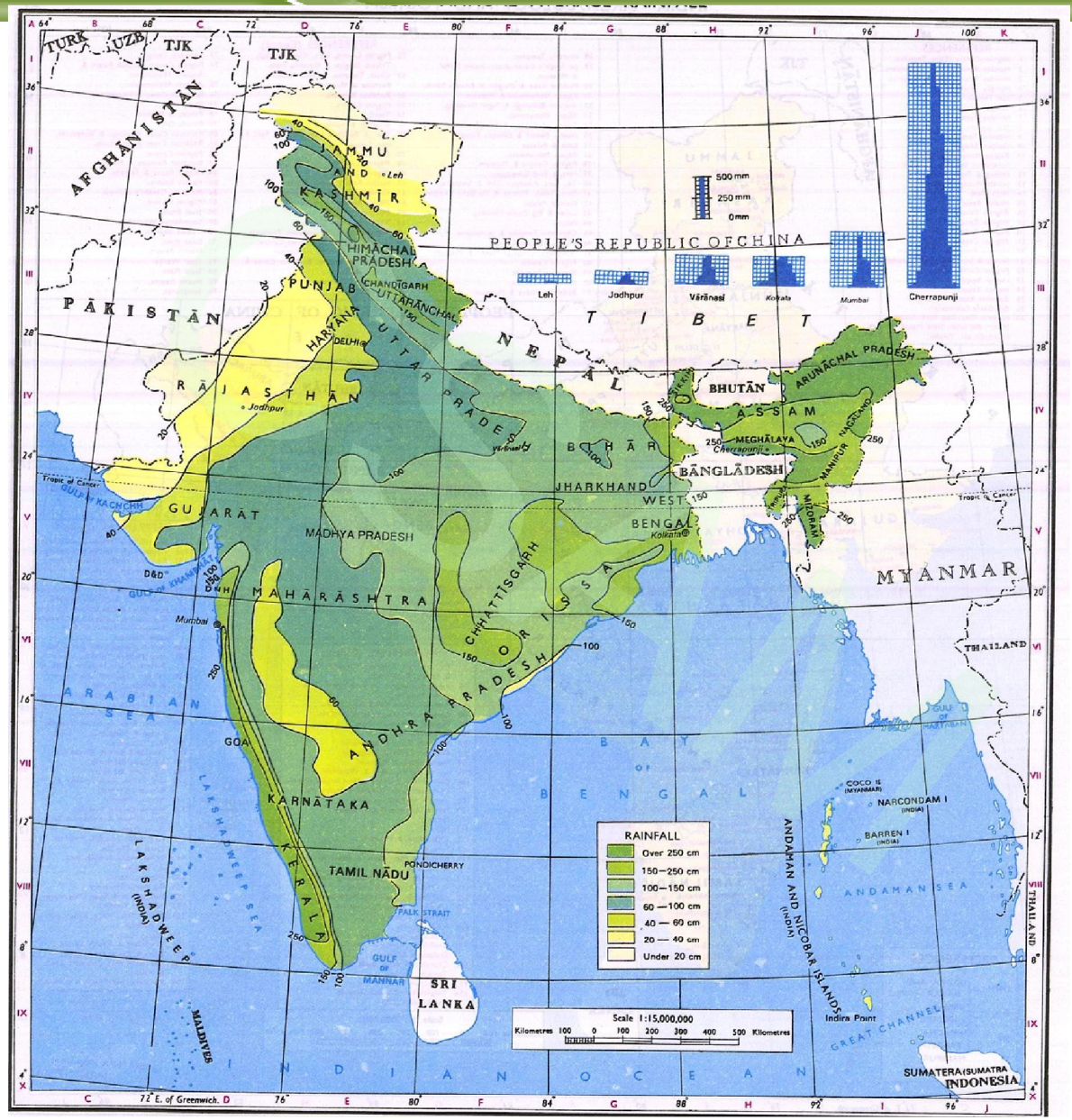
# Agricultural Mechanization Strategies in India

