Innovations and Technological Interventions for Agri-Food Systems Transformation

Raj Paroda

Demographic Pressure on Agri-food Systems

Global: 2050 - 9.8 Billion

Poverty: 800 million people + 157 since Covid

Needing: 56% more food & land 165-600 m ha ?

India : 2023 - 1.41 million

India is poised to surpass China this year

Poverty: 16.4% (about 195 million)

Food grain requirement by 2030 : 50 mt (6 mt/year)

Out of Box Options: Cut on food waste, Rethink on meat,
Improve production efficiency,

Regenerative agriculture & one health

Global Challenges


SUSTAINABLE DEVELOPMENT GOALS
1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
SUSTAINABLE DEVELOPMENT GOALS

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Meeting SDG by 2030

INDIA

No Poverty:

- **Currently: 16.4 % - 195 million**

Zero Hunger:

- Over 46% undernourished children below 5 yrs (WHO)

For meeting global targets, India must achieve SDG

Paris Agreement

(Global temperature not > 1.5 degree C)

20/20/20 Targets: Effective since November, 2016

Nationally Determined Contribution (NDC)

1. **Reduction in Emission intensity** **Target - 35% - on track**
2. **Clean energy by non-fossil fuel sources** **Target - 40% - on track**
3. **Additional carbon sink (forest)**

   Target - 3 billion tons of CO_2 equivalent

   Forest cover : From 25 to 33% ?

(Possible Options : CA and Agro-forestry)

Covid 19 Pandemic

Covid has drawn global attention towards Food, Nutrition and Environmental Security

UN WFP – 157 m additional poor across 93 countries

UN Food Systems Summit 2021: Emphasis on local food systems and regenerative agriculture

Initiatives and Options

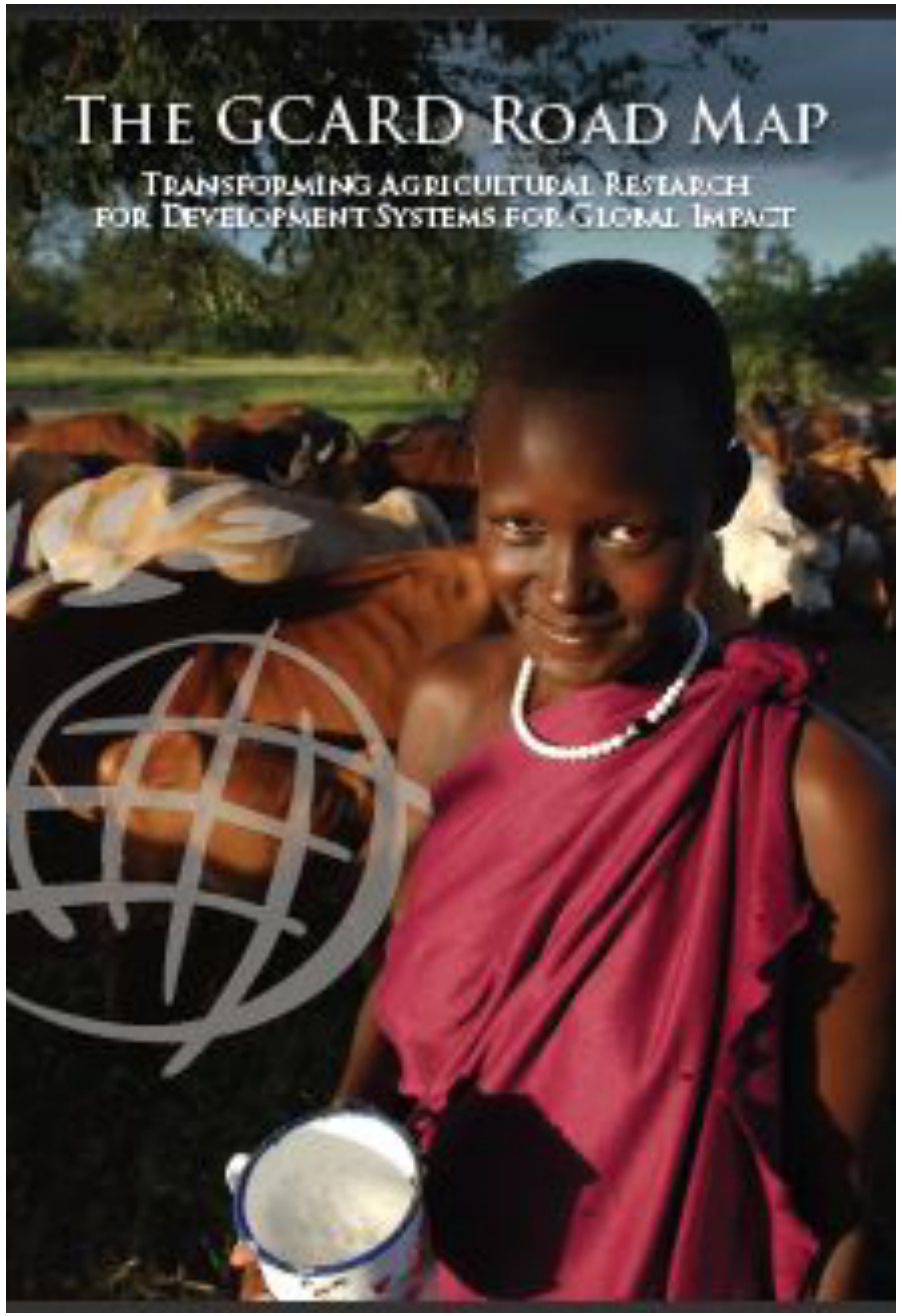
Green Revolution was Innovation Led

- Six fold increase in food grain production (50.0 mt – 323.5 mt)
- Horticulture production from 50 - 341 mt
- Milk production from 20 mt - 210 mt
- Fish production from < 1 mt -14.2 mt
- Buffer stock > 75 mt
- Export > US $ 50 billion
- Reduction in poverty (From 70.0 -16.4%)

Cradles of Success:

1. Political Will
2. Institutions and Human Resource
3. Progressive Farmers
4. Partnership (ex. CIMMYT & IRRI)

THE WAY FORWARD



GCARD Road Map

(Jointly by GFAR and CGIAR)

