Sustainable Intensification of Staple Crop Systems in the Eastern IGP

Mina Devkota Wasti

25 March, 2016
Kathmandu, Nepal
CHALLENGES: POPULATION, LAND, RESOURCES, CLIMATE

Each dot = 50,000 people living under $1 day$^{-1}$.

Data: K. Mottaleb

Erratic Precipitation – Central Bihar
Average:
1189 mm, CV (%): 24, Range: 690 - 1807

Arable land per capita (ha)

Data: K. Mottaleb
MAJOR ONGOING INITIATIVES

- Cereal Systems Initiative for South Asia – ‘CSISA’
- Climate Change, Agriculture and Food Security – ‘CCAFS’
- Agricultural Innovation Project – ‘AIP’
- Spurring a Transformation in Agriculture through Remote Sensing – ‘STARS’
- Sustainable and Resilient Farming Systems in the Indo-Gangetic Plains – ‘SRFSI’ (Koshi River Basin)
- Bourlag Institute for South Asia – ‘BISA’
<table>
<thead>
<tr>
<th>SI TECHNICAL PRIORITIES</th>
<th>WATER PRODUCTIVITY</th>
<th>LABOR SCARCITY</th>
<th>SOIL DEGRADATION</th>
<th>CLIMATE SMART</th>
<th>YIELD</th>
<th>PROFIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conservation agriculture (CA)</td>
<td>**</td>
<td>**</td>
<td>***</td>
<td>***</td>
<td>*</td>
<td>***</td>
</tr>
<tr>
<td>Precision nutrient management</td>
<td>*</td>
<td>*</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>***</td>
</tr>
<tr>
<td>Scale-appropriate mechanization</td>
<td>*</td>
<td>***</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>***</td>
</tr>
<tr>
<td>Efficient water acquisition, conveyance and use</td>
<td>***</td>
<td>*</td>
<td>*</td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>Laser land leveling</td>
<td>***</td>
<td>*</td>
<td>**</td>
<td>*</td>
<td></td>
<td>***</td>
</tr>
<tr>
<td>Elite seeds</td>
<td>**</td>
<td></td>
<td>**</td>
<td>***</td>
<td>***</td>
<td>**</td>
</tr>
<tr>
<td>Systems intensification (double cropping)</td>
<td>**</td>
<td></td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>Post-harvest</td>
<td></td>
<td>***</td>
<td>**</td>
<td>*</td>
<td></td>
<td>***</td>
</tr>
<tr>
<td>Livestock feeding</td>
<td></td>
<td></td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>Seed systems</td>
<td>**</td>
<td>*</td>
<td>**</td>
<td>***</td>
<td>***</td>
<td>**</td>
</tr>
</tbody>
</table>
**Leveraging the agricultural innovation system (AIS)**

‘a network of organizations, enterprises, and individuals focused on bringing new products, new processes, and new forms of organization into economic use…..’ (WB 2006)

**CIMMYT’s work plays complementary and catalytic roles by engaging and uniting partners for indirect impact pathways**
Optimizing intensive cereal-based cropping systems addressing current and future drivers of agricultural change in the northwestern Indo-Gangetic Plains of India

Mahesh K. Gathala\textsuperscript{a,c}, Virender Kumar\textsuperscript{a,b}, P.C. Sharma\textsuperscript{c}, Yashpal S. Saharawat\textsuperscript{a,d}, H.S. Jat\textsuperscript{c}, Mainpal Singh\textsuperscript{c}, Amit Kumar\textsuperscript{c}, M.L. Jat\textsuperscript{b}, E. Humphreys\textsuperscript{f}, D.K. Sharma\textsuperscript{c}, Sheetal Sharma\textsuperscript{a}, J.K. Ladha\textsuperscript{a,*}
Adoption of laser land leveling in IGP (ha)

Fragmented land
How Important to Level the Land: An Example

- Increase crop area
- 15-20% water saving
- 10-15% higher yield

DSR in unlevelled field
DSR in laser levelled field

Grain yield (kg ha\(^{-1}\))

<table>
<thead>
<tr>
<th></th>
<th>Levelled</th>
<th>Un levelled</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Platform for scaling out to farmers.
For ZT, 1,600 service providers, 98,000 HH and > 50,000 ha in 2013-14 in Bihar + EUP.
All other factors held equal, 458 kg ha\(^{-1}\) yield gain with an aggregate estimated value of ~ $4,400,000.
THE THERMAL WINDOW FOR WHEAT IS SHRINKING:
DIFFERENTIATING OPTIONS FOR INTERVENTION (BREEDING ADVANCES +++)

Bihar: Sowing date moved 5 d earlier, raising yield 0.25 t ha⁻¹

Systems approaches essential:
Short duration rice | Early establishment
Mechanized rice harvest | Drainage
Zero-tillage for wheat | Wheat variety
Time- and environment-specific N rates

Forgoing the fallow in Bangladesh’s stress-prone coastal deltaic environments: Effect of sowing date, nitrogen, and genotype on wheat yield in farmers’ fields

STRENGTHENING THE SCIENCE OF DECISION MAKING: HOW AND WHY DIFFERENT FARMER ‘TYPES’ CHOOSE TO INNOVATE (OR NOT)

FUNCTIONAL TYPOLOGIES

• Inform and guide research and interventions
• Strategic research for achieving scale

Data: S. López Ridaura
ENTRY POINTS FOR INTENSIFICATION REQUIRE MULTI-DIMENSIONAL ANALYSIS (AND PARTICIPATORY EVALUATION OF USER PREFERENCES) TO DEVELOP PALETTES OF OPTIONS
Axial flow pumps (AFPs) reduce energy requirements and costs for low-lift surface water irrigation

Private sector partners invest > $0.5 million to commercialize pumps
Geospatial surface water irrigation intensification targeting in Southern Bangladesh

Irrigation Assessment:
125,000 ha suitable for dry season intensification

Data: U. Schulthess, T. Krupnik, Z. Ahmed, A. McDonald
BIG CHALLENGES WITH BIG OPPORTUNITY: WINTER FALLOW DOMINATE

Only Possible through Proper Water Management and sustainable agriculture intervention
Critical research for coping with weather variability, developing fallows, and reducing the carbon footprint of intensive agriculture production.

- LLL for uniform water distribution
- Crop ecophysiology
- Terrain analysis and targeting
- Land design to minimize deep percolation
- CA: 1.5 t ha$^{-1}$
- AFP: 47%
Thank you for your interest!

Photo Credits (top left to bottom right): Julia Cumes/CIMMYT, Awais Yaqub/CIMMYT, CIMMYT archives, Marcelo Ortiz/CIMMYT, David Hansen/University of Minnesota, CIMMYT archives, CIMMYT archives (maize), Ranak Martin/CIMMYT, CIMMYT archives.