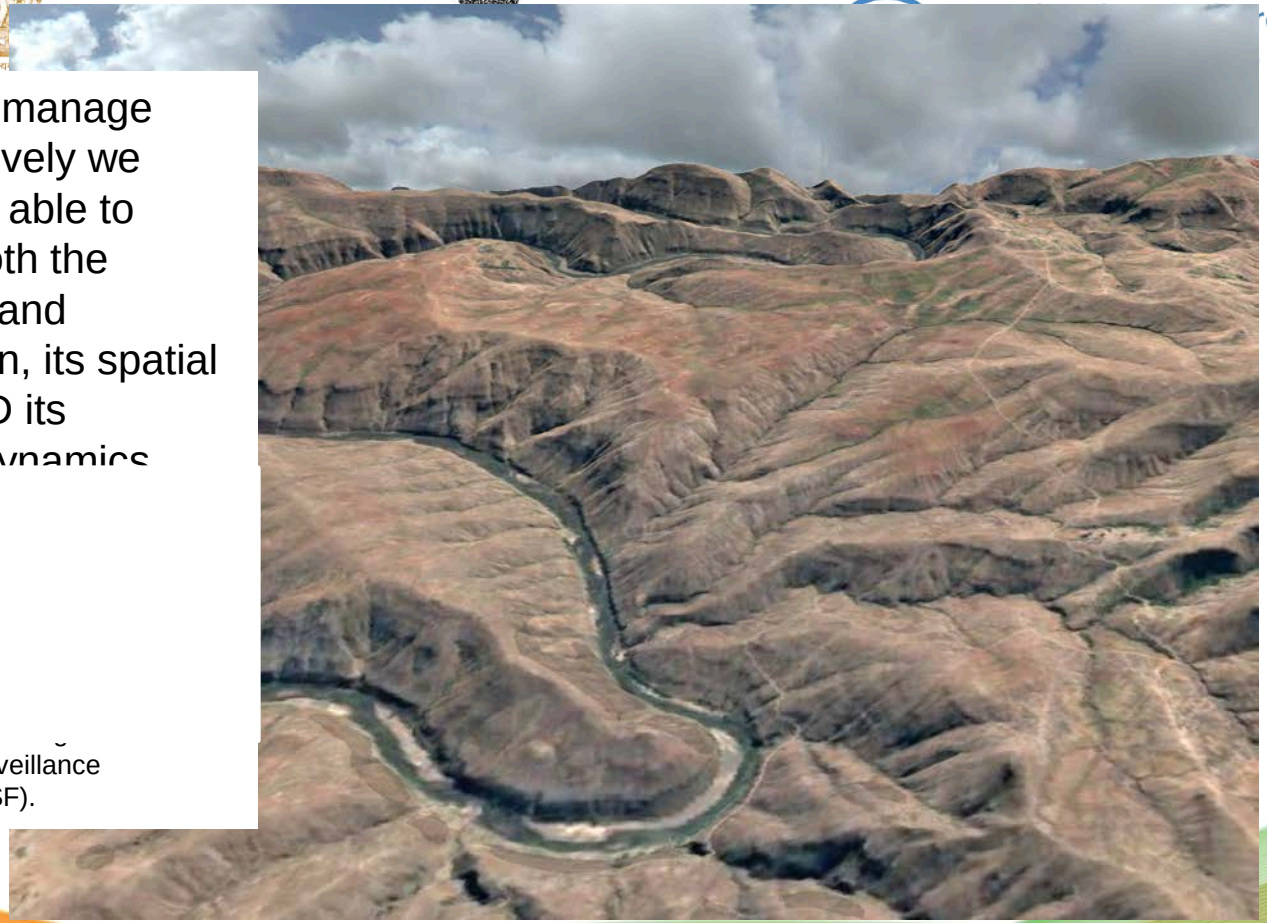


It is estimated that 40% of the Earth’s soil is degraded

Source: Leigh Ann Winowiecki

In order to manage land effectively we need to be able to quantify both the degree of land degradation, its spatial extent AND its temporal dynamics

Degradation Surveillance Framework (LDSF).

