Agricultural Engineering Research in Pakistan: An Overview, Impact, and Restructuring

by

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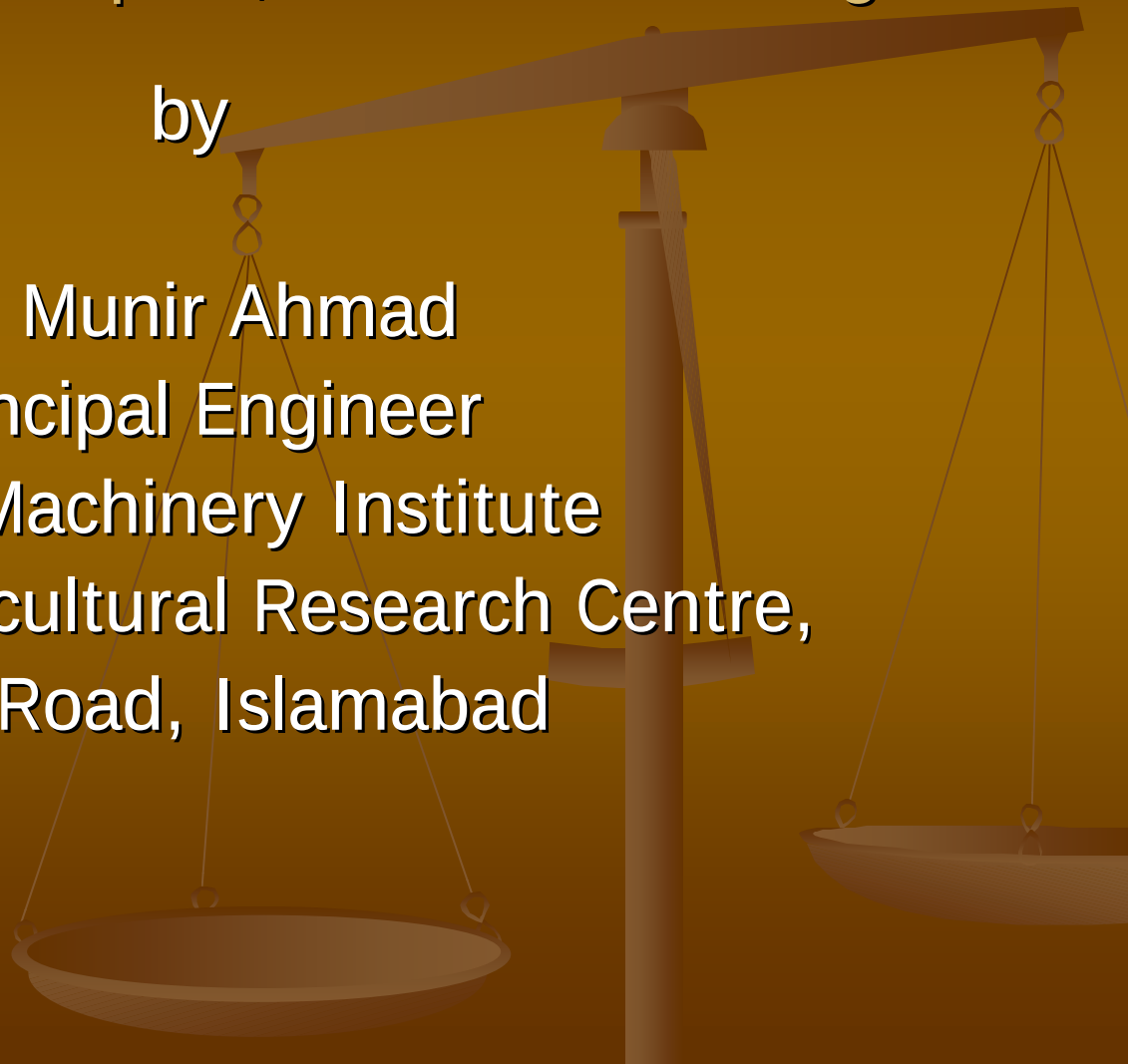


