



RAINFED AGRICULTURE:

Resource Base, Technologies and Societal Imperatives

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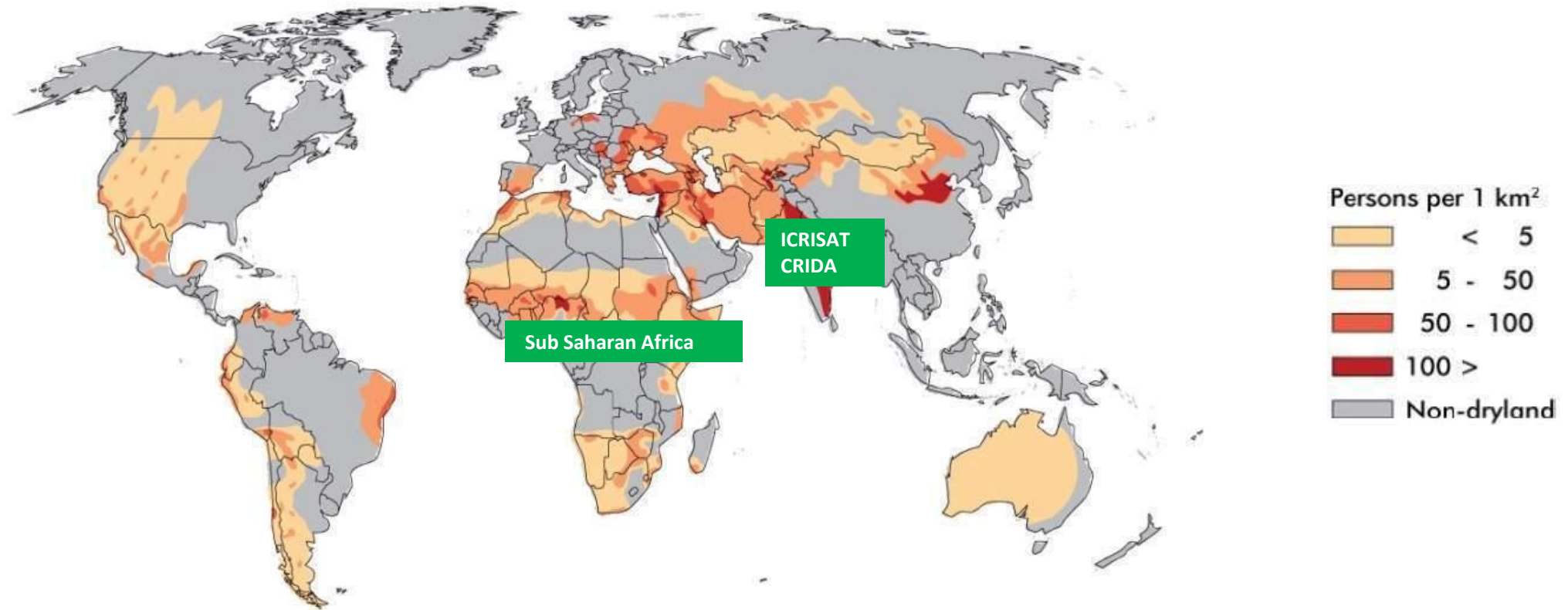
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RAINFED AGRICULTURE

- INTRODUCTION
- CHARACTERIZATION OF RAINFED FARMING SYSTEMS
- MAJOR CHALLENGES IN RAINFED PRODUCTION SYSTEMS
- TECHNOLOGICAL OPTIONS AVAILABLE
- CONTEMPORARY CHALLENGES AND OPPORTUNITIES
- ALTERNATIVE VISION AND STRATEGY
- CONCLUSION AND WAY FORWARD



GLOBAL RAINFED / DRY LANDS





PERVASIVE POVERTY

- 300 million people living on less than one dollar a day
- 700 million living on less than two dollars a day

