Scaling Regenerative Agriculture for Food and Nutrition Security in Drylands of Tropics
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 m³/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
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 soil conservation as the entry point to regenerate and contribute to multiple provisioning, regulating and supporting ecosystem services
- enhance not only the environmental, but also the social and economic dimensions of sustainable food production

<table>
<thead>
<tr>
<th>Principles</th>
<th>Practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum tillage</td>
<td>conservation agriculture, Zero-till, reduced tillage, controlled traffic</td>
</tr>
<tr>
<td>Maintain soil cover</td>
<td>Mulch, cover crops, permaculture</td>
</tr>
<tr>
<td>Build soil C</td>
<td>Biochar, compost, green manures, animal manures</td>
</tr>
<tr>
<td>Sequester carbon</td>
<td>Agroforestry, silvopasture, tree crops, no-till+Residues</td>
</tr>
<tr>
<td>Relying more on biological nutrient cycles</td>
<td>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</td>
</tr>
<tr>
<td>Foster plant diversity</td>
<td>Diverse crop rotations, multi-species cover crops, agroforestry</td>
</tr>
<tr>
<td>Integrate livestock</td>
<td>Rotational grazing, holistic grazing, pasture cropping, silvopasture</td>
</tr>
<tr>
<td>Avoid pesticides</td>
<td>Diverse crop rotations, multi-species cover crops, agroforestry</td>
</tr>
<tr>
<td>Encouraging water percolation</td>
<td>Biochar, compost, green manures, animal manures, holistic grazing, No-till+ residues</td>
</tr>
</tbody>
</table>
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
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)
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

Sustainability domains

- Environmental Sustainability
- Economic Sustainability
- Social Sustainability
- Human Well-being

Domain 1 (e.g. Social)

Source: Shalander Kumar (ICRISAT)
2. Mapping crop types and prioritize Cropping/farming systems for deploying RA:

- Significant advancements have been made in geospatial 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)
Identifying most profitable and resilient crop-livestock systems in Niger: Potential impact of different interventions on household cash flows

**Example**

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

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 govern 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.
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

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

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

Regenerative farming practices trading around $300 bn/year. The market size for carbon credits in the Indian market is expected to grow by 10-15% in the next two years, with a potential of $3 $5 bn carbon credit.
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

**Kharif season**
- Blackgram
- Sesame
- Groundnut
- Fallow

<table>
<thead>
<tr>
<th>Cultivable area (ha)</th>
<th>After</th>
<th>Before</th>
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<tbody>
<tr>
<td>0</td>
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<td></td>
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<tr>
<td>3000</td>
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</table>

**Rabi season**
- Wheat
- Fieldpea
- Chickpea
- Lentil
- Fallow

<table>
<thead>
<tr>
<th>Cultivable area (ha)</th>
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<tr>
<td>500</td>
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<tr>
<td>1000</td>
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<tr>
<td>1500</td>
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<tr>
<td>2000</td>
<td>450</td>
<td>750</td>
</tr>
<tr>
<td>2500</td>
<td></td>
<td></td>
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<tr>
<td>3000</td>
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Ramesh Singh et al, ICRISAT