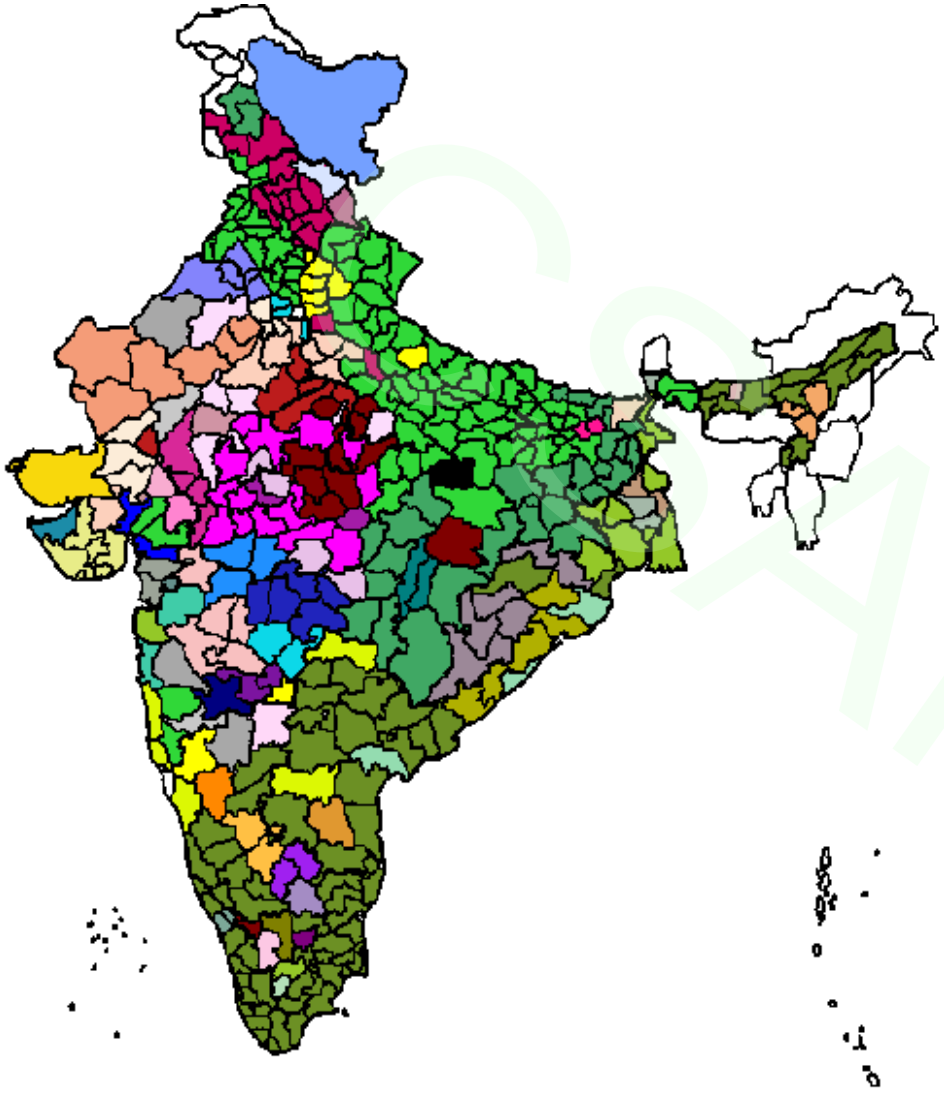


**C. R. Mehta**
**Project Coordinator, AICRP on FIM**
**Central Institute of Agricultural Engineering, Bhopal**
**Indian Council of Agricultural Research, New Delhi, India**

# Average Annual Rainfall Map of India



# Major Cropping Systems in India



- Rice – wheat (10.5 m ha)
- Rice – rice (5.89 m ha)
- Cotton – wheat (1.09 m ha)
- Soybean – wheat (2.23 m ha)
- Maize – wheat (1.86 m ha)
- P. millet - wheat (2.26 m ha)

# Indian Agriculture

- Net sown area: 140 million ha (42.6%)
- Agricultural workers - 263 million
- Employs about 55% of the work force
- Provides livelihood to about 60% of the population
- Contributes 14% to the Gross Domestic Product (GDP)
- Yearly production
  - Food grains – 259 million tonne (2012-13)
  - Fruits – 76 million tonne (2011-12)
  - Vegetables - 156 million tonne (2011-12)
- No. of land holdings – 138 million

# Indian Agriculture

- Small fragmented land holdings, hill agriculture and shifting cultivation
- 15% farms are semi-medium (2-4 ha), medium (4-10 ha) and large (more than 10 ha) sizes
- 85% are small and marginal (< 2 ha)

## Approach to mechanization of Indian agriculture

- Improved equipment and
- Enhanced farm power supply

**Maintain a socially desirable mix of human labour, draught animal power and mechanical power**

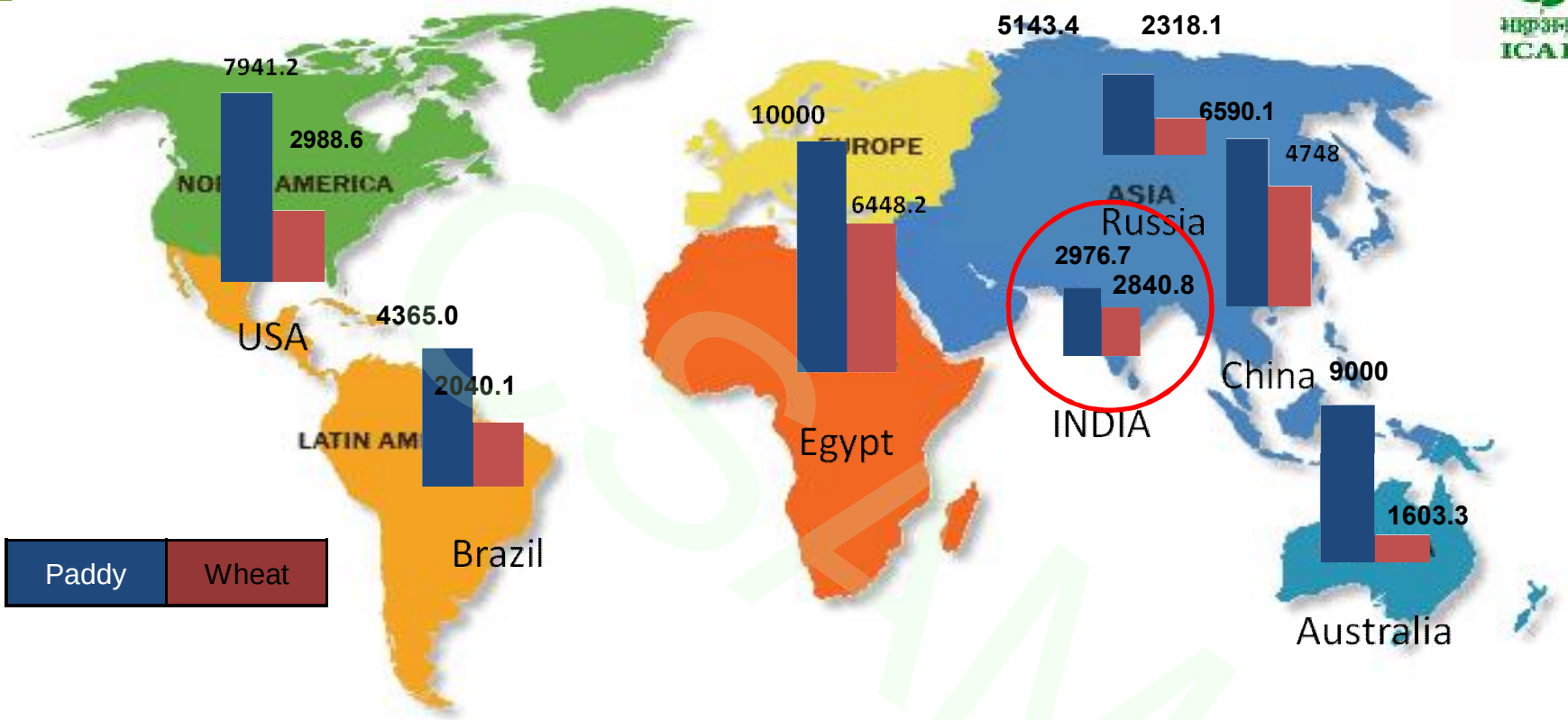
# Population Dynamics of Indian Agricultural Workers (No. in million)