FEATURES OF RAINFED SYSTEMS: FRAGILE RESOURCE BASE

Soils

- Major soils are red sandy to red sandy loam 37.3% geographical area
- Shallow, medium to deep black soils 27.77% of geographical area

Crops

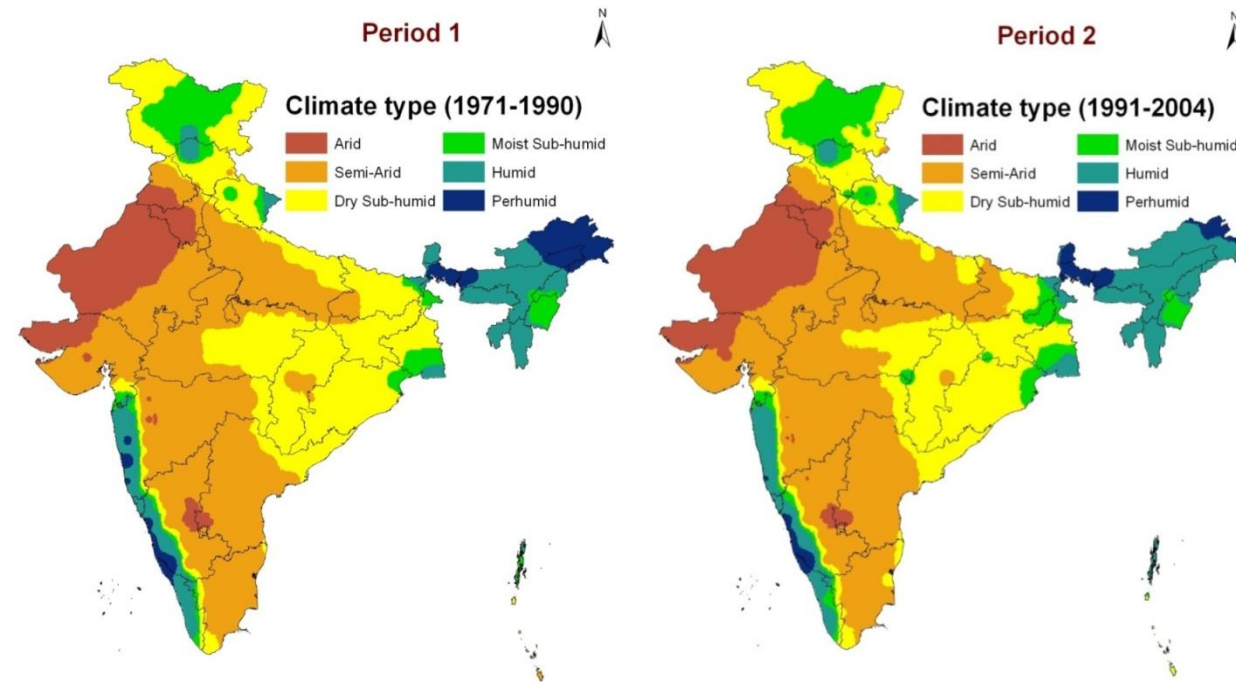
Jowar, Fingermillet, Maize, Bajra, Pigeonpea, Chickpea, Greengram, Cowpea, Blackgram, Horse gram, Field bean, Groundnut, Sunflower, Soyabean, Cotton and Minor millets