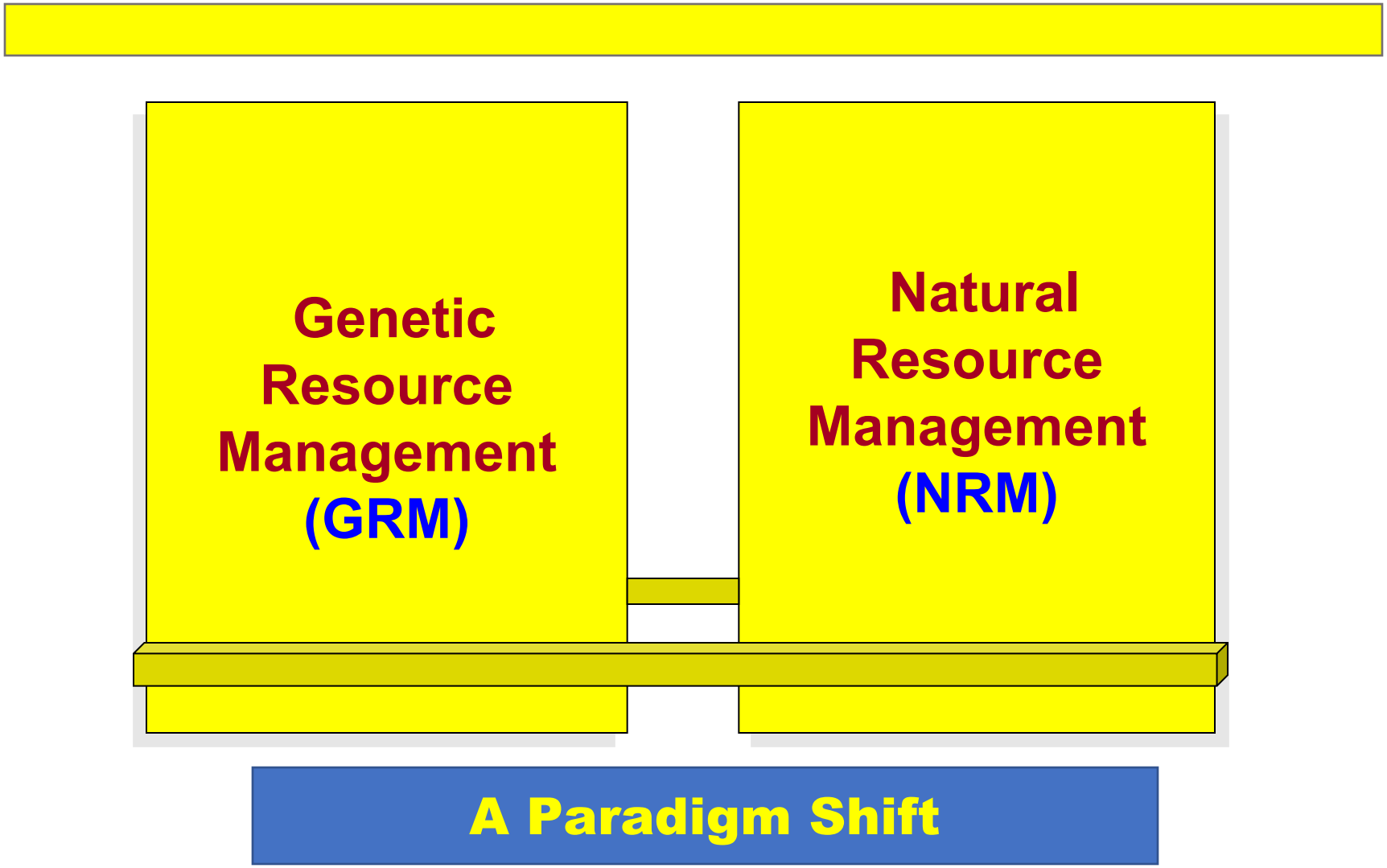
(2010)

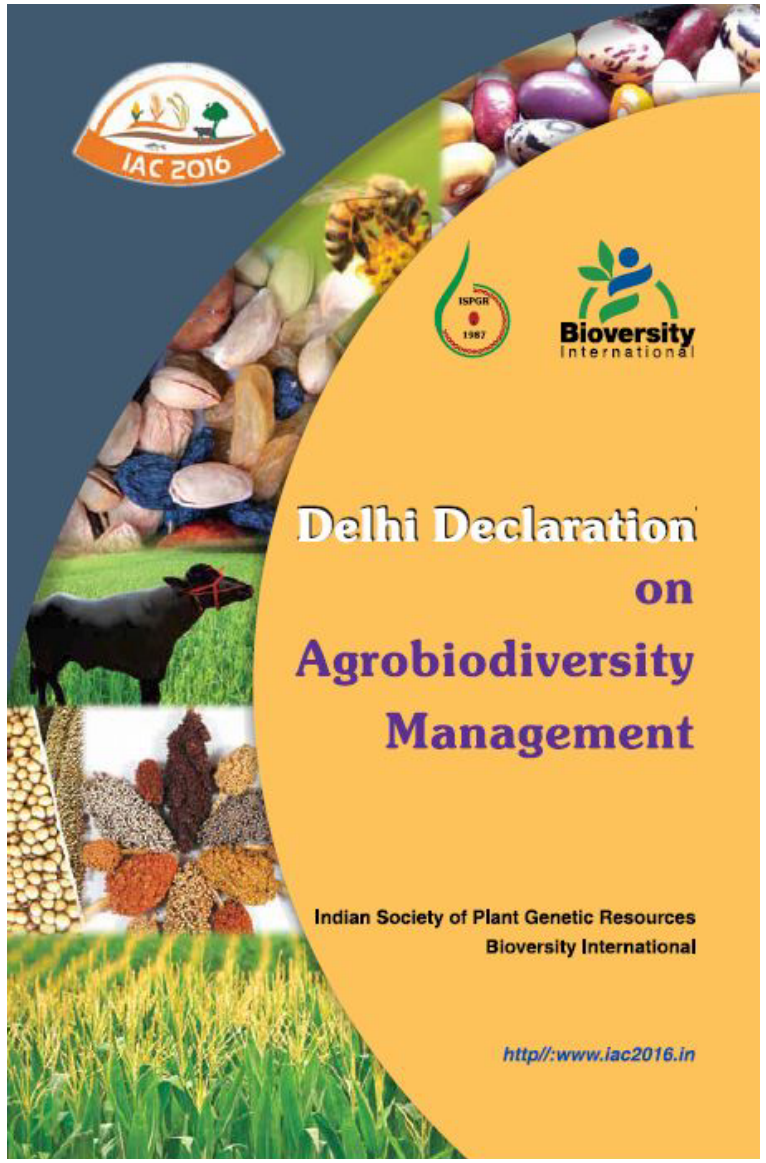
Key AR4D Messages:

1. **Needs of small holder farmers**
2. **Research reorientation towards**

   "Farming Systems" mode
3. **Increased Funding - 2-3 fold**


Farmer First
Agriculture


Genetic
Resource
Management
(GRM)
Natural
Resource
Management
(NRM)
A Paradigm Shift



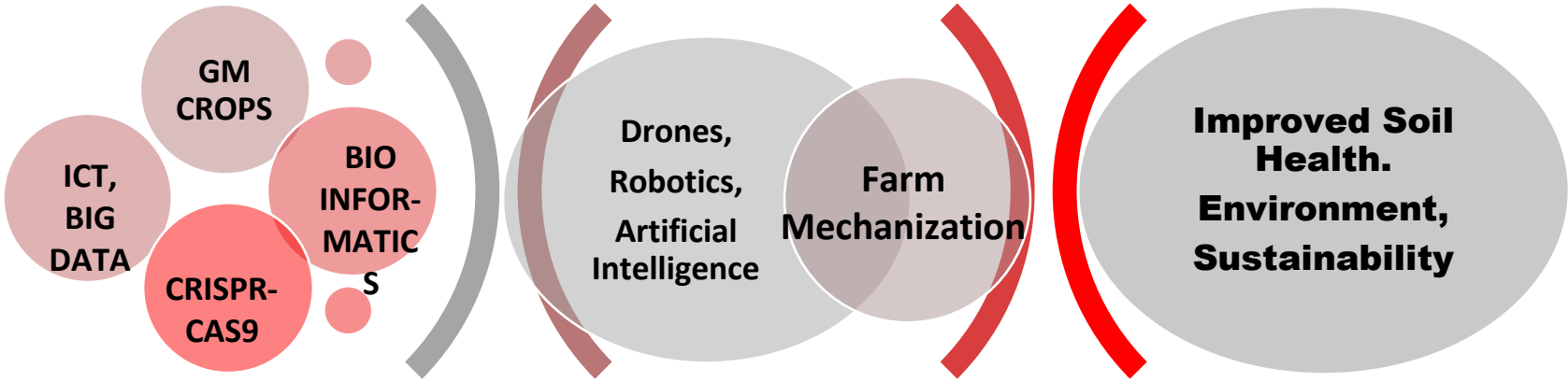
Complacency :

- Relatively less use of plant genetic resources in national breeding programs

- **The Global Partnership Initiative for Plant Breeding Capacity Building** (GIPB) is a multi-partner platform - by FAO since 2007 and supported by BMGF

- **Funding support for Pre-breeding has declined**

Harnessing Science for New Gains



NEW SCIENCE

PRESICION AGRICULTURE

ECO-REGIONAL PLANNING

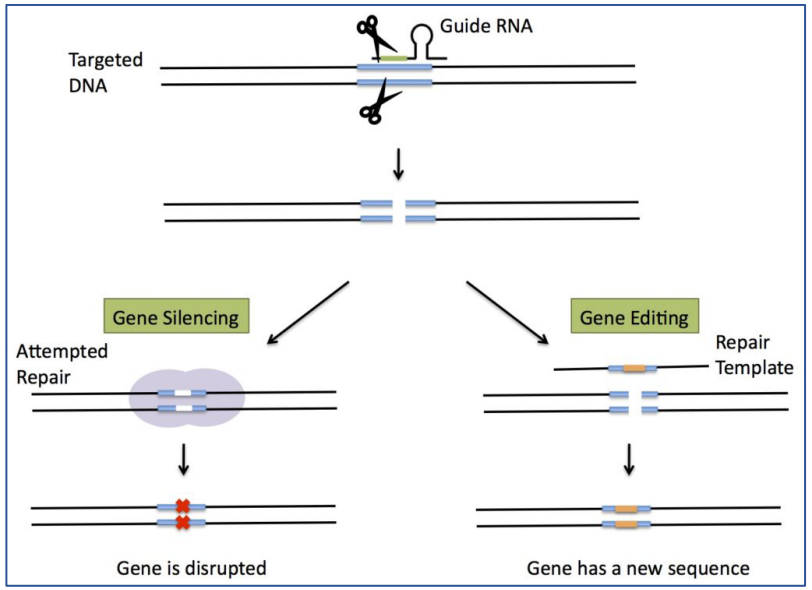
PPP and IP Protection ?