| Particulars | 2001 | 2011 | 2020 |
|---|---|---|---|
| Countryôs population | 1029 | 1211 | 1323 |
| No. of workers as % of population | 39 | 39.8 | 42.8 |
| Total no. of workers | 402 | 482 | 566 |
| % of agricultural workers to total workers | **58.2** | **54.6** | **40.6** |
| No. of agricultural workers | 234 | 263 | 230 |
| % of females in agril. work force | **39** | **37.2** | **45.0** |
| No. of male agricultural workers | 143 | 165.7 | 126.5 |
| No. of female agricultural workers | 91 | 97.31 | 103.5 |

# Global Ranking of India in Farm Production and Productivity

| Crop | Production Rank | Production in 2011 (million t) | Productivity Rank |
|---|---|---|---|
| Paddy | 2nd | 157.90 | 30th |
| Wheat | 2nd | 86.87 | 22nd |
| Maize | 6th | 21.76 | 35th |
| Groundnut | 2nd | 6.96 | 40th |
| Rapeseeds | 3rd | 8.18 | 28th |
| Pulses | 1st | 0.70 | 44th |
| Soybean | 5th | 12.21 | 44th |
| Potato | 2th | 42.34 | 26th |
| Sugarcane | 2nd | 342.38 | 9th |
| Fruits | 2nd | 76.40 | - |
| Vegetables | 2nd | 155.90 | - |

# Crop Scenario

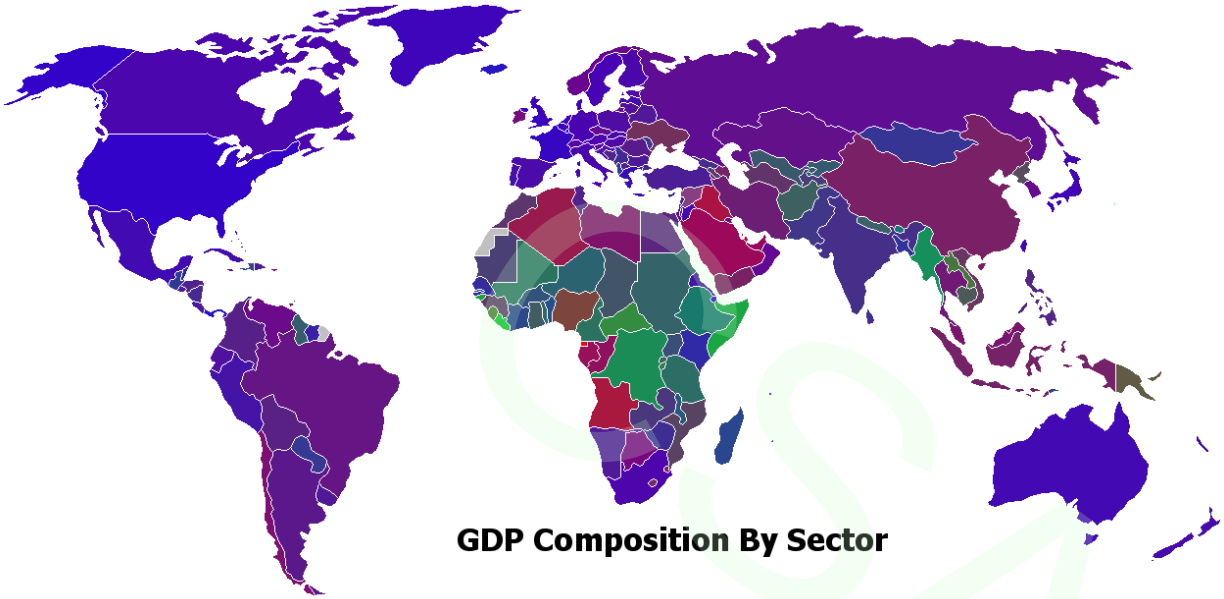



## India very low on Productivity

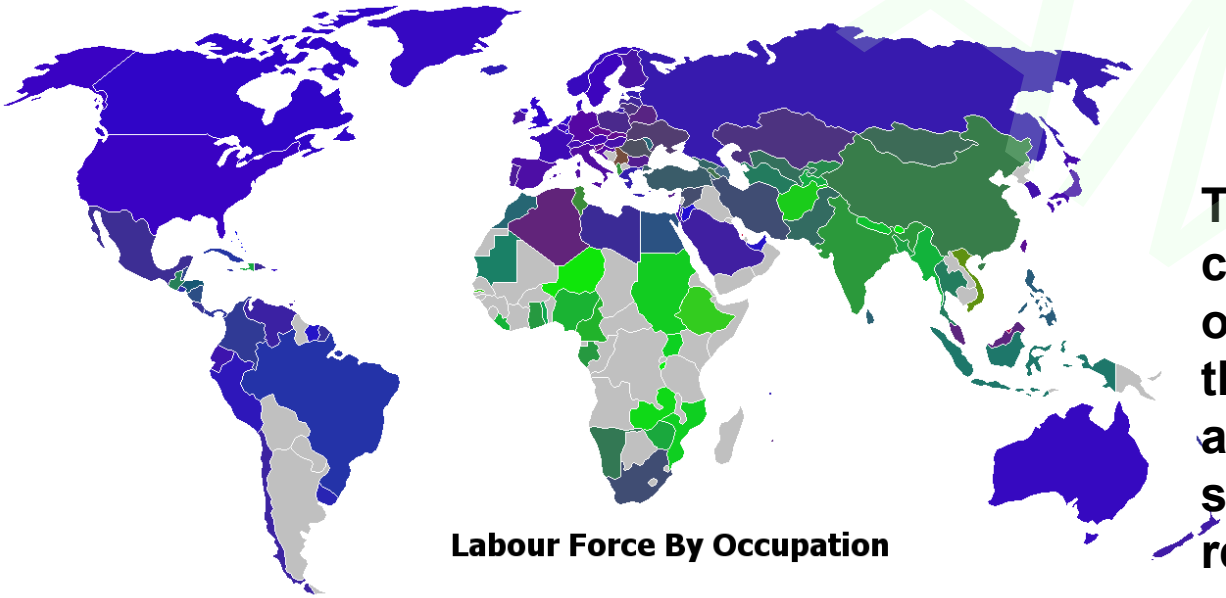
**Yield of principal crops in developed nations is much higher than other developing nations, one of the reason being less adoption of automation**

