INTERNATIONAL CROPS RESEARCH INSTITUTE FOR THE SEMI-ARID TROPICS

Scaling Regenerative Agriculture for Food and Nutrition Security in Drylands of Tropics

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Unparallel Challenges

- A global 'hotspots' for contemporary and future climate vulnerability
- ACC has reduced global agricultural TFP by about 21% since 1961, a slowdown that is equivalent to losing the last 7 years of productivity growth
- Food systems are responsible for a 18 Gt CO2 equivalent per year globally which is 34%, of the global anthropogenic GHG emissions
- Natural resources are highly stressed- land degradation, already water scarce which set to drop to 550 m^3/year by 2050
- Biodiversity loss- extinction
- Fertilizer crisis
- Emerging pest and diseases
- Need more nutritious food from less inputs, degraded/rapidly depleting natural resources and higher climatic variability

Global Cropland Extent and Change (2000–2019)

Only 8 annual harvests to achieve SDGs by 2030
We Need to Move Faster Not Only to Stop Degenerating But Regenerating Our Natural Resources for a Secured Future through Regenerative Agriculture

Potapov et al (2021), Nature Food

Regenerative Agriculture?

The farming/land management practices and approaches that-

- among other benefits, reverse climate change by rebuilding soil organic matter and restoring degraded soil biodiversity—resulting in both carbon drawdown and improving the water cycle
- uses <u>soil conservation as the entry point</u> to regenerate and contribute to multiple provisioning, regulating and supporting ecosystem services
- <u>enhance</u> not only the <u>environmental</u>, but also the <u>social</u> and <u>economic</u> dimensions of sustainable food production

Principles	Practices
Minimum tillage	conservation agriculture, Zero-till, reduced tillage, controlled traffic
Maintain soil cover	Mulch, cover crops, permaculture
Build soil C	Biochar, compost, green manures, animal manures
Sequester carbon	Agroforestry, silvopasture, tree crops, no-till+Residues
Relying more on biological nutrient cycles	Animal manures, compost, compost tea, green manures and cover crops, maintain living roots in soil, inoculation of soils and composts, reduce reliance on mineral fertilizers, organic agriculture, permaculture
Foster plant diversity	Diverse crop rotations, multi-species cover crops, agroforestry
Integrate livestock	Rotational grazing, holistic grazing, pasture cropping, silvopasture
Avoid pesticides	Diverse crop rotations, multi-species cover crops, agroforestry
Encouraging water percolation	Biochar, compost, green manures, animal manures, holistic grazing, No-till+ residues

RA Strategy for Systemic Transformation

01

Quality science

Science for food systems transformation towards key SDGs

02

Strategic and complementing partnerships

Working together: NARS, CG, ARIs, Private sector, Global and regional institutions

03

Greater investments

Govts, philanthropists, Foundations, Corporates, Civil Society

04

Production to consumption continuum

With focus on One Health

05

Science of scaling

Linking research outputs with local, national, regional & global priorities with business models

Source: Jat and Shirsath (2022)-Unpublished

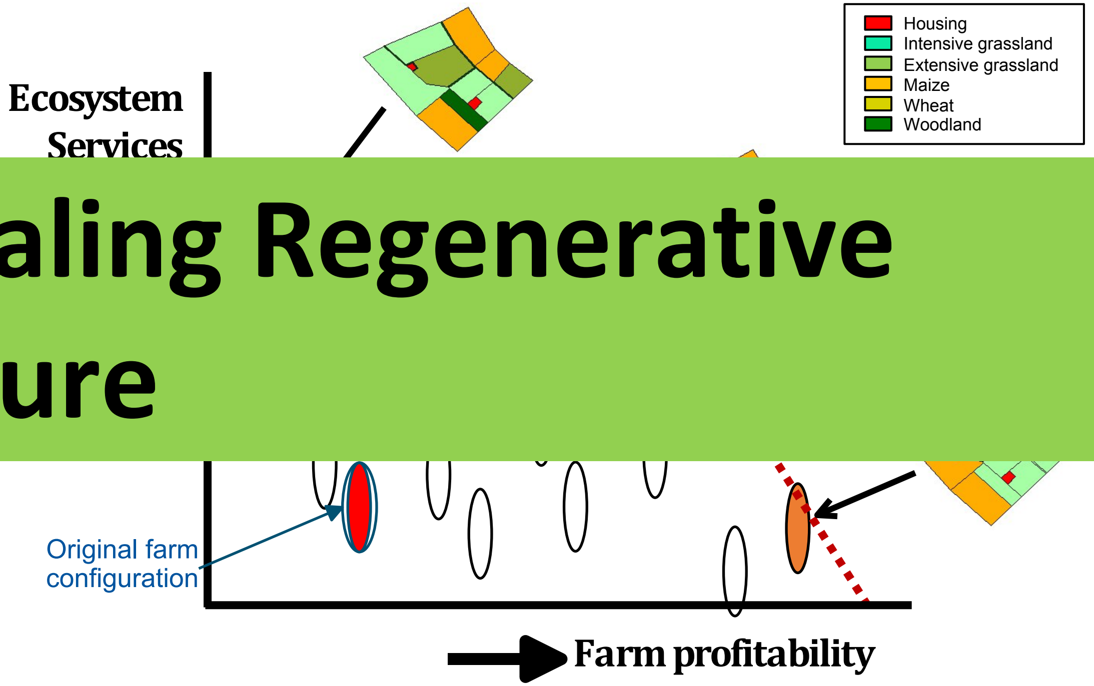
ICRISAT 1972-2022

Scaling Challenge for Regenerative Agriculture

Most agricultural R&D has been "component-focused" which often limits scaling and the potential for impact at scale and amplifies trade-offs between livelihood objectives of RA actors