Genome Editing

Gene silencing using Crisper-cas technology

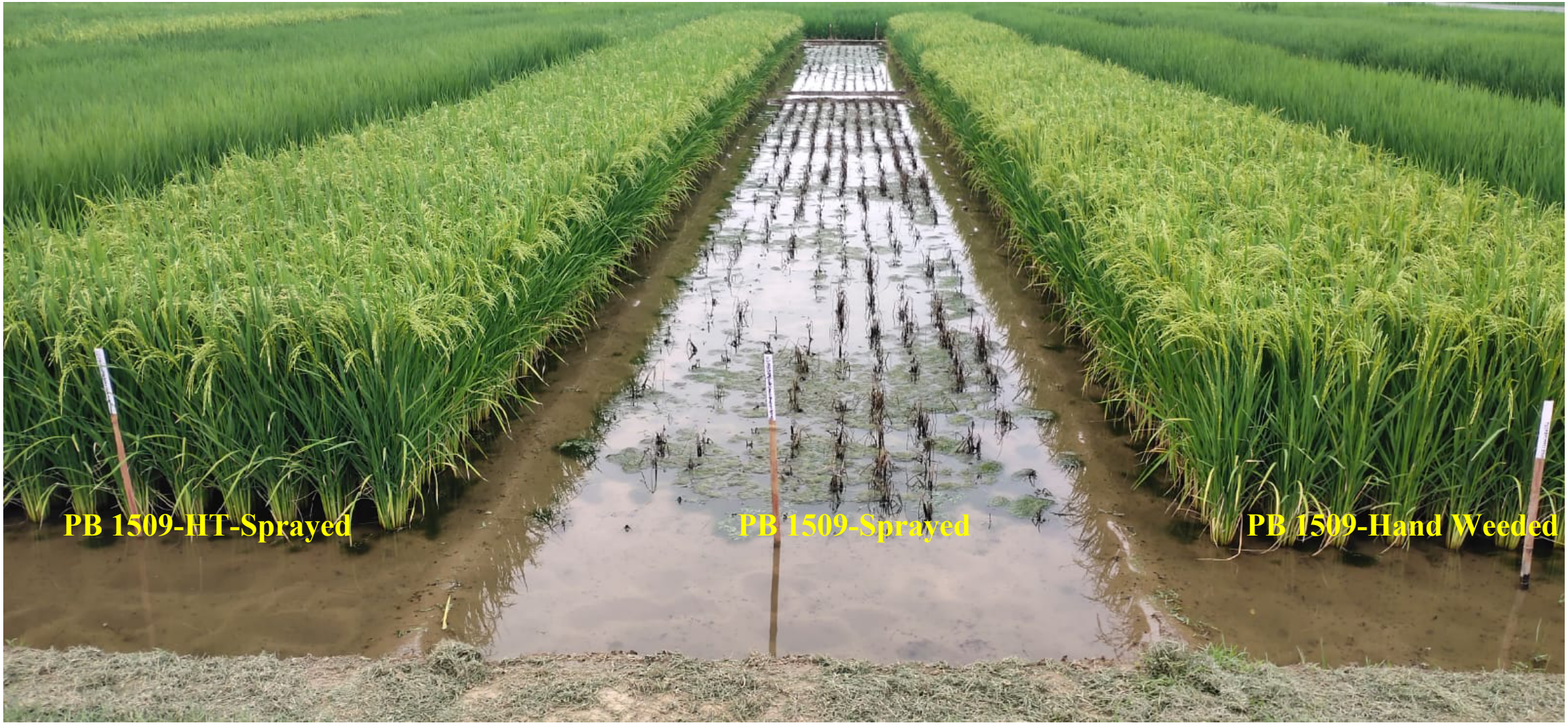
Crispr–cas (clustered regularly interspaced short palindromic repeats)

More precise and fewer safety concerns (SDN 1 & 2)



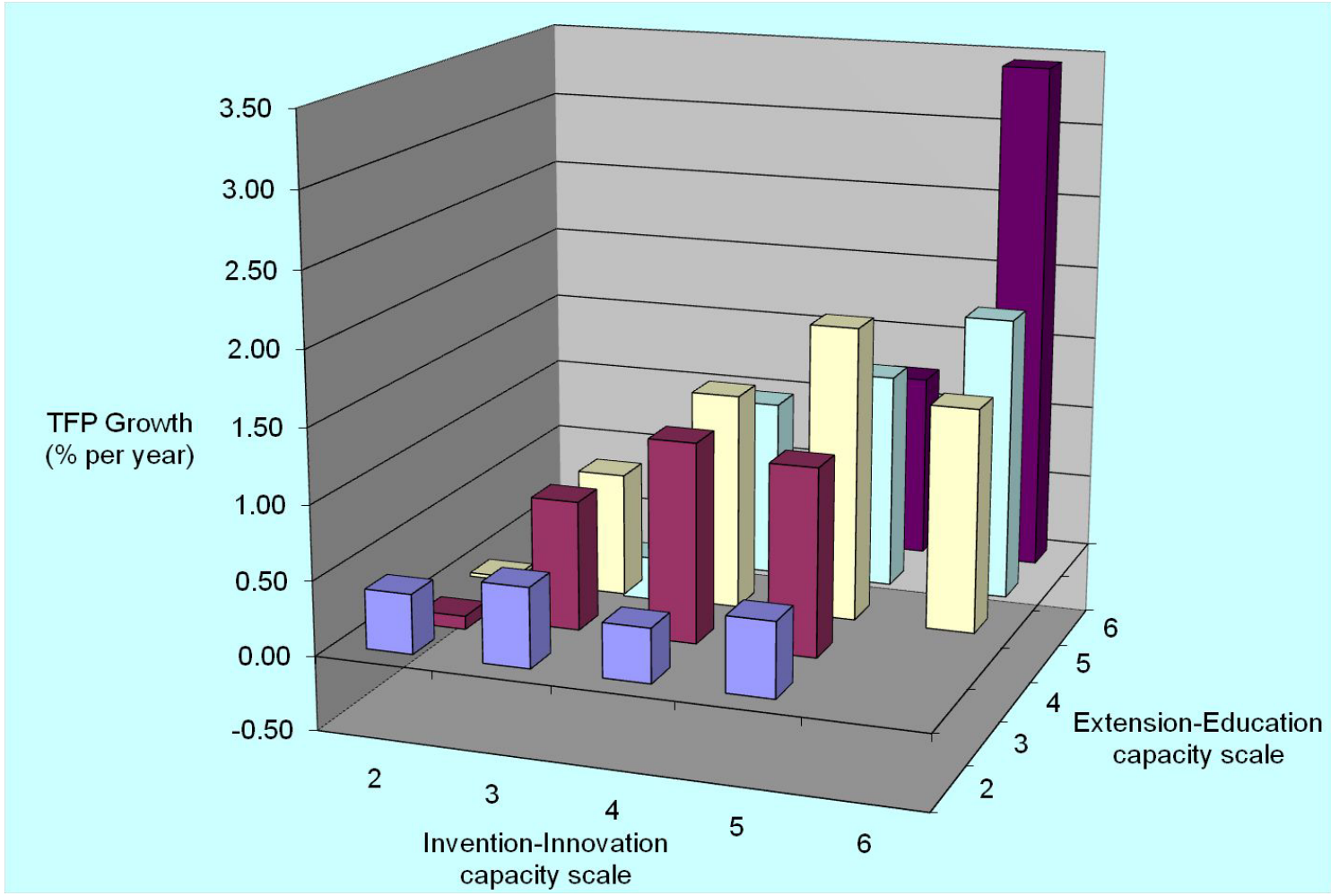
- **Potato, when fried, reduced acrylamide formation**
- **Wheat that produces less gluten**
- **Soybeans whose oil resembles olive oil**
- **Corn and wheat for drought tolerance and other traits**