** Figures represents Yield of major crops during 2009*
*** Yield is defined as kg/ha*
*Source: FAOSTAT*

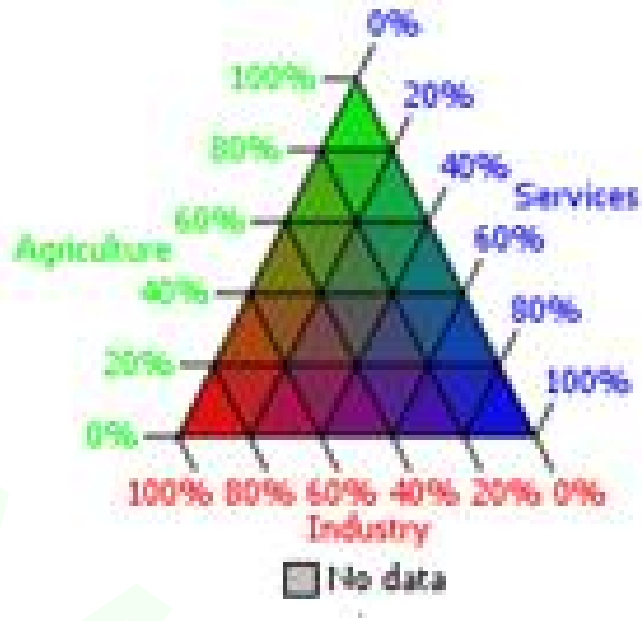
# Mechanization - Precursor of Development



GDP Composition By Sector

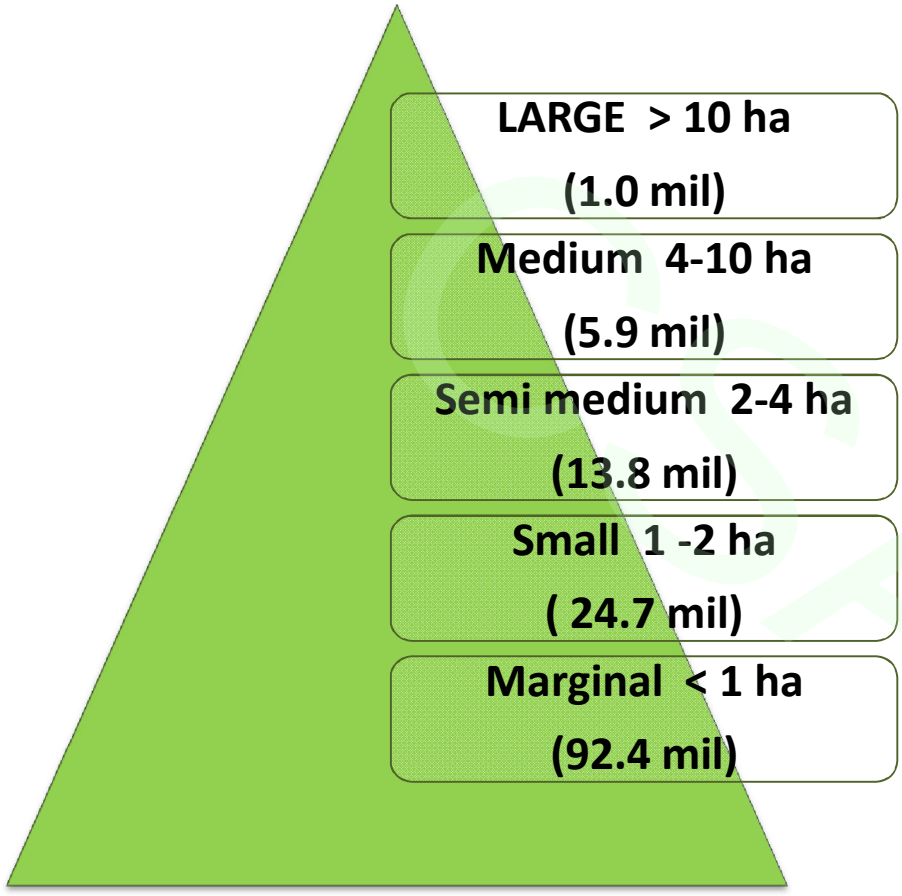


Labour Force By Occupation




**The green, red, and blue components of the colours of the countries represent the percentages for the agriculture, industry, and services sectors, respectively.**