10-Point Agenda for Scaling Regenerative Agriculture

Adapted from CGIAR-SI-MFS (2022)



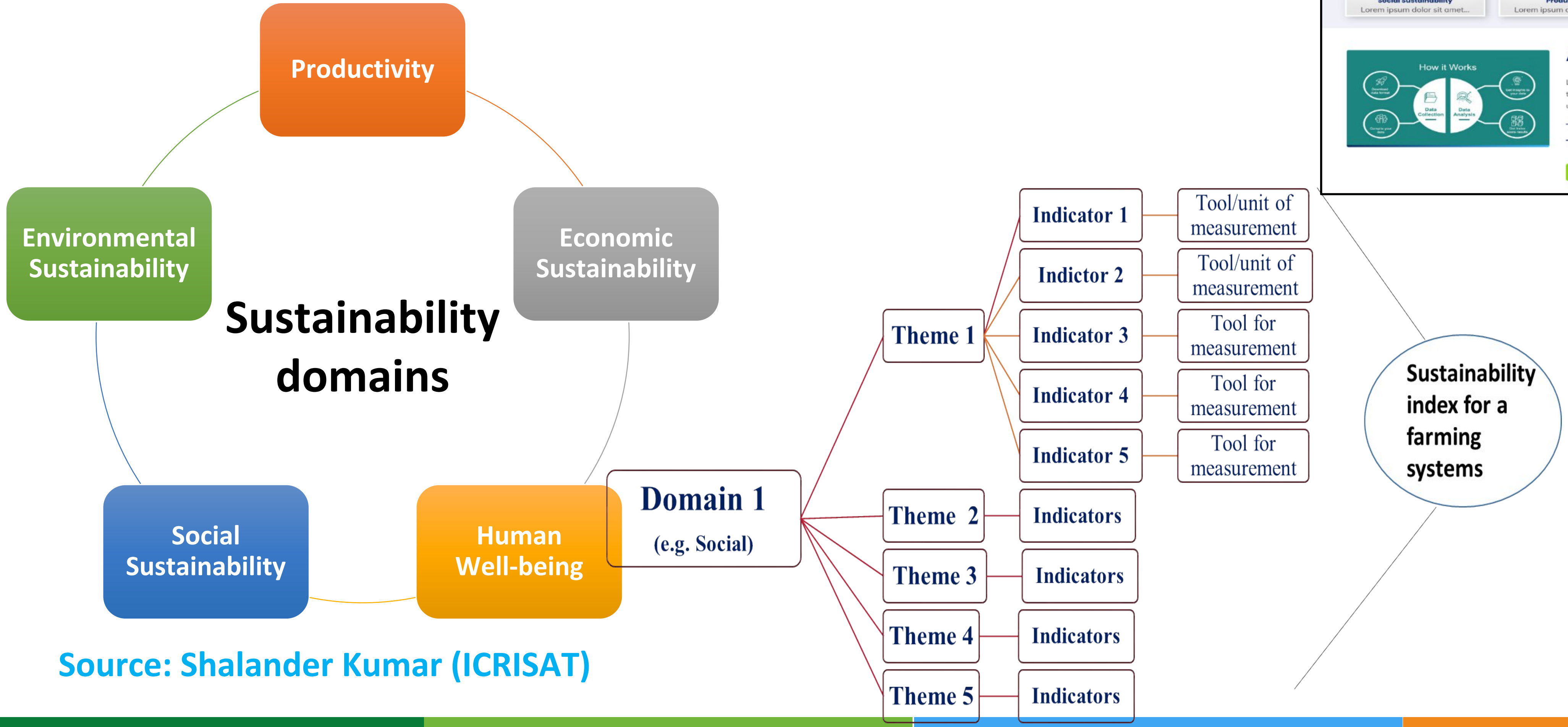
Groot et al

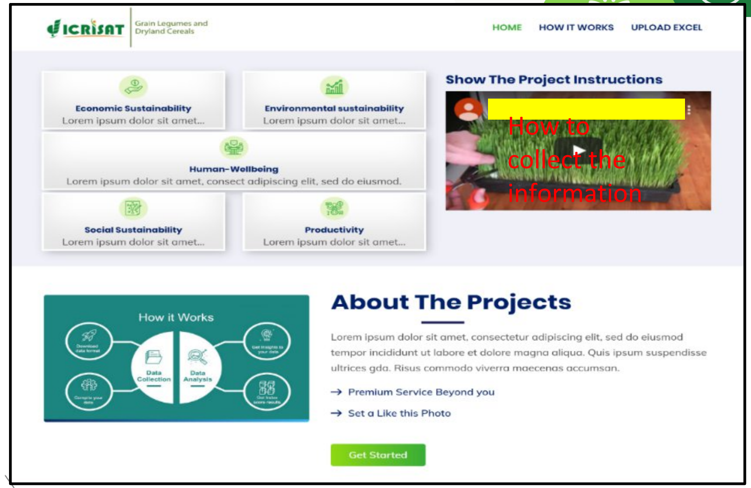
1. One Size Doesn't Fit All

- **A common set of principles can be identified, but the large diversity of farms, farming systems, farmer circumstances and take-off points across the diversity means that a tailored approach is needed for implementation of RA practices.**
- ***Tailor made solutions for RA:*** **Integrate genetic, ecological, and socio-economic innovations & information and Consider whole-farm & household issues**