Herbicide tolerant (Ht) direct seeded Basmati rice



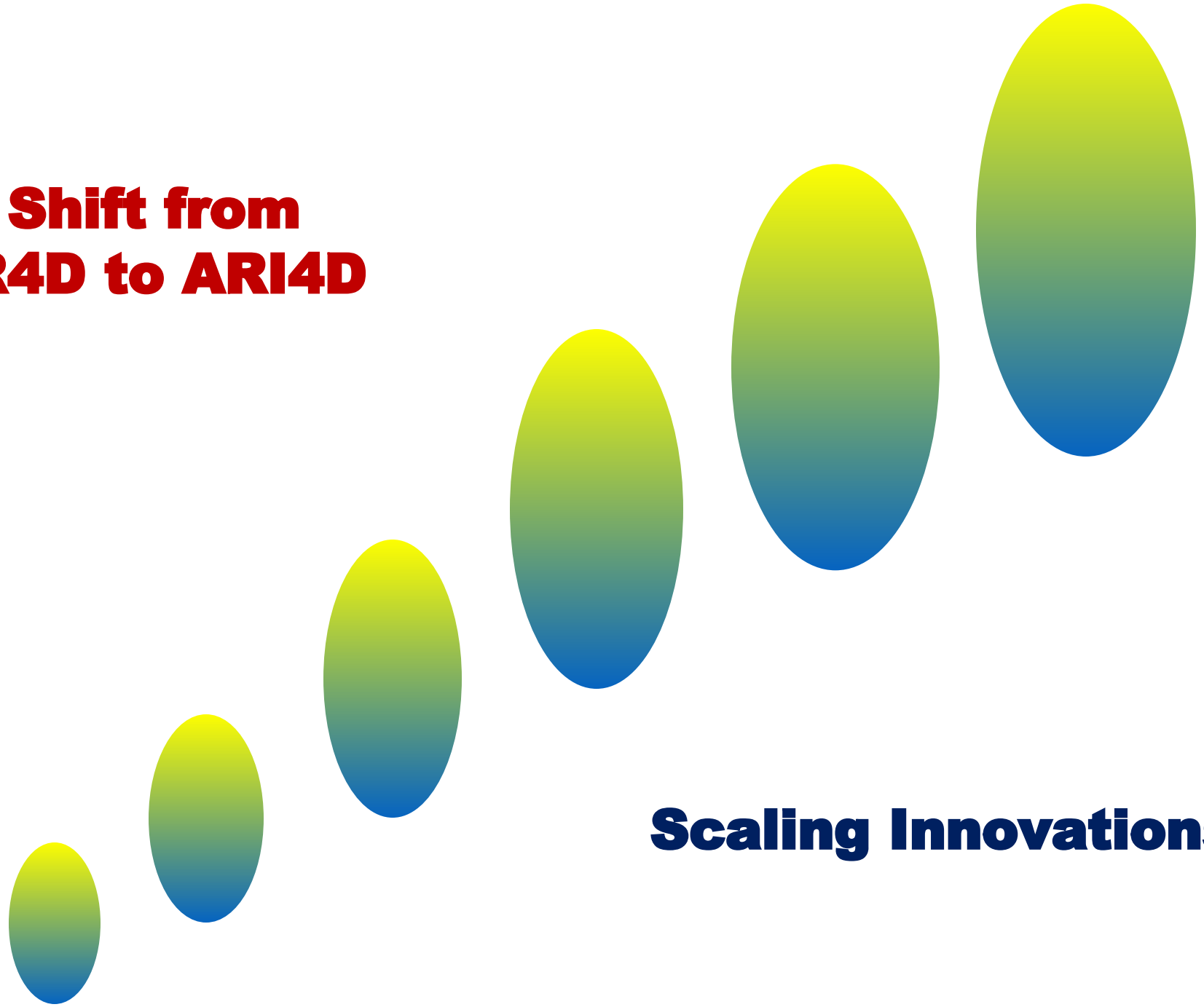
PB 1509 - AK Singh, IARI

"Technology Capital" strongly correlated with agricultural growth



Source: Evenson & Fuglie (2010)

Shift from AR4D to ARI4D



Scaling Innovations

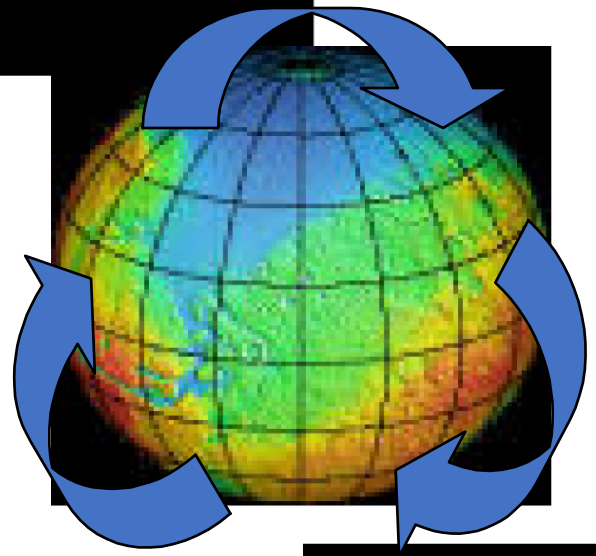
Digital Public Infrastructure

Income Inequality 1000 : 1 ?