Map of Pakistan

Introduction

- Agriculture contributes:
  22 % of GDP
  44.8% of total employment
  66% of rural population depend on agriculture

Major crops and their production:

Crops	Area (m. ha)	Production
Wheat	8.35	21.61 million tons
Rice	2.51	5.02 million tons
Maize	0.98	2.79 million tons
Cotton	3.20	14.26 million bales
Sugarcane	0.97	47.24 million tons

Objectives

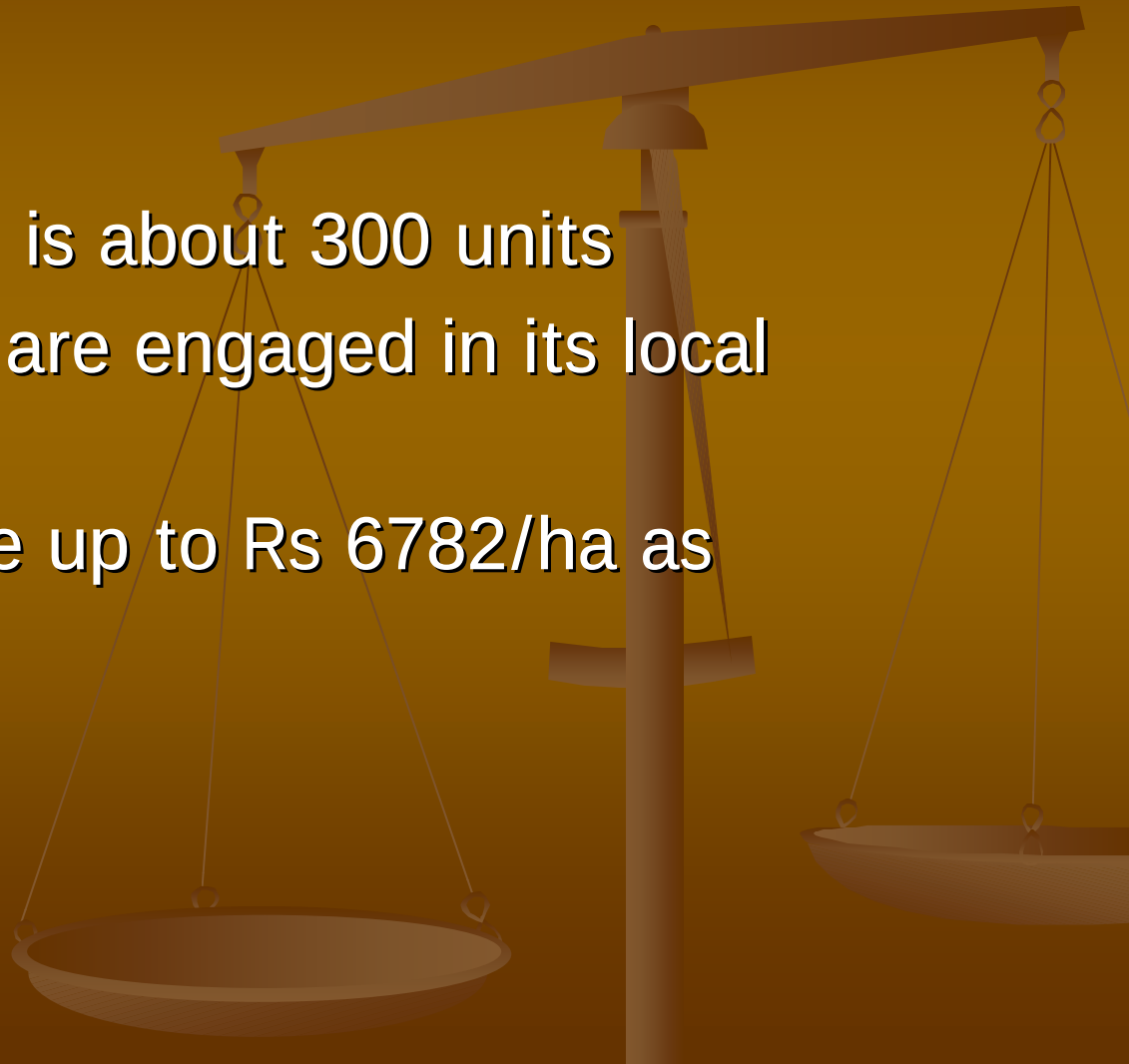
- To present an overview of agricultural engineering research
- To present its impact, financial resource mobilization, and the capacity building of the public funded research institutions
- To present the role of commercial's enterprises, and restructuring of agricultural engineering research in the country