Rainfall

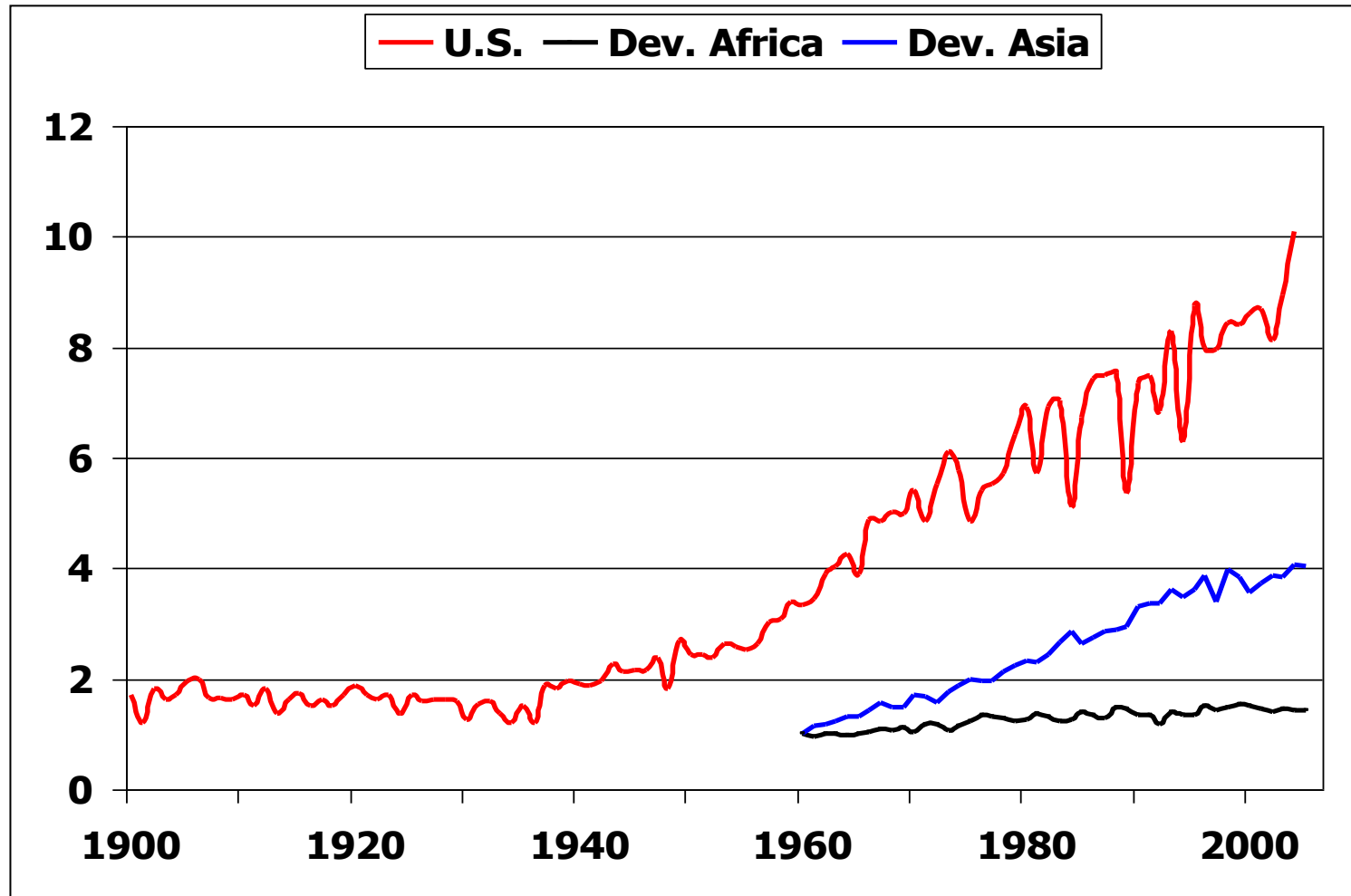
- 1150mm Average rainfall, ranges from 400mm in Pavgada taluk of Tumkur District to 4500 mm in Sringeri Taluk of Chikkamagalur District.
- Low/variable and erratic distribution of rainfall causing drought, low productivity: Farming highly risk prone.

Changes in Status of Agro ecological Regions



- Rainfed areas increased by 8.45 M ha in MP, Bihar, UP, Karnataka and Punjab; over all 3.45 m ha added to SAT
- Dryness and wetness are increasing in different parts of the country in the place of moderate climates existing earlier in these regions

Average Maize Yield t/per Ha (Source: AFSTA)



- In 1961 Developing Asia and Africa had approx equal maize yields.
- Why did 30 years of investment in Africa achieve so little?
- Why did developing Asia (excluding China) achieve 4x increases ?