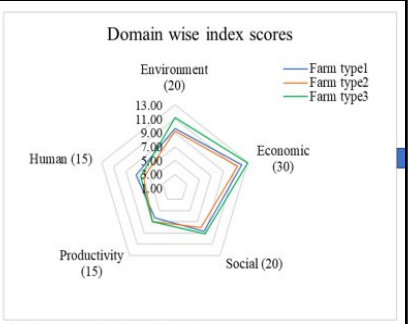
Toolbox for Designing Sustainable Farming Systems

- ✓ Multi-dimensional sustainability assessment tool
- ✓ Identifying and evaluating alternative strategies for resilient agriculture
- ✓ Co-designing sustainability interventions
- ✓ Tracking impact of sustainability indicators





Example of Suryapet district in Telangana

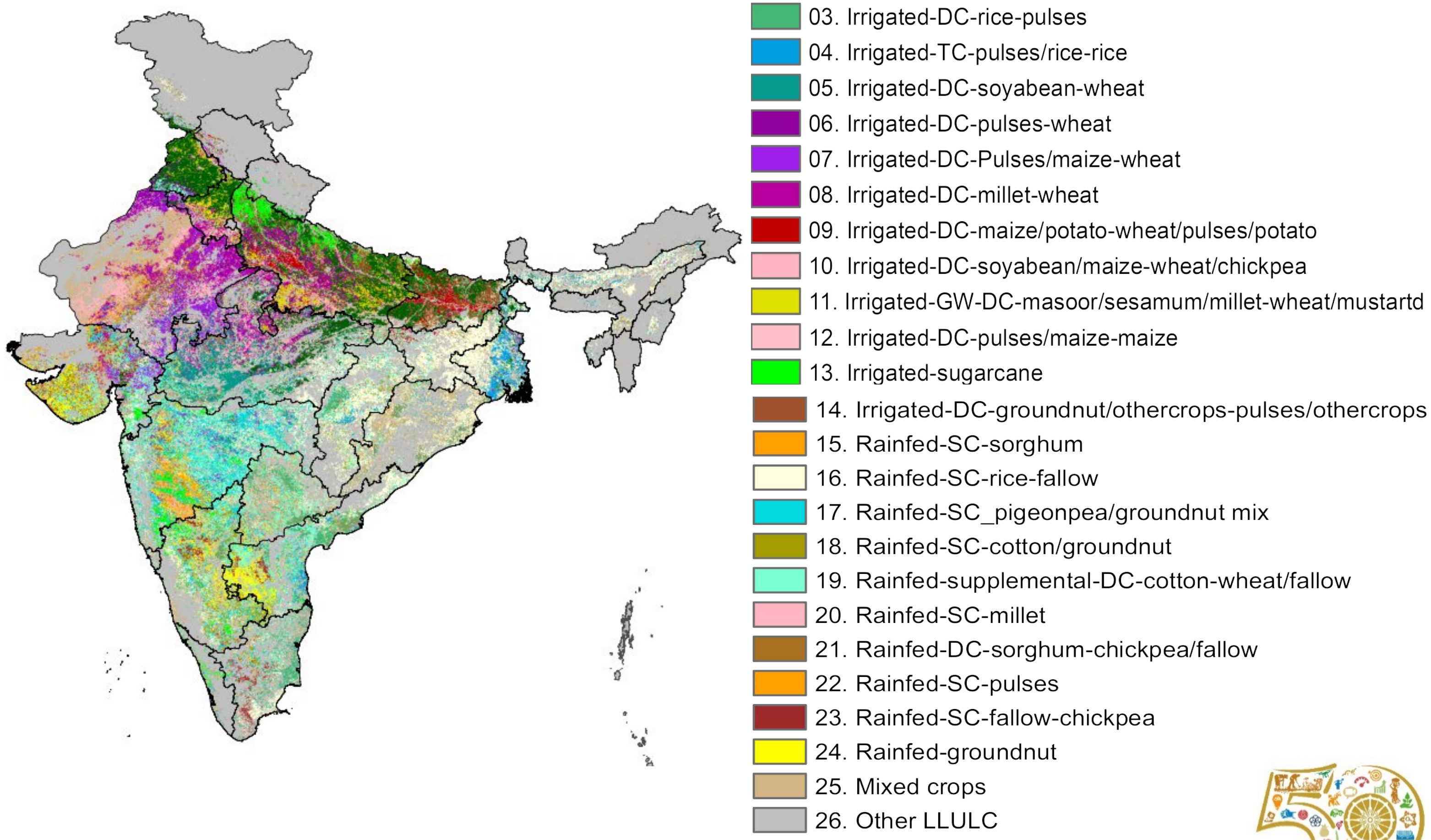


Performance of different farm types across sustainability domains

Source: Shalander Kumar (ICRISAT)