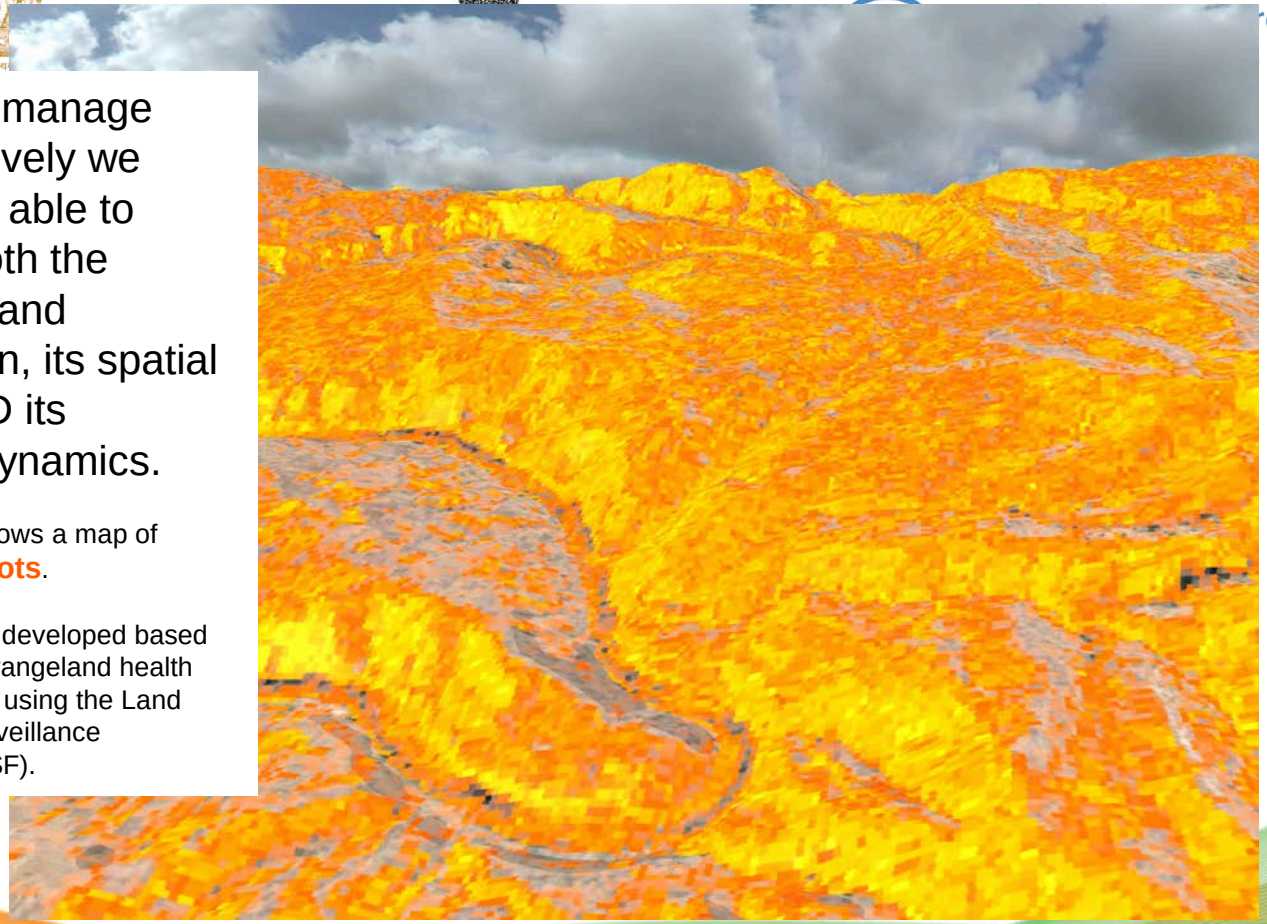


Source: Tor Gunnar Vagen

In order to manage land effectively we need to be able to quantify both the degree of land degradation, its spatial extent AND its temporal dynamics.