DRYLAND RESEARCH & DEVELOPMENT- Since 1933



Crop Improvement and
Resource Management:
Watershed Management

Technological Options (CRIDA, ICRISAT, SAUS)



- Soil and Water Conservation
- Rain Water Harvesting and Reuse
- Groundwater Recharge
- Soil Health and Integrated Nutrient Management
- Crops and Cropping System
- Efficient use of Rain Water
- Alternate Land Use System
- Integrated Farming System
- Farm Mechanization

Important *In-situ* rainwater harvesting practices

- ✓ Micro catchments
- ✓ Graded ridges
- ✓ Land smoothing
- ✓ Early tillage
- ✓ Furrow on grade
- ✓ Increasing infiltration
- ✓ Broad beds and furrows
- ✓ Contour bunds
- ✓ Earthen bunds
- ✓ Compartment bunding
- ✓ Tied ridges
- ✓ Ridges and furrow
- ✓ Conservation furrow
- ✓ Vegetative barriers (*Khus* and *Nase* grass) as live bunds
- ✓ Conservation tillage
- ✓ Contour farming
- ✓ Cover crops
- ✓ Mulching
- ✓ Inter cultivation
- ✓ Green manure incorporation
- ✓ Deep trencher for soil moisture conservation
- ✓ Recharging ground water aquifers
- ✓ Scooping

Efficient use of water (More Crop per Drop)

- In-situ conservation of rainwater
- Rain water harvesting and recharging of borewells
- Adoption of drip and sprinkler system
- Growing vegetables and pulses instead of paddy
- Piped supplemental irrigation
- Alternate furrow irrigation between rows
- Providing protective irrigation at critical stages of crop growth
- Roof water harvesting and for kitchen gardening
- Rearing small ruminants in water scarce areas



SOIL HEALTH: INM in DRY LANDS

- Band placement of fertilizer preferably by seed-cum-fertilizer drill
- Application of N in splits
- Fertilizer composition should be balanced to suit the crop requirement
- Organics like FYM, Compost, Crop residue, Green manures etc
- Where ever possible, bio-fertilizer is to be used like P- solubilizers (PSB), Crop rotation
- *In-situ* moisture conservation helps to increase the nutrient and water use efficiency

Drought mitigation

Some of the drought mitigation strategies help in effective response and mitigate the hardship of the people as follows:

- ✓ Arrangement of reasonable buffer stock of food grain and fodder.
- ✓ Ensure supply of good drinking water in rural areas for human and livestock in drought affected areas.
- ✓ Assess fodder requirements in drought affected districts and locate areas where shortages are likely to occur and arrange supplies from outside.
- ✓ Fodder cultivation to be encouraged wherever feasible.
- ✓ Rejuvenation of traditional rainwater systems *viz*; Rivers, tanks, nalas, etc.
- ✓ Rainwater harvesting for both drinking and cropping.

DROUGHT PROOFING: Contingent Crop Plan

When the rains are delayed:

- Use short duration varieties
- Sow sunflower, cowpea or horse gram instead of finger millet.
- Transplant seedlings instead of direct seeding of finger millet.
- Dry seeding when the land is ready but dry at normal sowing seasons.
- Increase the seed rate to get more population as late sown ones do not makes much growth.

If rain stops after germination:

- Inter cultivate to remove weeds
- Remove weak seedlings and reduce population
- Irrigate from farm pond water
- Gap fill after rains revive and top dress with nitrogenous fertilizers.