2. Mapping crop types and prioritize Cropping/farming systems for deploying RA:

- Significant advancements have been made in geo-spatial technologies which can help in spatial and temporal mapping of crop types and cropping systems
- This will help in defining RA input-value chains, market linkages and knowledge hubs for scaling RA

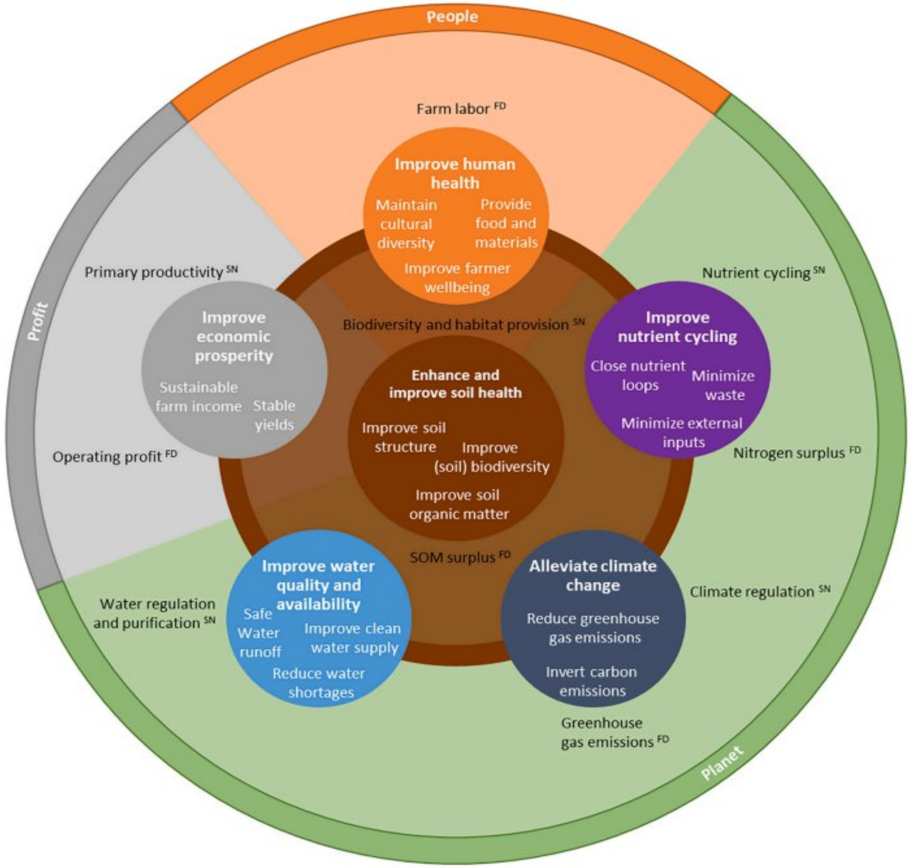


Map: Murli et al (2022), ICRISAT

3. Targeted Bundled System Solutions

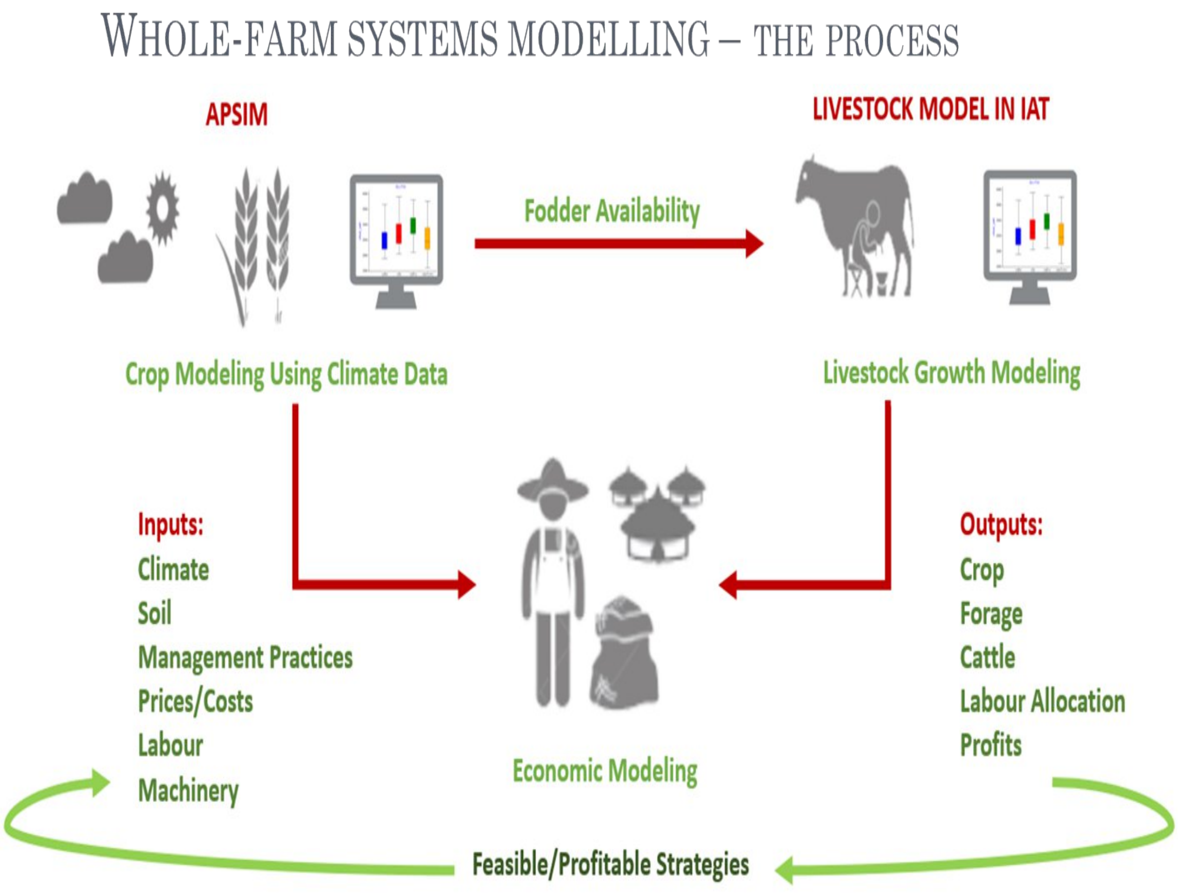
- **Congruence Between the Three Pillars (People, Planet and Profit) of Sustainability, the Core Objectives of RA/SI**