An Overview of Agricultural Engineering Research

- Resource conservation technologies
- Crop harvesting and threshing technologies
- Crop drying and processing technologies
- Water management/saving technologies

Low-cost Zero-Tillage Drill

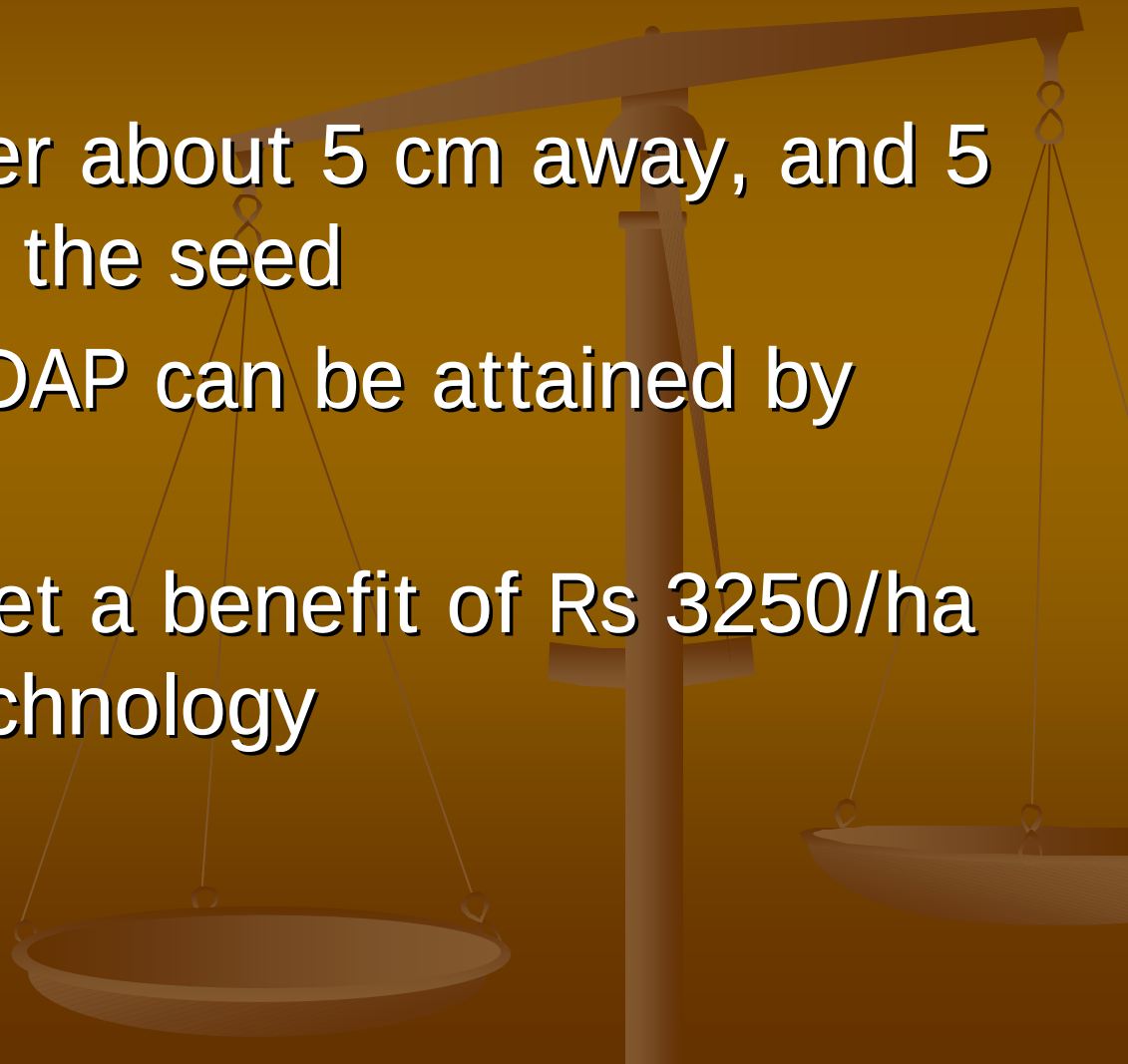
Low-cost Zero-Tillage Drill



- Annual production is about 300 units
- 25 manufacturers are engaged in its local production
- A farmer may save up to Rs 6782/ha as timeliness cost

Fertilizer Band Placement Drill

Features of Fertilizer Band Placement Drill



- It places fertilizer about 5 cm away, and 5 cm deeper than the seed
- 50% saving of DAP can be attained by using this drill
- A farmer may get a benefit of Rs 3250/ha by using this technology

Reaper-windrower for Harvesting Wheat

Features of Reaper-Windrower

- It can be used for harvesting wheat and rice
- About 30,000 units are in operation
- A farmer may save Rs 1400/ha by using this machine through timeliness of operation and reduced labor input
- Its per annum benefit to farming community is Rs 2542 million

Wheat Straw Chopper

Features of Wheat Straw Chopper

- It harvest the uncut straw, and pick up the combine ejected straw from the combine harvested fields
- It chopped the straw, and then blew it to a trolley
- Seven manufacturers are engaged in local production of this machine
- About 250 units are in operation

High Capacity Rice Thresher

High Capacity Rice Thresher

- In Sindh and Baluchistan, all rice harvesting is done manually, and threshing is done with manual beating, bullock/tractor treading followed by manual cleaning