# Indian Agriculture

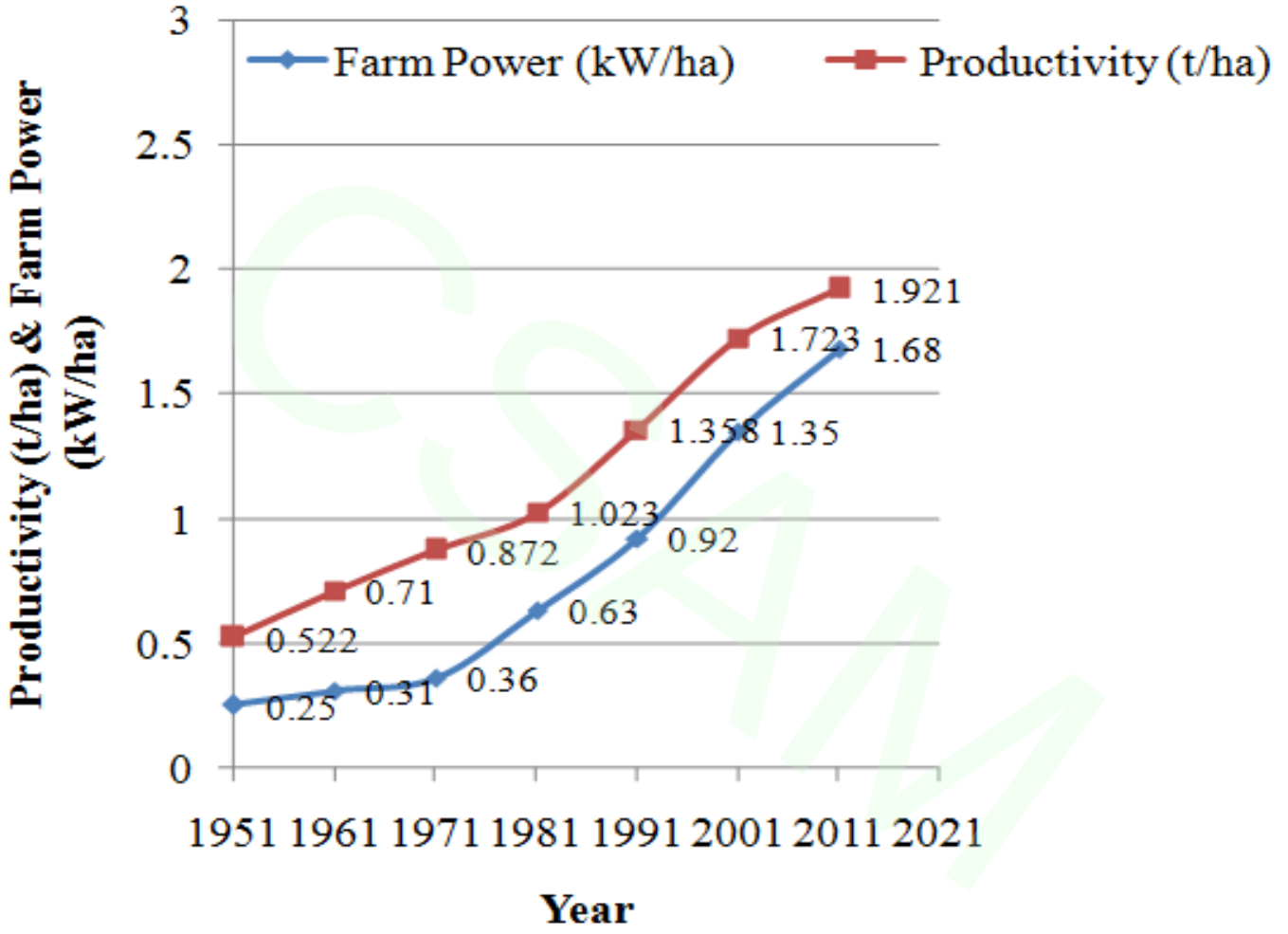



Average land holding and no. of farmers

- **Highest arable land -** 47% of total land against Avg. 11% in the world
- **Round the year cultivation -** 20 Agro-climatic regions and 46 soil types suited for round the year cultivation
- **Ranks first** in production of Pulses, Sorghum, Jute and allied fibers
- **Second largest producer** of Wheat, Rice, Groundnut, Tea, Fruits and Vegetables, Sugarcane
- **Third largest producer** of Mustard, Potatoes, Cotton lint, etc.
- **137.8 million cultivators,** over 5.0% own > 4 ha. Avg farm land size <2 ha,

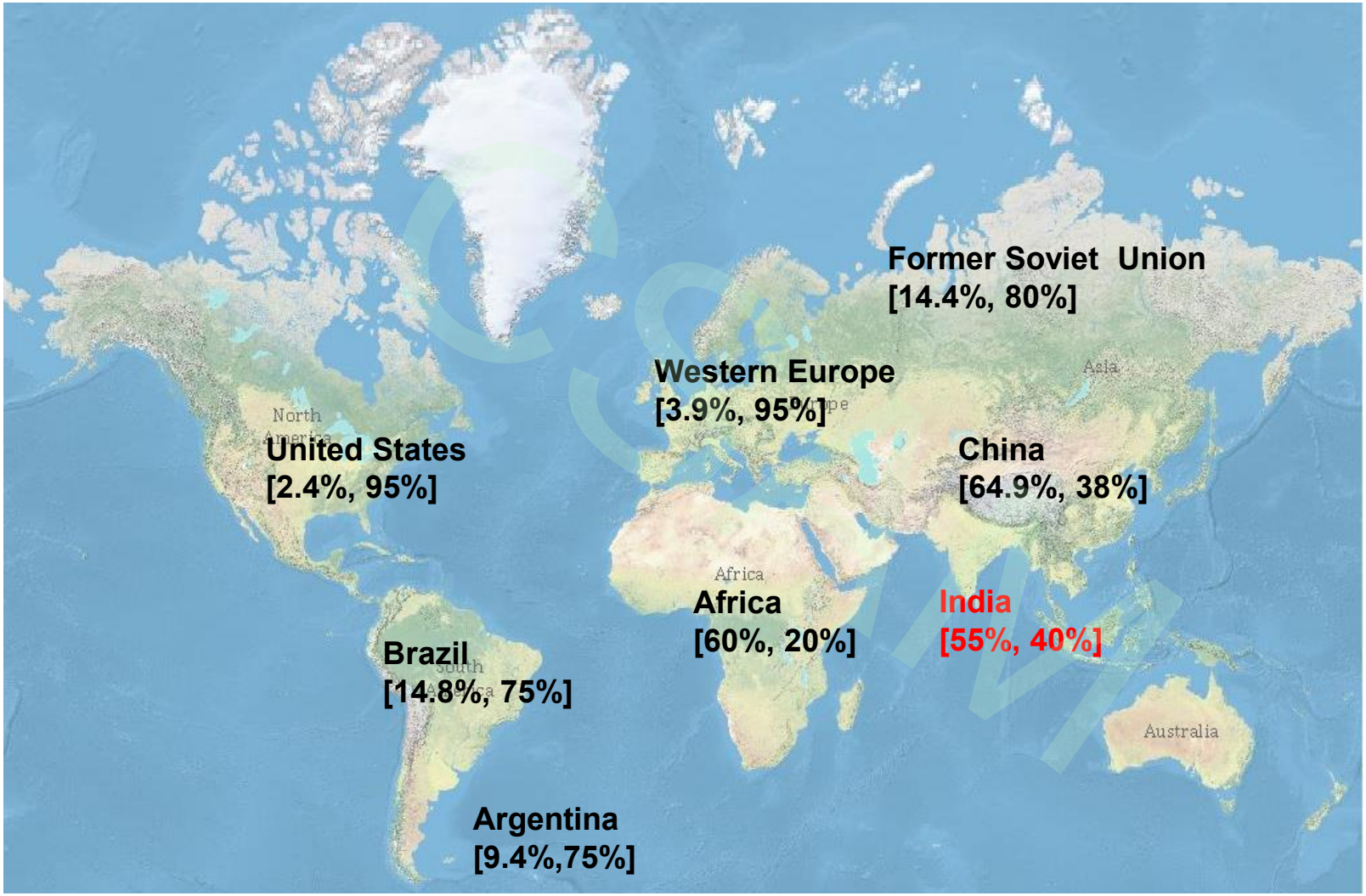
**Bottom of Pyramid Country; Affordability, Equipment size are key to success. Emerging - Cooperative ownership model/custom hiring, use of high end equipment**