Access Equality 1:1

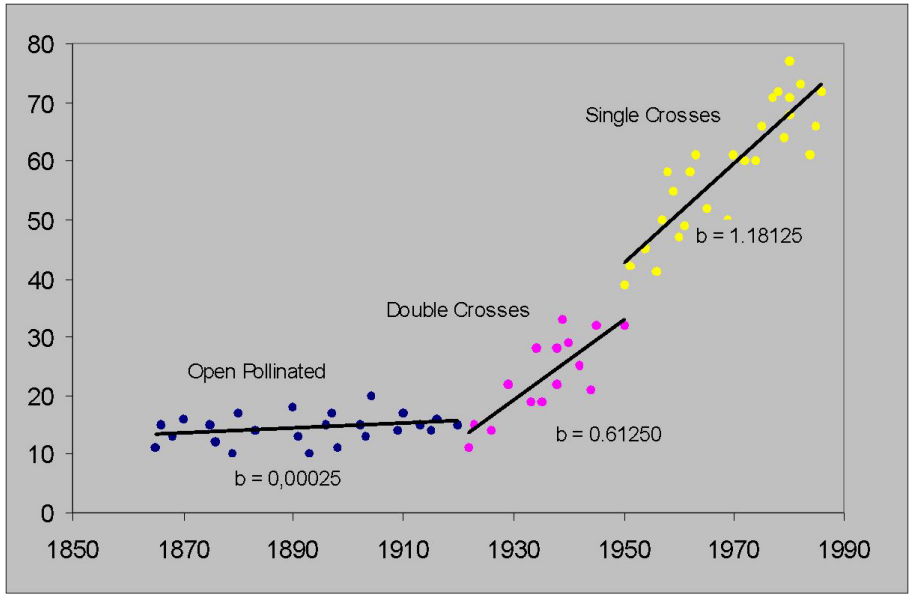
Disruptive Innovation : M-L-M

Think globally



Act locally

SCALING HYBRID TECHNOLOGY



Maize Production in USA

Single Cross Maize Hybrids in India

- **No such hybrid till 2000**
  - **New Seed Policy (1988)**
  - **PPVFRA in 2001**
- **First Public bred hybrid in 2001**
- **Production doubled in one decade : 25 mt**
- **Production now : 37.5 mt (three times)**
- **Productivity increased by 150 %**
  (From 1.8 to 3.0 t/ha)
- **Area : 9.0 m ha (under hybrids : 60%)**
- **Global rank – 4th in area (9 m ha)**
  and 7th in production

Highest growth rate among cereals > 4.0%

Hybrid Rice in China

Prof. Yuan Longping
(Father of Hybrid Rice)

Historical Development

1964: Research on hybrid rice started
1970: A wild rice with aborted pollen was identified
1974: First set of hybrids was developed
1976: Hybrid rice released to the farmers
In 1966: ~15 mha (53%) under hybrid rice gave 15 mt extra production

In India : Only 2.9 m ha in last 20 yrs

Bt Cotton - A Success Story

- The area under Bt cotton has increased to 12.0 m ha
- The cotton production almost doubled from 2.3 m tons to 4.9 m tons
- Pesticide consumption got reduced to 40 %
- Income of 5 million cotton farmers increased three fold
- Export of cotton fetching US $ > 4.0 billion

GM Crops : 67 Countries; Area >200 m ha
(Crops: Maize, Soybean, Mustard, Cotton)

Issues:

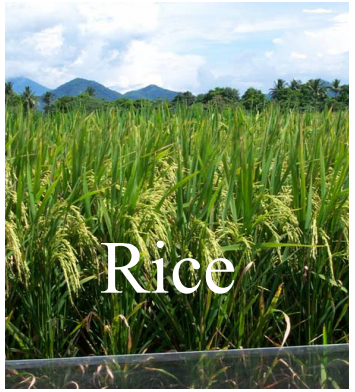
An unfortunate Global Divide? How much scientific evidence will be enough?

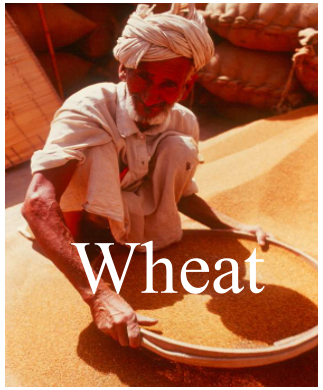
- Policy Logjam?

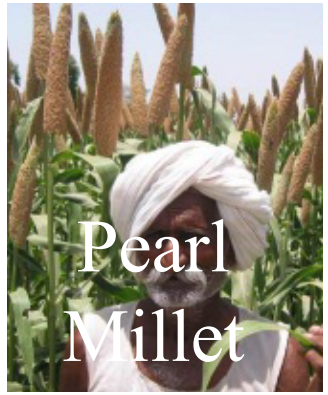
- Regulatory System – How robust?

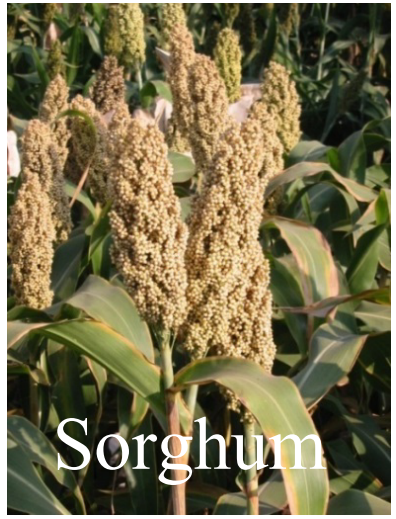
- Informed knowledge for Public Awareness

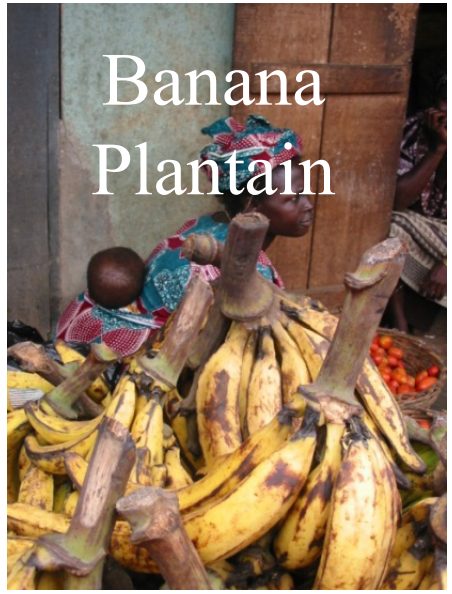
Biofortified crops released in 30 countries

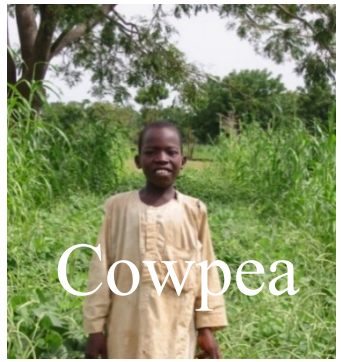












Other Innovations

- **Conservation Agriculture** (3.5 to 20 m ha)
- **Micro-irrigation** – From 6 to 10 m
- **Protected Cultivation** (Area from 50,000 ha to 0.5 m ha)
- **Bioenergy/Biofuel** (sugar cane and maize – use up to 20%)
- **Bio-fertilizers & Bio-pesticides**

Conservation Agriculture – A Game Changer

Area covered : 3.5 m ha under irrigated R-W system

Potential area : 10 m ha

Dryland Area : Almost 45% ?