- Therefore, this machine has great scope in these provinces
- Its output capacity is 1.5 tons/hr
- About 700 units are in operation
- Seasonal saving from one machine is Rs 0.5 million

Solar-cum-Gas Fired Fruit Dryer

Salient Features of Solar-cum-Gas Fired Fruit Dryer

- Solar-cum-gas fired dryer is capable to dry about 500 kg of fresh dates within 5 days
- The economic analysis revealed that one may earn Rs 72,100/season by adopting this technology
- More post harvest technologies are required to introduce in the country

Mobile Flat-bed Dryer for Sunflower

Mobile Flat-bed Dryer for Sunflower

- Autumn sunflower can be grown successfully in Pakistan, but its drying is not possible in sun, because of cold weather
- A mobile flat-bed dryer is developed to solve this problem
- It requires 3 hrs to dry 1.25 tons of sunflower from 30% moisture content down to a safe storage level of 10%
- Cost of drying sunflower is Rs 1.25/kg

Mobile Seed Processing Unit

Mobile Seed Processing Unit

- One of the constraints in providing healthy seed to growers is the un-availability of small scale seed processing technology
- To solve this problem, a mobile seed processing unit was designed and developed
- It has 98% cleaning efficiency, and its processing capacity is 1.5 tons/h, and 1000 tons/3-months season

Water Management Technologies

Research is being focused in:

- Improving water use efficiency by adopting sprinkler and drip irrigation techniques
- Developing innovative water saving practices such as bed planting, and zero-tillage techniques
- Developing laser levelers for leveling agricultural fields in order to improve water use efficiency