# Farm Power Availability and Productivity of Food Grains in India (1951-2011)




**Agricultural productivity has a positive correlation with farm power availability**

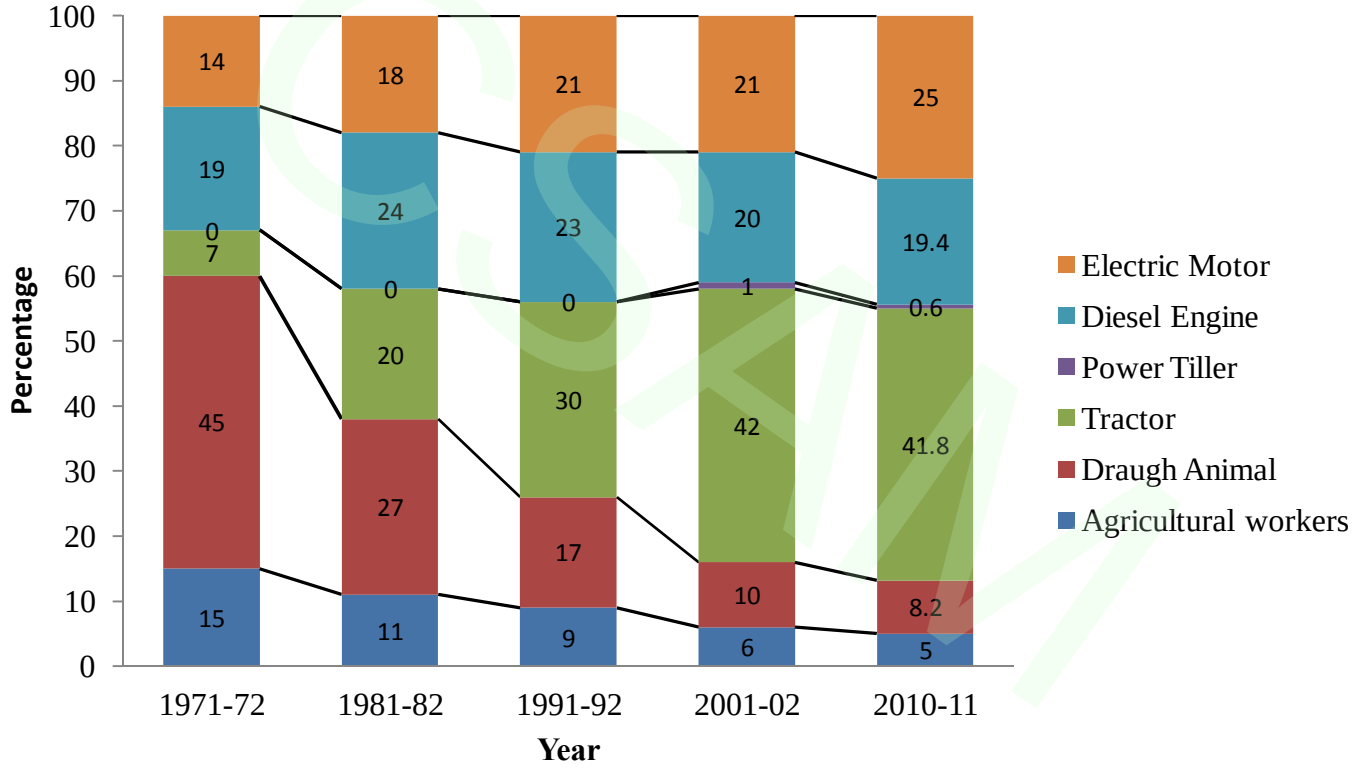
# Population Engaged in Agriculture Vis-a-vis Level of Farm Mechanization




**Higher share of labour (55%) with lesser contribution to farm mechanisation (40%) in India makes farming less remunerative and leads to farmers' poverty**