- **Science evidence-based consensus with context and farming systems-specific adapted bundled RA practices with well-defined recommendation domains for accelerated adoption**



Schreefel et al (2022)

WHOLE FARM BIO-ECONOMIC MODELING - A Systems Approach
Identifying most profitable and resilient crop-livestock systems



Example

Identifying most profitable crop-livestock systems in Niger: Potential impact of different interventions on household cash flows

Scenarios	Farm HH type 1	Farm HH type 2	Farm HH type 3
1. Improved dual purpose cultivar of pear millets	5%	9%	4%
2. Improved local cow (in place of existing low yielding cows)	50%	40%	27%
3. Improved small ruminants ((in place of existing breed)	3%	1%	1%
4. Improved dual purpose millets + Improved local cow	54%	76%	42%
5. Improved dual purpose millets + Improved local cow + improved SR	54%	77%	44%
6. Improved dual purpose millets + Improved local cow + improved SR + 15% higher price for cattle and SR	57%	79%	45%

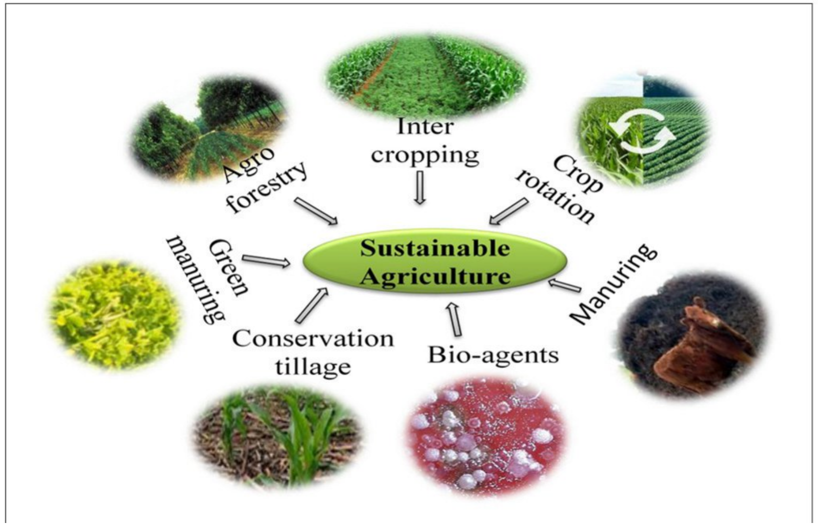
Source: Shalander Kumar (ICRISAT)