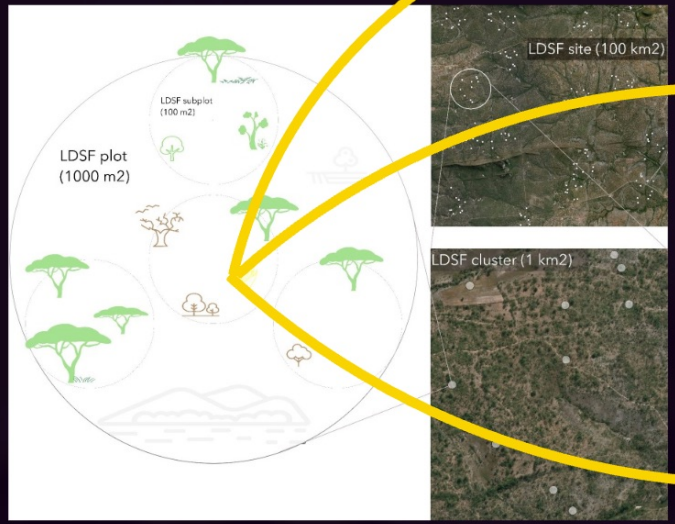
This example shows a map of **erosion hotspots**.

These maps are developed based on a network of rangeland health monitoring sites, using the Land Degradation Surveillance Framework (LDSF).