If rain stops before stipulated time:

- Irrigate from farm ponds
- Inter cultivate to reduce evaporation
- Mulching with organic residues, including removed weeds from the fields
- Harvest for fodder (jowar and bajra) and vegetable (cowpea, field bean and pigeon pea)

Type of bunds	Rainfall region	Remarks
Contour bunds	Low rainfall region (<750 mm)	Suitable for medium soils of slope up to 6%, not suitable for <i>Vertisols</i> .
Graded bunds	Medium to high rainfall regions (>750 mm)	Suitable for <i>Vertisols</i> when provided with up-stream channel. With <i>Alfisols</i> , no upstream channel needed.
Graded border strips	Medium rainfall regions (750-1150 mm)	Suitable for deep <i>Alfisols</i> and Vertic <i>Inceptisols</i> .

Choice of bunds for different soil and rainfall situations (CRIDA)



Silvi - pasture



Stylo on bunds



Agro forestry



Agri- horti

Rainfall (mm)	Soils	Water availability (weeks)	Potential cropping system
350-600	Alfisols & shallow <i>vertisols</i>	20	Single Kharif cropping
350-600	Ardisols & Entisols	20	Single cropping either in Kharif or rabi
350-600	Deep Vertisols	20	Single rabi cropping
600-700	Alfisols, Vertisols & Entisols	20-30	Intercropping
750-900	Entisols, Deep Vertisols, Alfisols & Inceptisols	>30	Double cropping with monitoring
> 900	Entisols, Deep Vertisols, Alfisols & Inceptisols	>30	Assured double cropping

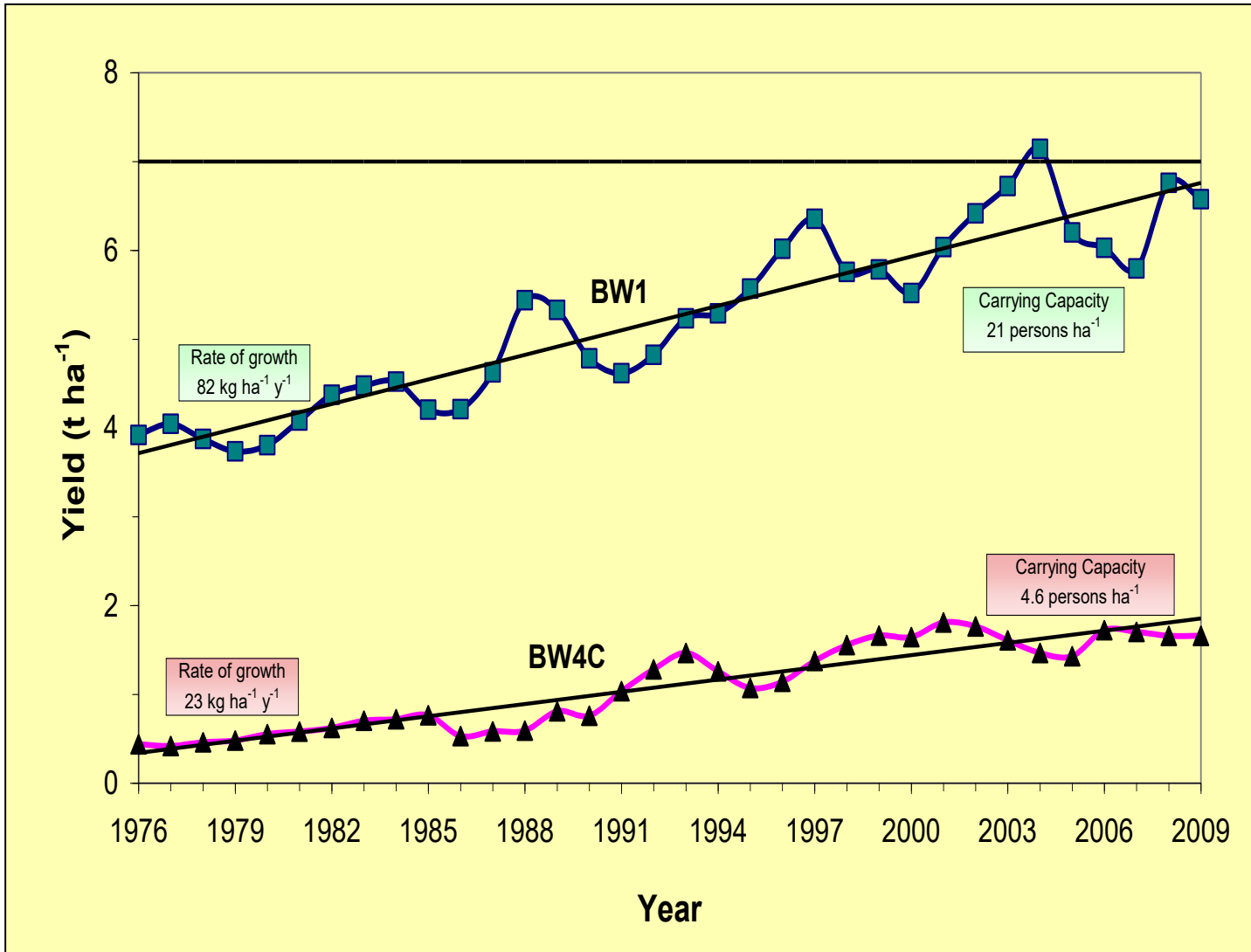
Suitable Cropping Systems based on rainfall and water availability