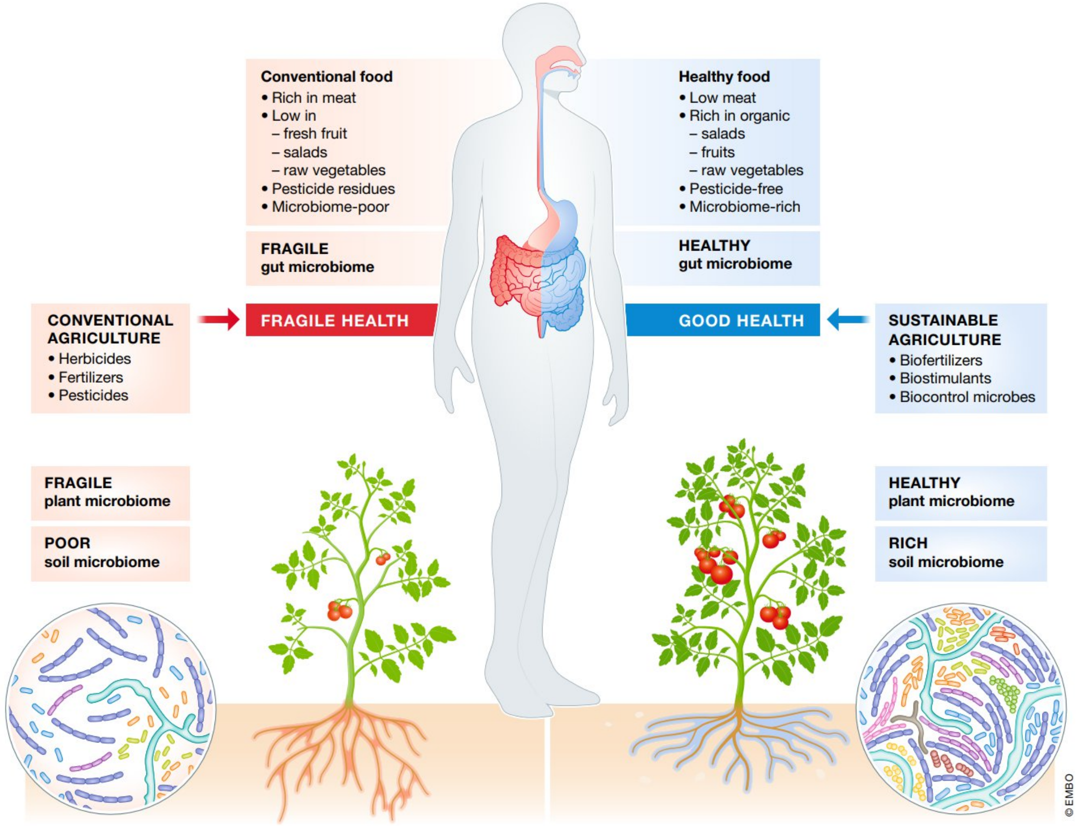
4. Phased Build-on Approach

- Neither we have full packages of RA ready, nor those can be developed over-night but that doesn't mean we should wait for long.
- A phased approach would therefore can help to immediately integrate the well tested elements/practices of RA to build the confidence of stakeholders specially farmers.
- This can be built on success stories/learnings, constraints and opportunities on RA. Parallelly, need to co-design and conduct basic and adaptive research

5. Bio-Banks for Regenerative Agriculture

- Soil-crop microbiome interactions governs the management practices, production potential and sustainability of RA systems.
- Comprehensive strategic research would be needed on ecological plant protection, rhizosphere microbiome effects of nutrient cycling, capture and release, plant uptake and produce quality



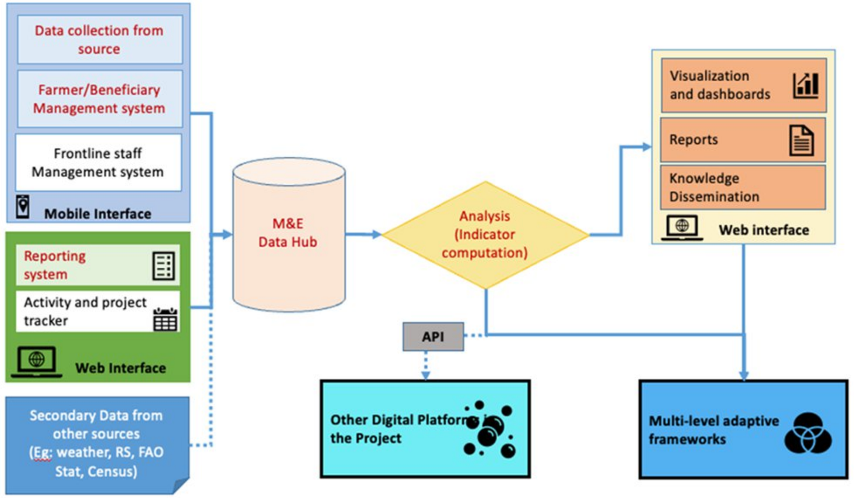


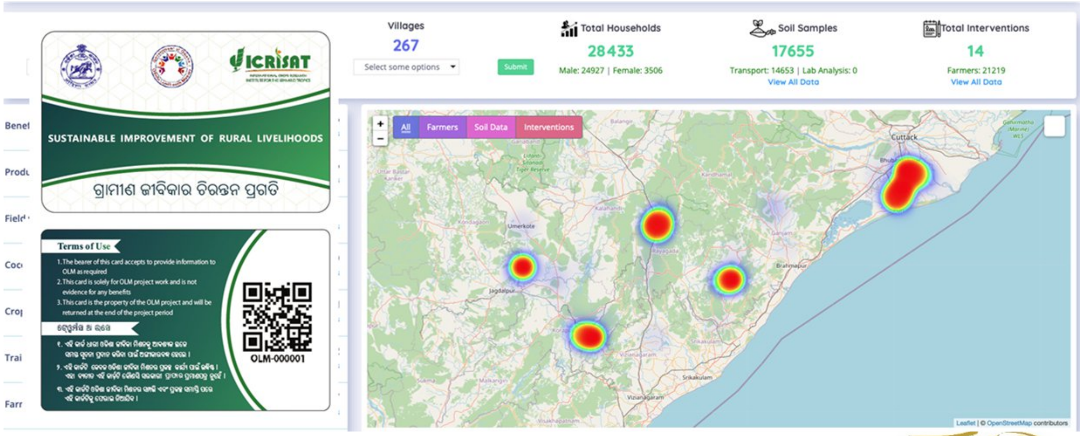
Direct and indirect effects of the plant microbiota on the human gut microbiome (Hirt, 2020)