Globally : 200 m ha mainly in drylands

Benefits of Conservation Agriculture:

Meta analysis from South Asia (Jat et al., 2020)

5-12% System Yield (increased)

10-30 % in WUE (increased)

26-44% Labor (saving)

46-62% Energy (saving)

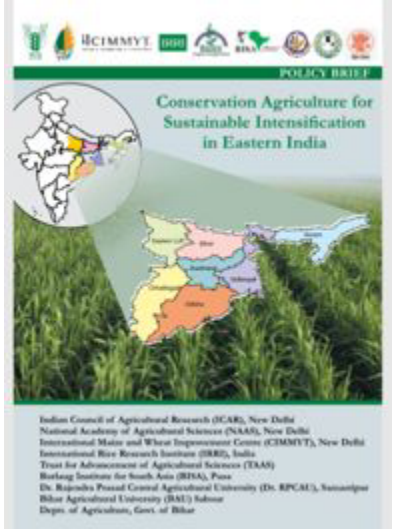
20-27% Profitability (increased)

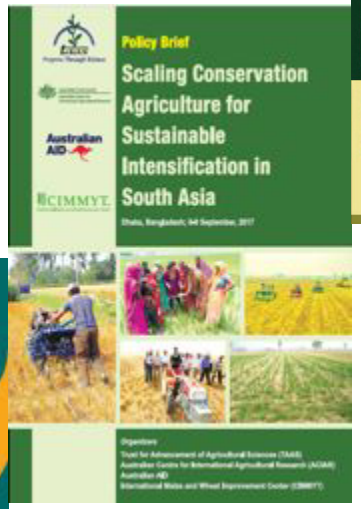
12-33% reduction in pollution

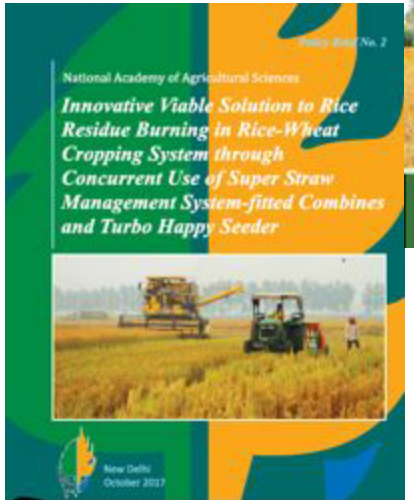
It saves biodiversity, increases soil organic matter, ensures environmental safety, minimizes abiotic stresses etc.

Towards Regenerative Agriculture

How much evidence enough for Scaling CA ?