IMPROVED CULTIVARS and CROPPING SYSTEMS

B:C Ratio =3.25 (UASB)

**Package of
Technologies**



Untapped Potential of Rainfed Farming: Sustained Productivity

Current farmers' yields are 2 to 5 times lower than yields achievable by IGCRM



Many Successes by ICRISAT, ICAR & Partners –

- 680 varieties released by countries
- 119,000 genetic resources conserved & studied
- Improved water & soil mgmt methods devised
- Improved policy understanding
- 15,000 scientists trained
- 190 current partnerships



BUT WIDER ON-FARM IMPACT LIMITED

Lessons Learned from 40 Years of Effort

Isolated techno-fixes are not enough to stimulate a “Ever Green Revolution” in
Dry lands:

ALTERNATIVE APPROACH NEEDED

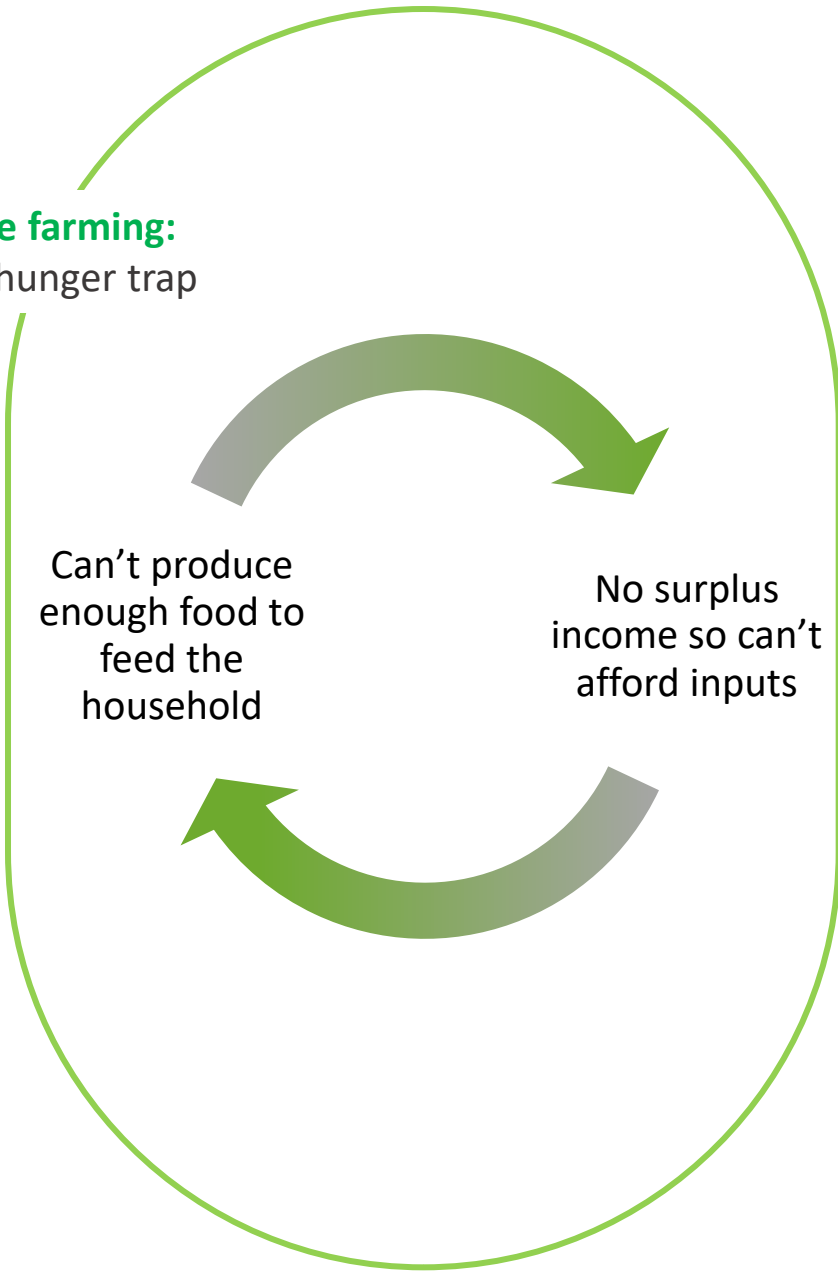


Key Lesson: TECHNOLOGY + ???

Even Dr Borlaug warned

“They can’t eat potential.. (RFA) needs inputs, access to markets, infrastructure and credit (and Monsoon and Market Safety nets)...”

Subsistence farming:
A poverty/hunger trap



What's Wrong with Current Dry Land Farming Systems Dynamics?