Research Institutes

- Farm Machinery Institute (FMI), National Agricultural Research Centre, Islamabad
- Agricultural Mechanization Research Institute (AMRI), Multan
- Agricultural Mechanization Research Cell (AMRC), Tandojam

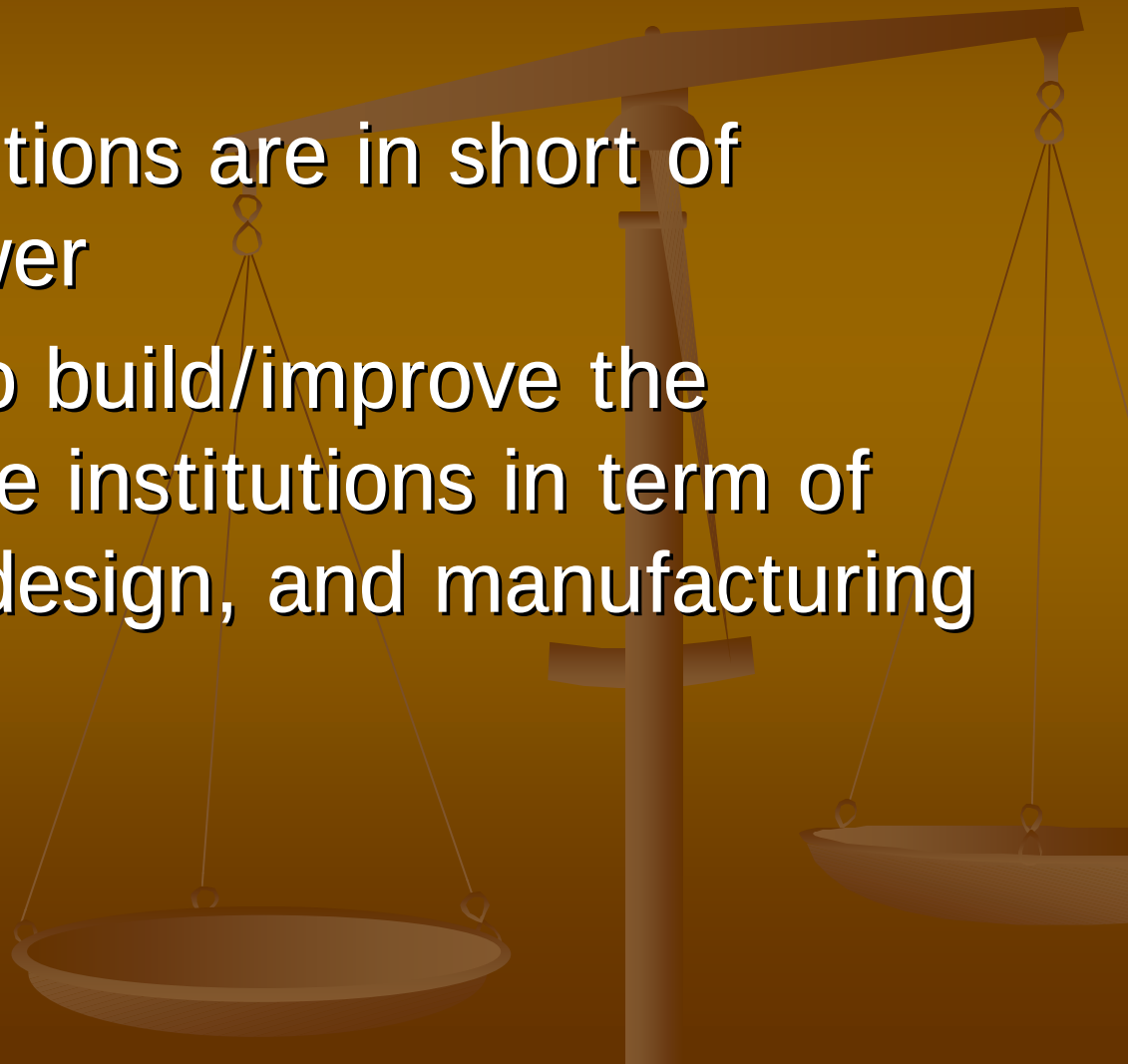
Universities

- Faculty of Agricultural Engineering and Technology, University of Agriculture, Faisalabad
- Faculty of Agricultural Engineering, Sindh Agriculture University, Tandojam
- Department of Agricultural Engineering, N.W.F.P. University of Engineering & Technology, Peshawar