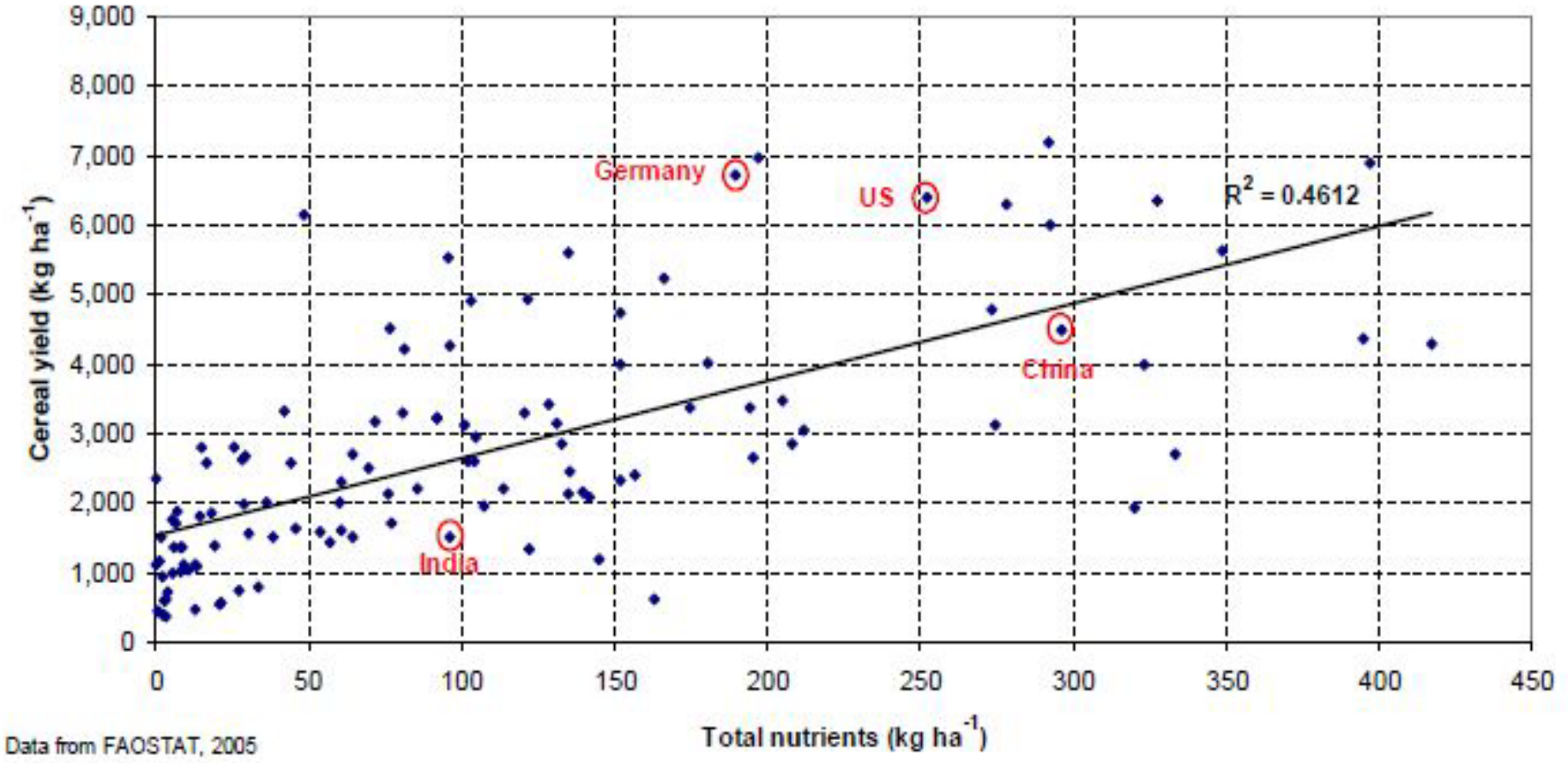






Building resilient system in drylands - through CA

Nutrient Use Efficiency: A Real Concern



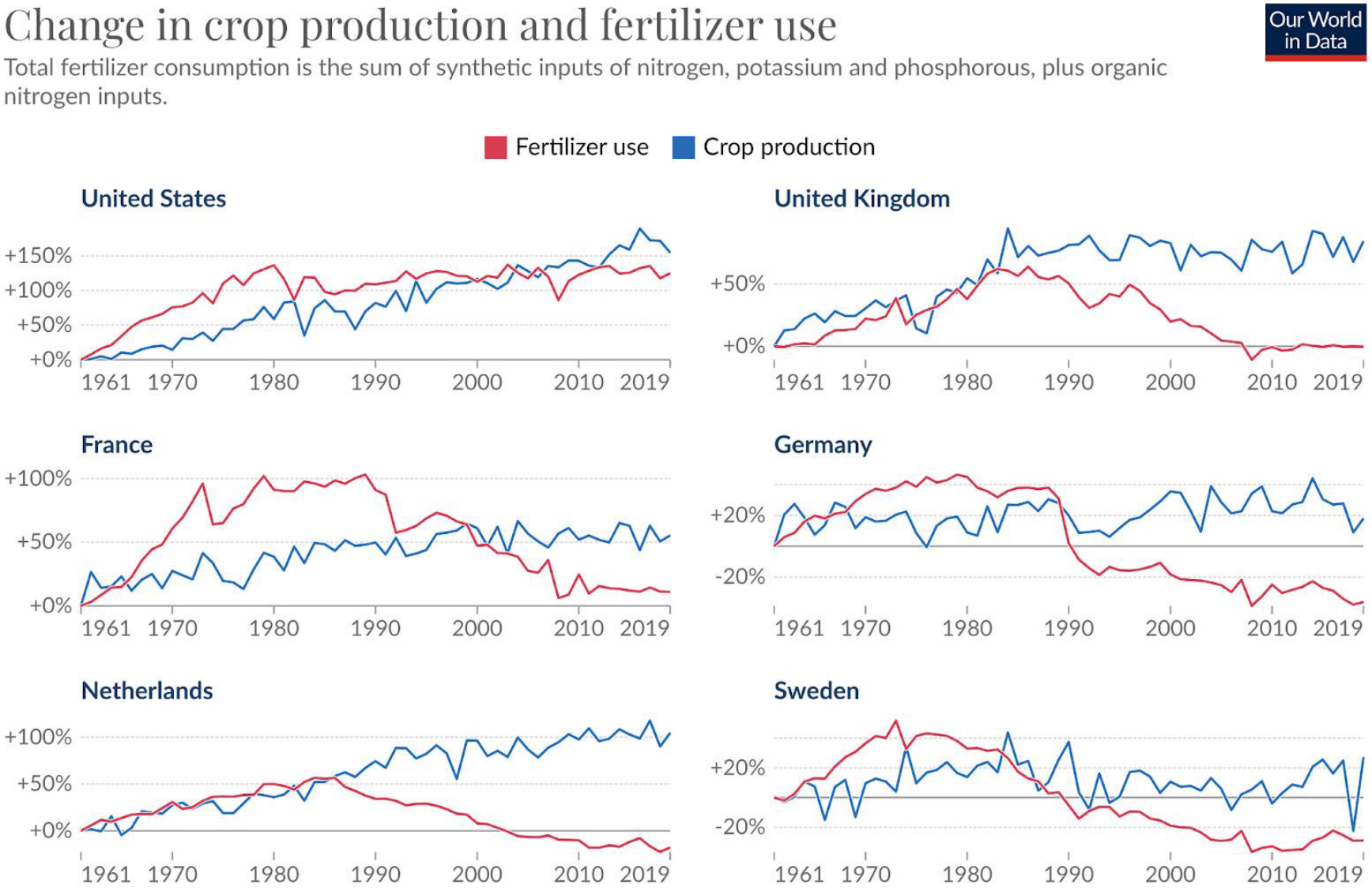
Data from FAOSTAT, 2005

India - Only around 30 %

Shift Needed Towards Precision Farming

Use of Decision Support Systems

Global fertilizer use reaching peak (around 220 mt)



GAP for Climate Smart Agriculture

Rain-water harvesting + Solar energy + sub-surface fertigation + CA

UN International Year of Millets - Value Chain

Millet Recipes

Developed **85 millet based recipes** that comes under different categories like breakfast, lunch, sweets and savories to include in our daily diet.

Packaging & Labelling

eatrite™
Eat Jowar - Stay Healthy

Other Value added Millet Technologies – Offered for technology licensing

All Millet Flakes

Other Products Technologies in Pipeline

G20 MACS Strategy on Agri-food Systems

G20 MACS Strategy

One Earth, One Family, one Future

1. Urgency to achieve SDG and Paris Agreement - time left is short
2. Greater trust in science, innovation and technology
3. Emphasis on food systems (production & post-production)
4. Building strong Partnerships – PPP; NARS-CGIAR
5. Motivating and attracting youth in agriculture
6. A Knowledge Platform for decisions & policy advocacy
7. Funding for ARI4D : Minimum 1% of Agri. GDP

Finally, Agriculture for Food, Nutrition and Environmental Security