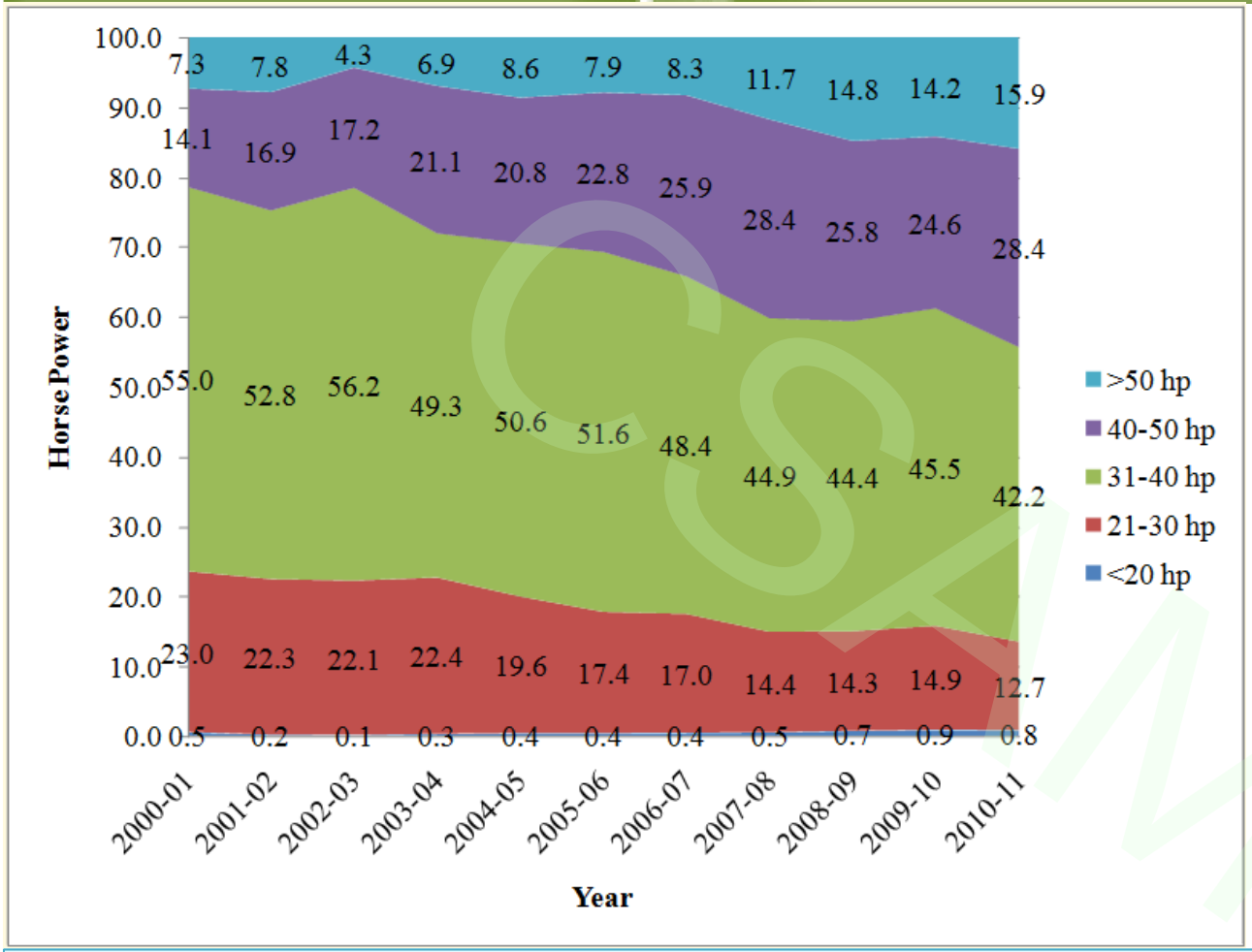
# Power Availability Trend….

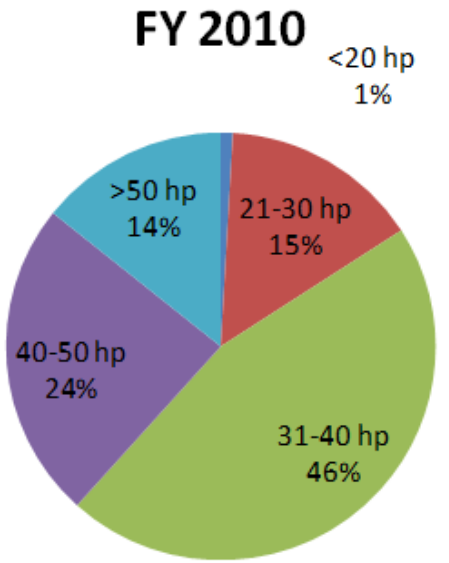
**The changing face of technology is leading to increase in mechanisation and this trend is expected to continue in near future**

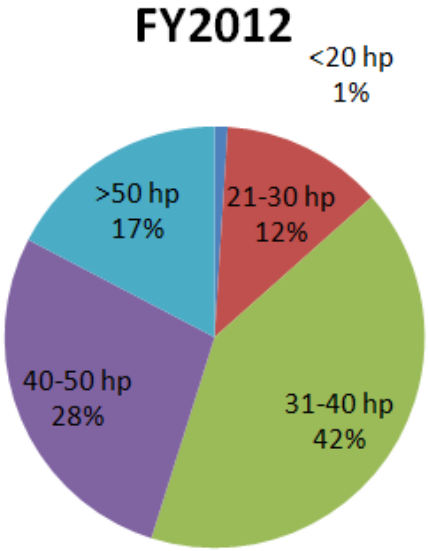



**Share of agricultural worker & draught animals came down from 60.5% in 1971-72 to 13.2% in 2010-11**

# Power-wise Trend in Sale of Tractors in India




Huge opportunity at entry level, virgin sub 15 hp segment replacing bullock

Sales to witness polarization towards high- and low-power segments

# AGRICULTURE SCENARIO IN INDIA

- Poor utilisation efficiency of critical inputs like water, seeds, fertilizers, chemicals and energy
- Benefits of engineering R&D not reaching the farmers expeditiously
- Very high post harvest losses in grains and perishables
- Only 10% of produce is processed in the country as against 40-60% in other South Asian countries
- Very low value-addition in production catchments
- Nutritional insecurity of rural population.