Financial Resource Mobilization in R&D Institutions

- Non-Development Funding- Core funding provided to research institutions
- Development Funding- PSDP (Public Sector Development Program)
- Agricultural Linkages Program (ALP)- Scientists may get funding on competitive basis
- Funding from International Agencies- such as ACIAR (Australian Centre for International Agricultural Research)

Capacity Building of Research Institutions



- Research institutions are in short of trained manpower
- There is need to build/improve the capacity of these institutions in term of measurement, design, and manufacturing capabilities

Extension of R&D Output
(Mechanism for Industrial Extension)

- Development of 1st Prototype
- Field evaluation of 1st prototype
- Modifications in 1st prototype, if required
- Demonstration of 1st prototype to commercial enterprises (C.E.), and end users
- In case C.E. shows interest, an agreement is signed between PARC & C.E.
- Research institutes provide technical assistance to C.E. for local manufacturing of these newly developed machines

Impact of Public Funded R&D Institutions

Farm machines already been developed and commercialized:

FMI, Islamabad

Reaper-windrower
Zero-tillage drill
Groundnut digger and Thresher
Paddy thresher
Wheat straw chopper
Pneumatic row crop planter

AMRI, Multan

Pesticide sprayers
Wheat thresher
Maize sheller
Inter-culture tool bar
Rotary slasher
Bed and furrow shaper/ planter

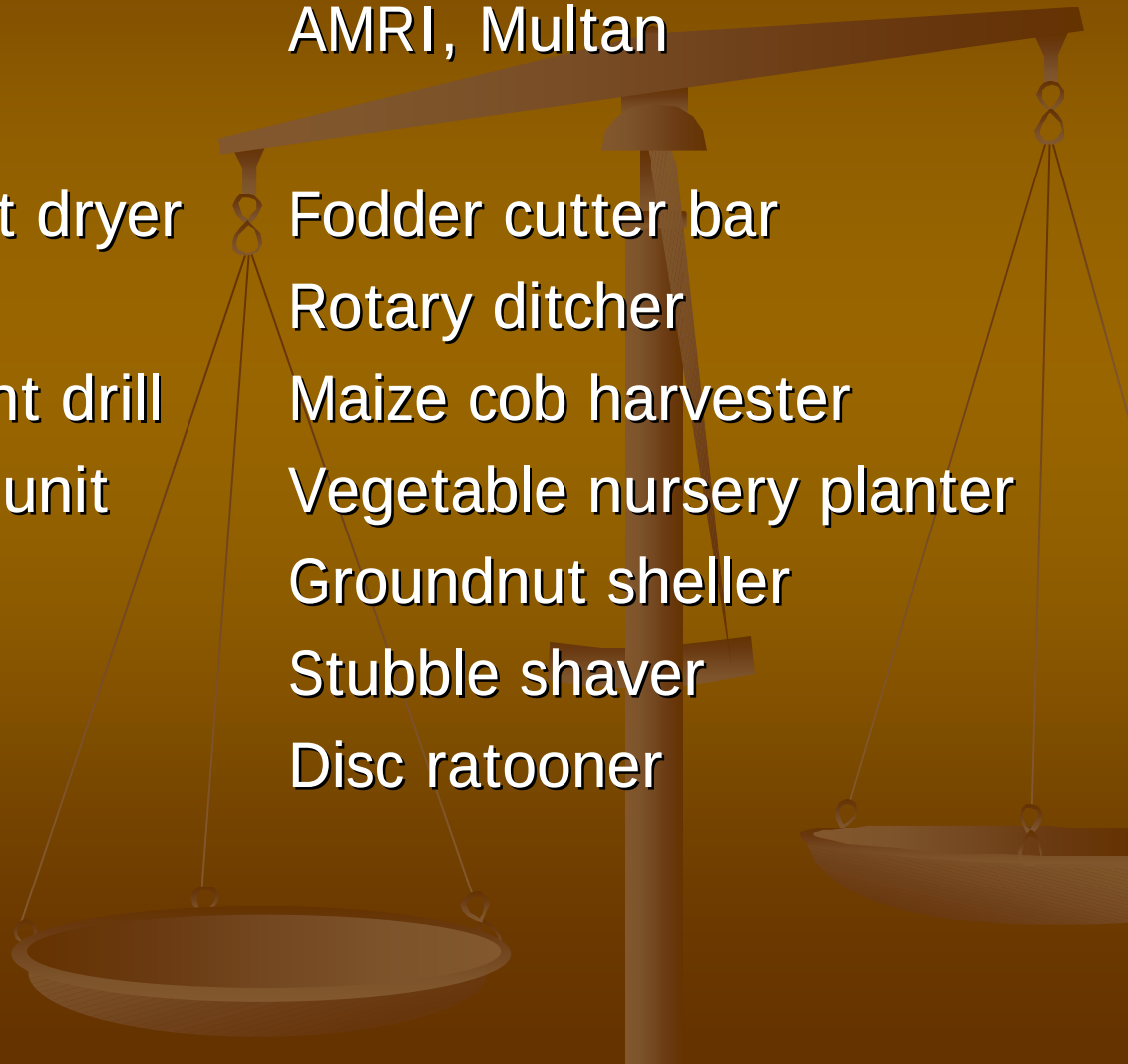
Farm Machines being Developed and Commercialized