- ***'Engine of Development' absent / can't gain traction!***

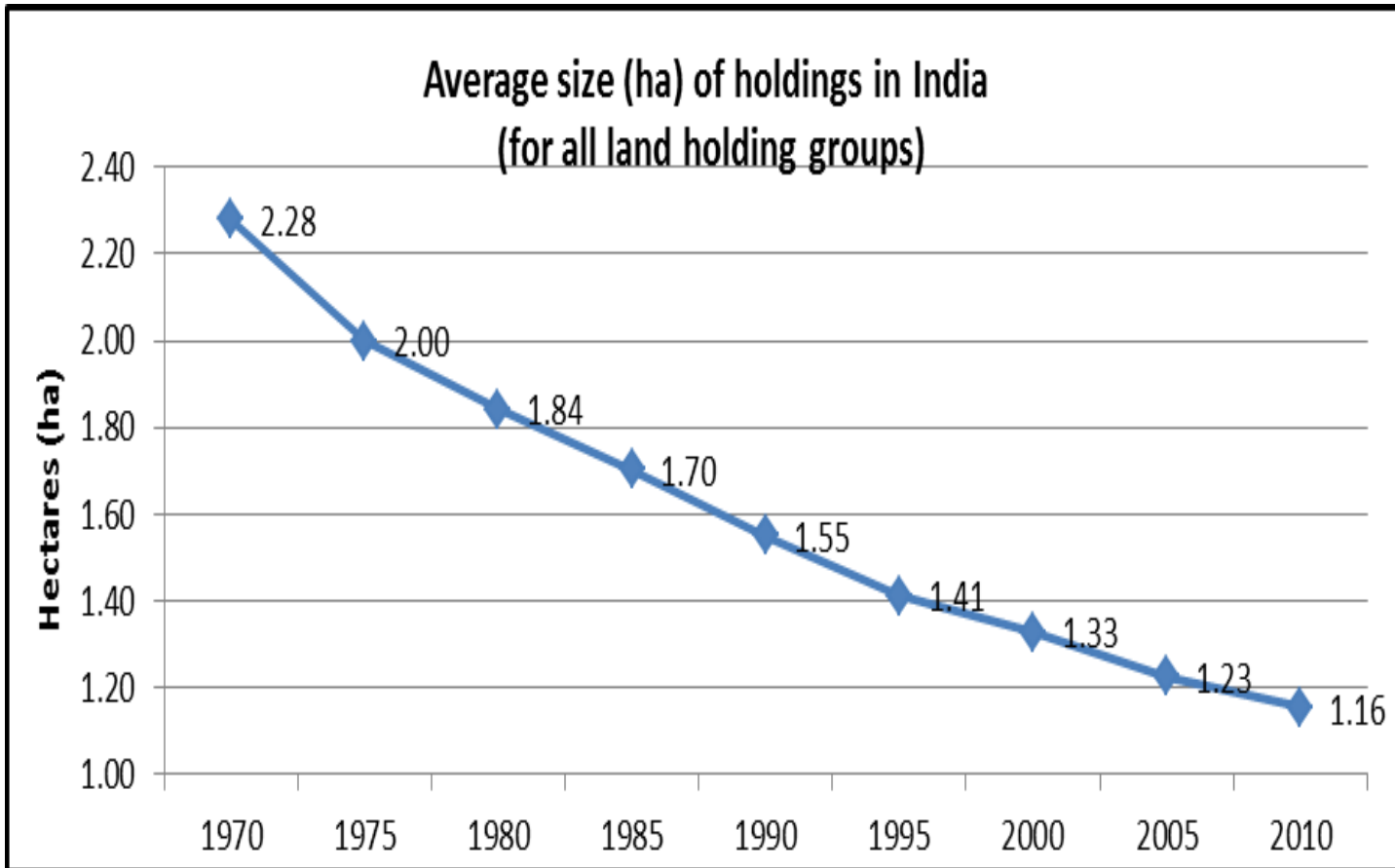
CONTEMPORARY CHALLENGES

- Rapid growth in urbanisation and middle class population
- Growing urban markets, income rise, and changing consumption patterns
- Gap analysis: Critical role of smallholder & marginal farmers
- Sustaining agriculture productivity and incomes of SH farmers
- Cost of inputs increasing and labor becoming scarce and unaffordable

Effects of climatic change

- Frequent natural disasters -- flood and extreme weathers
- Persistent droughts
- Hotter temperature
- Current sea level rise
- Higher pest and disease incidence
- Changes in cropping patterns





Land and Labour Crisis

Trends in farm size in
India (1970-2010)

Key Focal Areas to get Rainfed Agriculture Moving

1. [Harness markets](#) in ways that include Farmers
2. [Manage risks](#) that are stumbling blocks for Sustainable and Profitable Farming

Systems Perspective, Oriented to Markets

Diversity delivers:

- ✓ Higher income
- ✓ Better nutrition
- ✓ Greater resilience





SUMMARY

Holistic Consortium Approach to Sustainable and Prosperous Agriculture:
Two Key Focal Areas

- ✓ Sustainable Intensification
- ✓ Agribusiness for Prosperity

Through
ALLIANCES / PARTNERSHIPS: 4P

**Public-Private-Producer Partnerships: Innovation /
Technology and Entrepreneurships**

Conclusion: Way Forward

Address twin challenges:

- Build Productive and Resilient Rainfed Agriculture
- Create quality employment in rural areas

Strengthen S&T institutions through Reform and Alliances and focus on key issues (Water, Land/Ecosystem, Energy, Agri- business, Diversification, cutting edge technologies, Science based policies/safety nets...etc)

Invest on rural infrastructure : Smart villages, Integrated Farming systems, Risk aversion, Skill rural India, Digital agriculture, Start ups on rural agri-business



Photo: Icrisat