6. Harness The Power of Digital Tools:

RA is knowledge intensive concept- digital tools and techniques can help

- Data-driven **predictive and prescriptive weather advisories** for better planning of crop cultivation
- Use of **Artificial Intelligence (AI) and computer** vision -based **pests and disease detection**
- Leverage **Machine Learning (ML)** tools for **site specific fertilizer recommendations**
- **IoT based sensors** for better understanding, manage of soils
- Digital tools to **Measure, Report and Verify and Value-add** in realizing **value from carbon**
- End-to-end digitally enabled **monitoring to enable traceability** of food source
- **Gamification** based **learning, behaviour change tools and resources** for targeted data-driven **extension services and farmer engagement**





Slide: Satish, ICRISAT

7. Approaches, Tools, Protocols and Processes for Ecosystem Services- Environmental, Social and Economic dimensions

- **The potential for farmers to directly benefit from soil C sequestration may be limited but life-cycle analysis can provide larger carbon offsets to incentivise farmers through carbon credits and ecosystem services from RA**
- **Approaches, tools, protocols, tracking, verification and enabling policies are needed for mainstreaming RA in the R&D plans**
- **Pull-factors for accelerated adoption**

Considering bringing 1.5 mha under DSR-ZT wheat and 0.5 mha under maize-wheat from conventional RW system (Usha, Umang, ML Jat)

CO_2 N_2O CH_4

10 Million Ton reduction in GHG (CO_2e)

₹ 1500 Cr of gross value added in agriculture

13 km^3 reduction in ground water usage

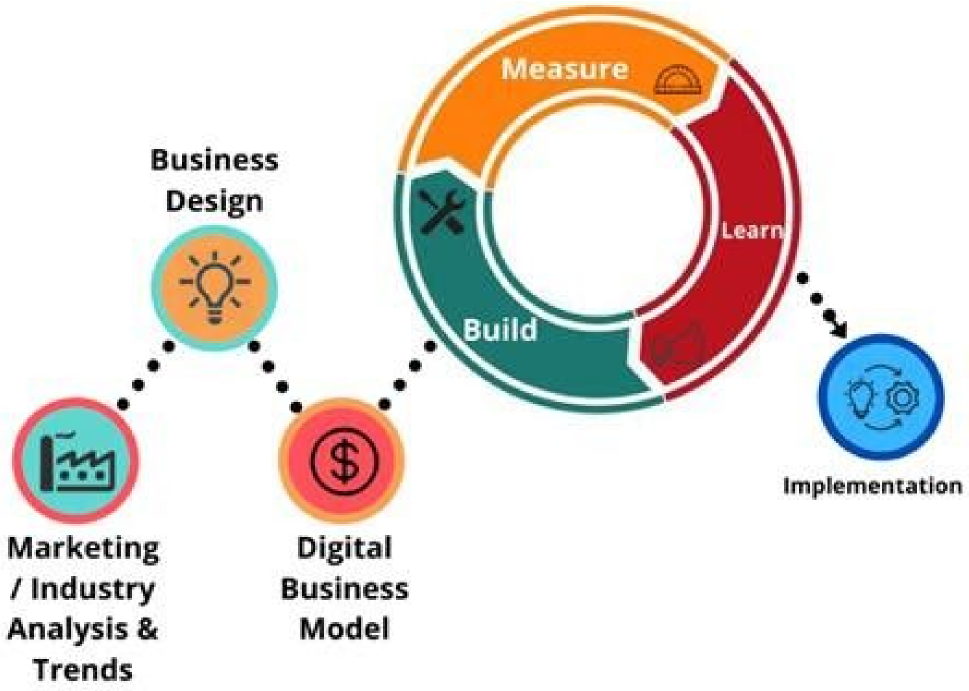
₹ 1,100 Cr Saving on energy cost

₹ 155 Cr Saving on N fertilizer subsidy

8. Define Business Models and Market Opportunities

Identifying the potential niche for scaling and accelerated adoption of RA

- Comprehensive assessment –
  - ✓ Consumer perceptions & preferences,
  - ✓ Market size (local-FPOs, regional and international)
  - ✓ Entrepreneurship opportunities- Agricultural produce and carbon markets from RA



Potential Opportunities for Carbon Farming

- Aligning national governments commitments to global priorities: Paris Agreement & SDGs
- Obligations towards C-neutrality

regenerative farming practices

- A win-win business model which may create PULL factor for adoption of regenerative sustainable agriculture practices

INTERVIEW: MAHUA ACHARYA, MD & CEO, CESL

‘Market size for carbon credits trading around $300 bn/year’

The globalcarbon credit market is promising to become a significant source of funding for development projects across the world. However, the amount of

26 UN Climate Change Conference held in Glasgow in November 2021, where India made its 2070 net zero announcement. Edited excerpts:

How do you think the global carbon credit market is shaping up?