# SCENARIO

**Declining profitability in agriculture is due to:**

- **High cost of production and low levels of productivity**
- **Subsistence farming rather than professional enterprise**
- **Low returns to farmers**
- **Low levels of by-product utilisation**

# SWOT

## Strengths

- Large infrastructure of over 20,000 manufacturers in small scale industry
- Vast network of academic and R&D institutions including AICRPs under NARS for human resource development, R&D and extension
- Trained manpower for R&D in agricultural engineering
- Over 100 cooperating centers of AICRPs is the area of agricultural engineering
- Computer Aided Design adopted by the institutes for high pace of R&D.

# SWOT

## Weaknesses

- Unreliable after sales service of agricultural equipment
- Poor TOT for agricultural engineering technologies through state departments
- Poor liaison with industries for R&D and commercialization
- Non effective feedback system
- Absence of non-land economic activities
- Non systematic marketing of agricultural equipment.

# SWOT

## Opportunities

- Entrepreneurship development for custom hiring of farm machinery and agro-processing equipment
- Post harvest loss reduction and value addition at the production catchments through rural level agro-processing centers
- Establishment of value chain for commercial supply, transport and marketing of agricultural produce
- Opportunity to increase in irrigated area by introducing micro-irrigation
- Reducing yield gaps and increasing productivity through precision farming technologies.

# SWOT

## Threats

- Low profitability in agricultural enterprises due to subsistence farming
- Migration of farmers from agriculture
- Fragmentation and continuous reduction of operational holdings
- Slow pace of R&D and commercialization
- Inadequate infrastructure back up for after sales support for farming equipment
- Renewable energy technology still subsidy dependent.

# Strategies for Mechanization of Indian Agriculture

# Strategies

- **Design, development and commercialisation of farm implements and machinery for mechanisation of -**
  - **conservation agriculture**
  - **high capacity energy efficient machines for custom hiring**
  - **spraying of tall tree**
  - **cotton picking**
  - **sugarcane harvesting**
  - **horticultural crops**
  - **hill area agriculture**
  - **nursery raising under covered cultivation**

# Strategies

- Design, development and commercialisation of farm implements and machinery for mechanisation of -
  - root crops harvesting
  - feed and fodder production
  - seed spices crops
  - dryland agriculture
  - oilseeds and pulses
- Development of machinery for adoption of precision farming for improved input use efficiency of seed, fertiliser and chemical.

# Strategies

- Development/adoption of manually guided power operated equipment for hilly terrains
- Farm machinery management for efficient and optimum utilisation of available agricultural machinery
- Streamlining of testing procedure, training of engineers and conducting testing of farm equipment for standardisation and quality control in farm equipment manufacturing
- Development of package of farm equipment for major cropping systems for different states
- Multiplication of R&D products at Prototype Manufacturing Workshops (PMWs) for multi-location trials.

# Strategies

- Establishment of Farm Machinery Bank for machines being manufactured elsewhere in the country and supply to users/farmers
- Conducting prototype feasibility testing and front line demonstration of improved farm implements and machinery in different regions to bridge mechanisation gap and to obtain feedback for design refinements.
- Promoting custom hiring services through entrepreneurship for use of high capacity farm equipment to ensure timeliness of operation and reduction in cost of operation.

# Strategies

- Increase in average supply of power to agriculture from about 1.7 kW/ha in 2010 to 2.5 kW/ha by 2025.
- Consolidation of widely fragmented and scattered land holdings in many parts of the country
- Mechanization for all categories of farmers and to all regions of the country especially the rainfed areas.
- Increase interaction among farmers, R&D workers, departments of agriculture and industry to have access to the latest equipment and technology.

# National Mission on Farm Mechanization

- **Increasing the reach of farm mechanization to small and marginal farmers and to the regions where availability of farm power is low**
- **Offsetting adverse 'economies of scale' and 'higher cost of ownership' of high value farm equipment by promoting 'Custom Hiring Centre' for agricultural machinery**
- **Passing the benefit of hi-tech, high value and hi-productive agricultural machinery to farmers through creating hubs for such farm equipment.**
- **Promoting farm mechanization by creating awareness among stakeholders through demonstration and capacity building activities**
- **Ensuring quality control of newly developed agricultural machinery and equipment through performance evaluation and certifying them at designated testing centers located all over the country.**

# Sub-mission on Agricultural Mechanization during 12th Five Year Plan

| S. No. | Components |
|---|---|
| 1 | Promotion & strengthening of agricultural mechanisation through training, testing and demonstration |
| 2 | Post harvest technology and management |
| 3 | Financial assistance or procurement subsidy for selected agriculture machinery and equipment |
| 4 | Establishment of farm machinery banks for custom hiring by small and marginal farmers |
| 5 | Establishing hi-tech and high productive equipment hub for custom hiring |
| 6 | Enhancing farm productivity at village level by introducing appropriate farm mechanization in selected villages |
| 7 | Creating ownership of appropriate farm equipment among small and marginal farmers in the eastern/north eastern regions |

# Conclusions

- Future farm mechanization through mechanical sources of power
- R&D in farm mechanization through Public Private Partnership mode
- Equipment/technology for increasing input use efficiency
- Machines suitable for custom hiring – high capacity and high labour productivity
- Quality manufacturing and after sales support for reliability of farm machinery.

# Conclusions

- Mechanization of horticulture and hill agriculture
- Mechanization of sugarcane harvesting and cotton picking
- Centralized nursery raising for horticultural crops and rice
- Covered cultivation
- Adoption of conservation agriculture and precision farming
- Consideration of ergonomics and safety in farm equipment/machinery design
- Contract farming
- Farm machinery bank

# Thank You

**E-mail: crmehta@ciae.res.in**

**http://www.ciae.nic.in**

**http://www.icar.org.in**