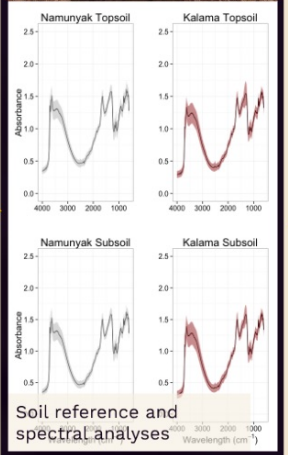


Source: Tor Gunnar Vagen

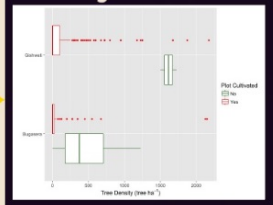
Field measurements and observations

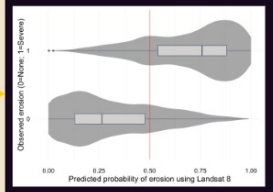


Measure

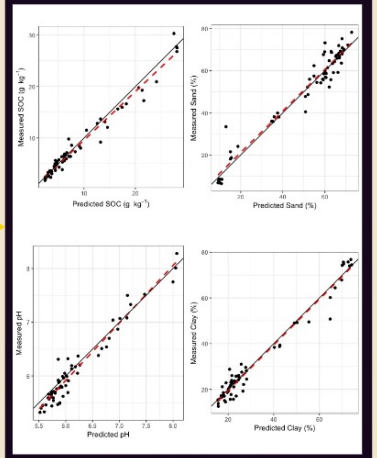


Analyze

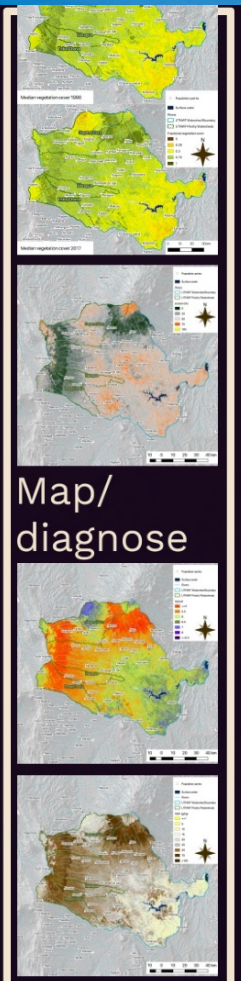




Predict



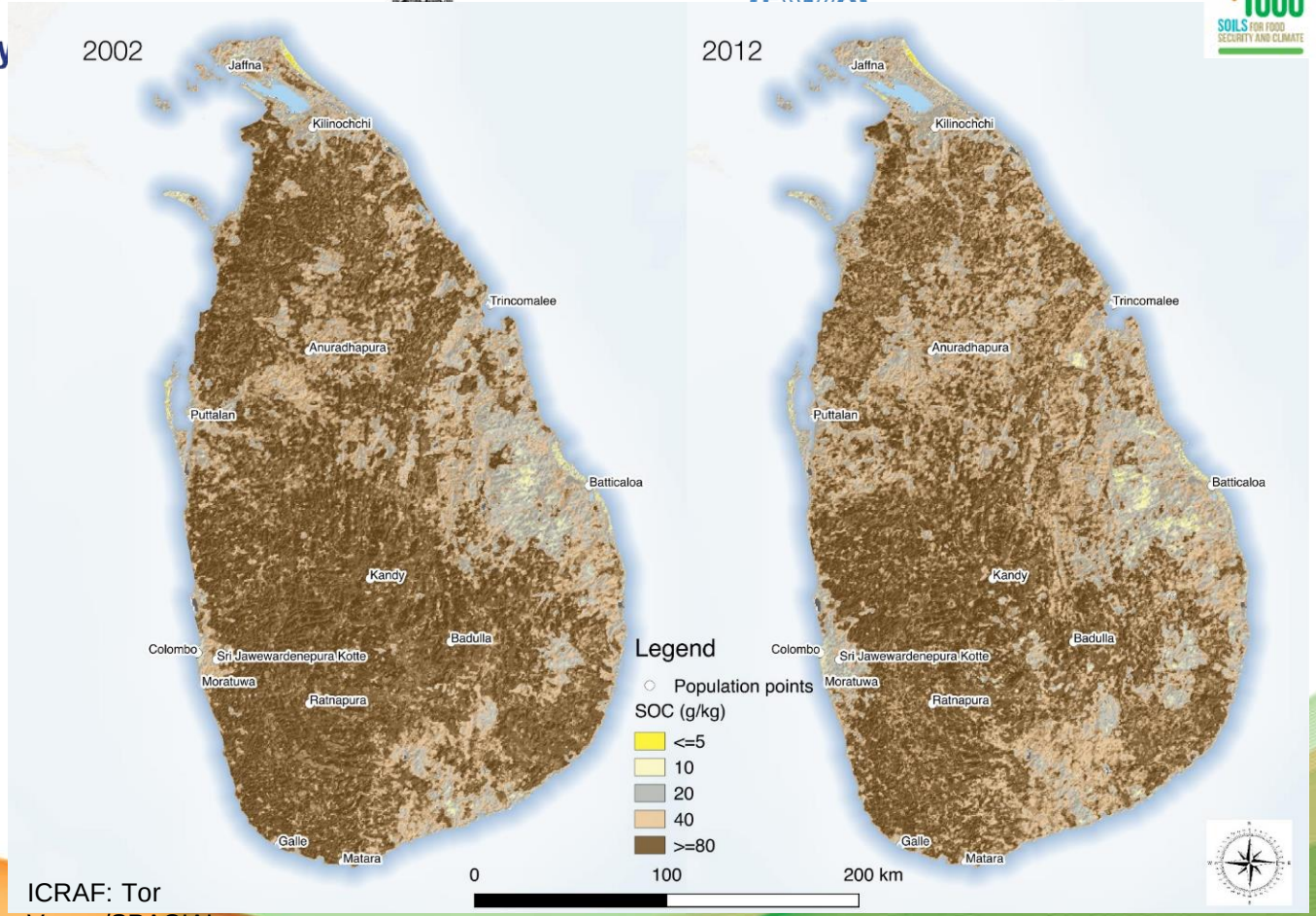
Map/ diagnose

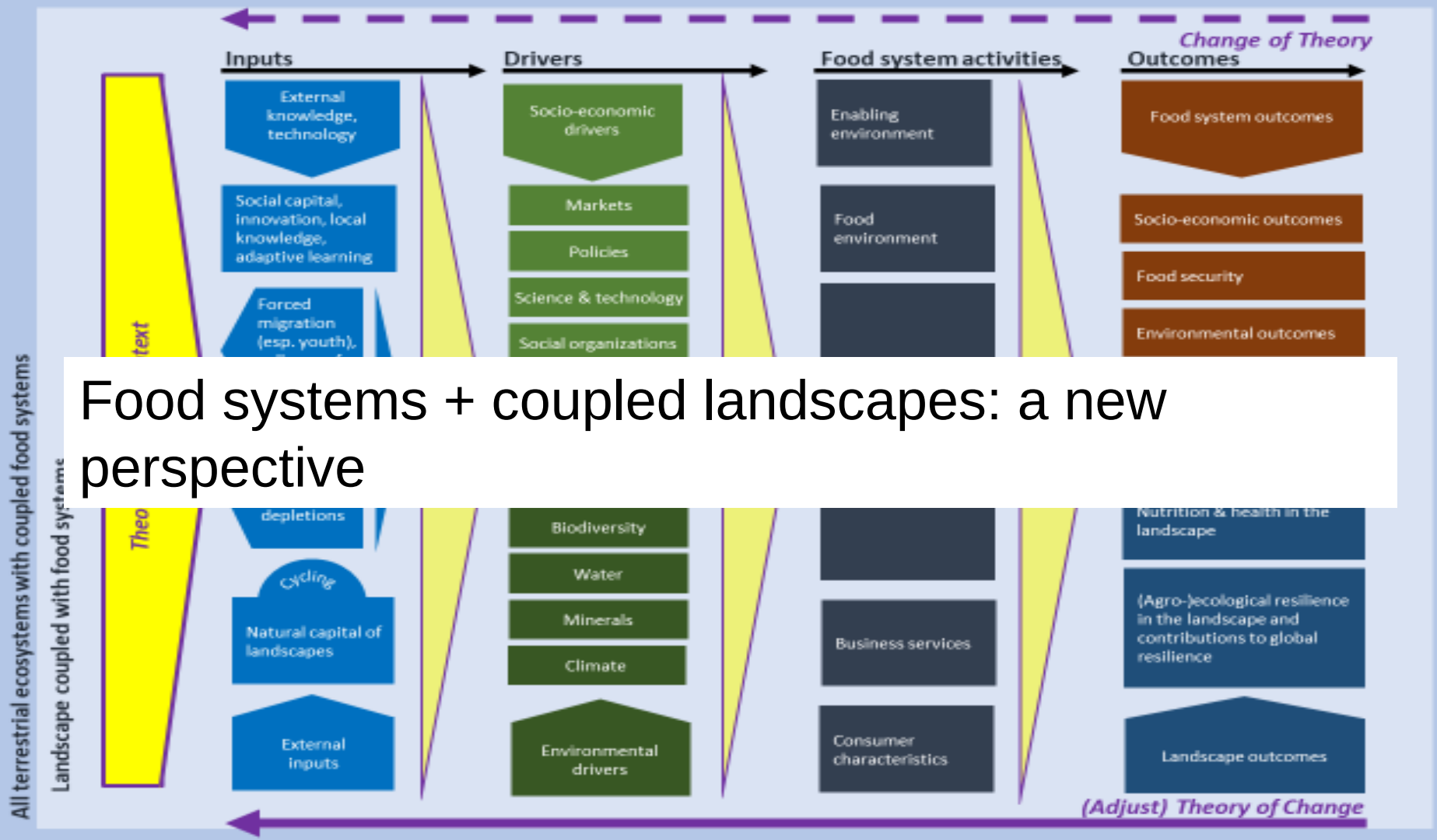


Source: Leigh Ann Winowiecki

Changes in Soil Organic Carbon Overtime

- Tracking soil health over time is key for informing and prioritizing investments.
- In order to do this, the maps produced must be accurate to detect these changes.
- This map of Sri Lanka shows hotspot areas in the north and east that have lost SOC between 2002 and 2012 (500 m resolution)
  - dark brown is high carbon,
  - yellow is low carbon





Food systems + coupled landscapes: a new perspective

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Emerging ICAR-ICRAF research agenda

- Comparative analysis of productivity, profitability and nutritional values
- Assessment of contributions to and impacts on ecosystem services
- Contributions of microbes (soil microbiota)
- Modeling

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ICAR-ICRAF contd.

- Capacity building on research and application tools and technologies
- Data and evidence generation and management
- All-India scope, but with immediate collaboration in Andhra Pradesh (avail resources)

Thanks and over to **Mr Vijay Kumar!**

(Questions after his presentation)

Contact: Dr Ravi Prabhu/ Dr J Rizvi/ Dr SK Dhyani

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Email id: r.prabhu@cgiar.org