There is no one single market for carbon credits. While there are sovereign markets, there is also the voluntary market. We are using the voluntary market for now. Private companies have been preferring the voluntary market where prices of carbon credits vary significantly, from as low as 10 cents to $80 as pricing depends on various factors. The market

alleviation and enhance women's empowerment, tend to fetch higher prices. Projects such as supplying three-wheeler electric vehicles, though they affect people's lives and impact employments, have no specific guidelines for carbon credits. After Glasgow, along with India's 2070 net zero announcement, CESL's LED programme becomes particularly important.

What is the status of CESL's LED distribution programme and how does it aim to gain from the global carbon trading market?

We charge ₹10 for each LED

completed by July. We are hoping to sell the credits in the market by August, where we are expecting a price of around $3-$3.5 per carbon credit.

its or simply invest in energy efficiency. We are planning to reach out to the states to show them clearly how the mechanism works.

How are things in the other areas where CESL is operating?

For our EV bus programme, where we are the demand aggregators, we have received orders from Hyderabad, Bengaluru, Delhi and Surat. We are also expecting orders from Chennai, Ahmedabad and Kolkata. We will also be extremely excited to get orders from Mumbai and Pune as well. Altogether, we expect to place orders for more than

Indian Parliament Sabha recently passed a Bill to set up a nationwide carbon trading market

9. Capacity Development and Certification Courses

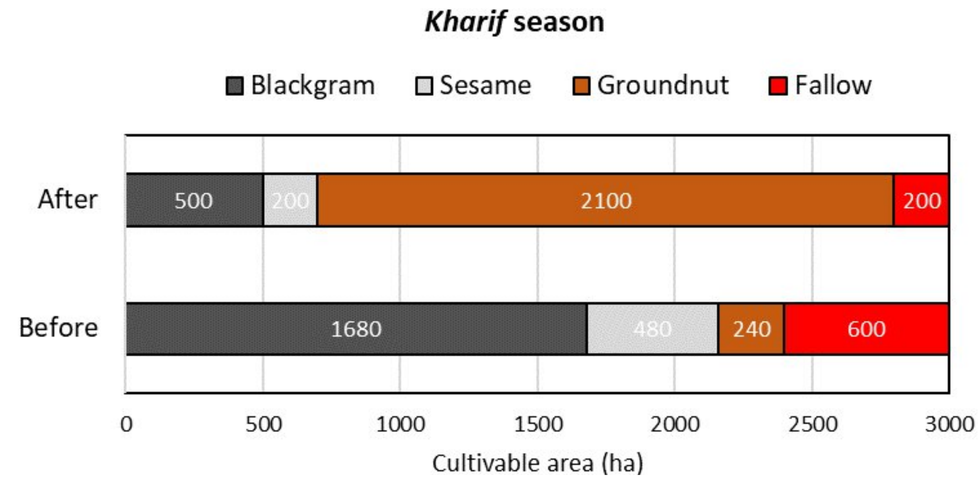
A new cadre of RA-Community of Practitioners (RA-CoP) need to be developed

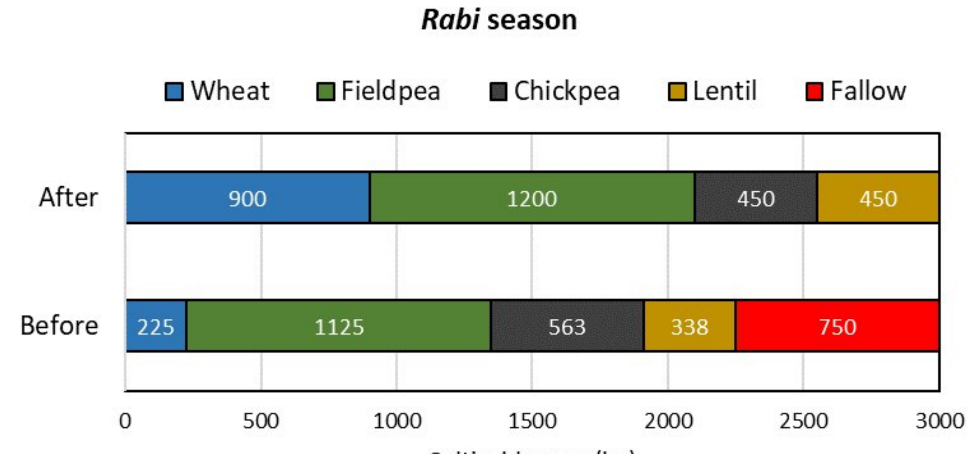
- ✓ Inclusion of RA in course curriculum,
- ✓ Development of inclusive training modules,
- ✓ Hands-on training on bundled RA practices and
- ✓ Certification courses on RA as structured and regular activity
- ✓ Centre of Excellence on RA

10. Science Evidence Based Policy and Investments

Low Emission Landscape Approach for Sustainable Modernization of Traditional Rainwater Harvesting in drylands: Example From Bundelkhand, Central Indian Landscapes

Change in cropping pattern/Sustainable Intensification





Ramesh Singh et al, ICRISAT

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Thank YOU

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