FMI, Islamabad

Solar-cum-gas fired fruit dryer
Canola thresher
Fertilizer band placement drill
Mobile seed processing unit
Mobile Flat-bed dryer
FMI seeder for combine harvested paddy fields

AMRI, Multan

Fodder cutter bar
Rotary ditcher
Maize cob harvester
Vegetable nursery planter
Groundnut sheller
Stubble shaver
Disc ratooner



Impact of Mechanical Reaping of Wheat

(Cost-benefit from Mechanical Reaping of Wheat in Pakistan)

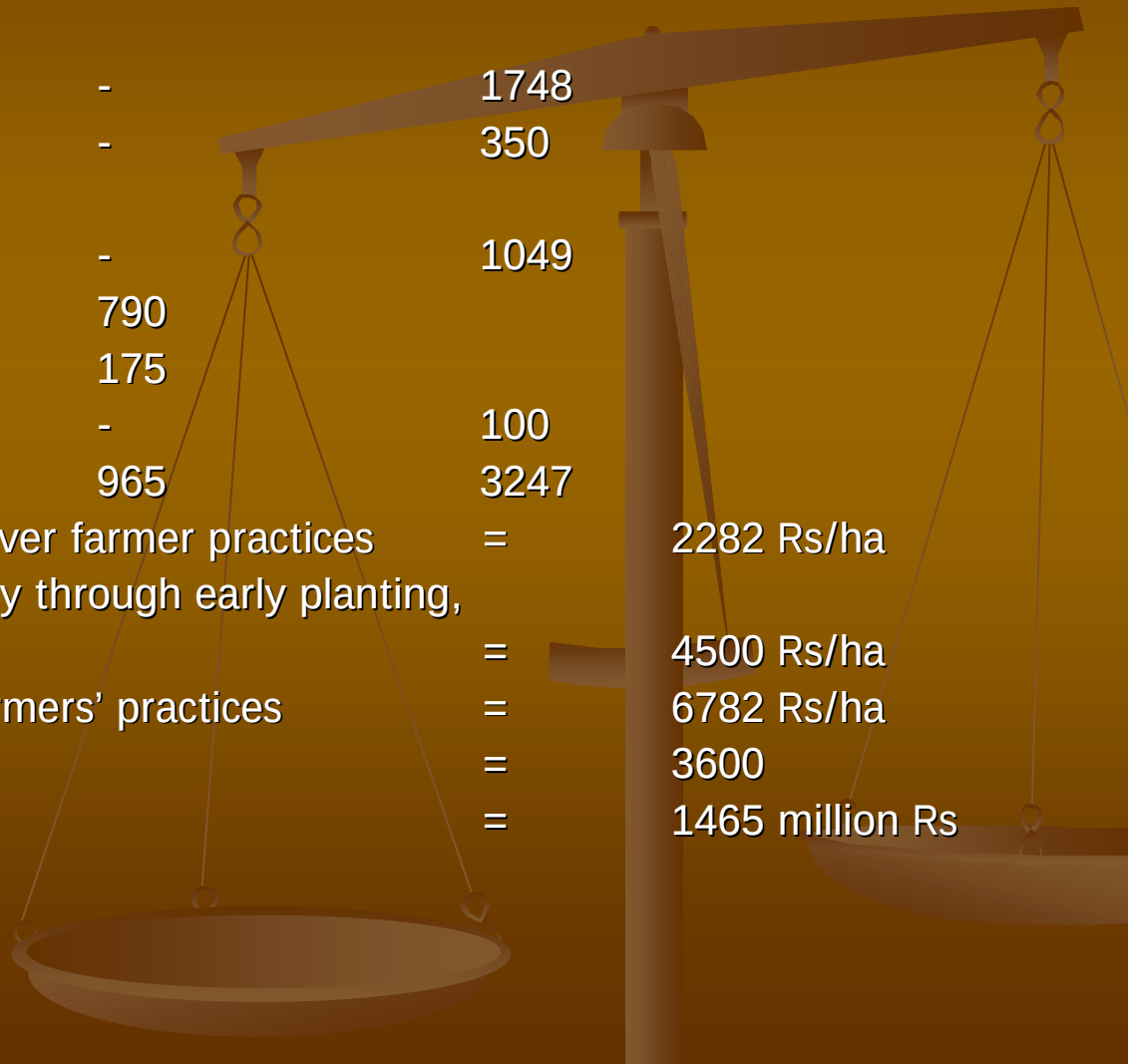
Cost of manual reaping (Rs/ha)	1564
Cost of mechanical reaping (Rs/ha)	652
Benefits to farmers (Rs/ha)	912
Number of reapers in operation in 2006	30,000
Number of ha wheat harvested with reapers in 2006	1.8 million ha
Cost-benefit on 1.8 million ha (Rs million)	1641.6
Average yield (kg/ha)	2500
Increased yield/ha due to reduced timeliness losses (2%), kg	50
Increased yield from 1.8 million ha (million kg)	90
Additional benefit due to reduced losses (at 2006 wheat price of Rs 400/40 kg), million rupees	900
Total benefit to farming community (million Rs)	2542

Impact of Adopting Zero-Tillage Technology

(Cost-benefit of using Zero-Tillage Technology)

Operation	Cost in Rs/ha	
	With zero-tillage drill	Farmers' Practices
Land preparation		
▪ 4-cultivations @ Rs 437/ha	-	1748
▪ 2-planking @ Rs 175/ha	-	350
Planting		
▪ 2-cultivation and 1 planking	-	1049
▪ Driling	790	
▪ Planking	175	
❖ Broadcasting	-	100
▪ Total	965	3247

- ❖ Cost advantage of zero tillage over farmer practices = 2282 Rs/ha
- ❖ Benefit of zero-tillage technology through early planting, 15 days at 30 kg/day/ha = 4500 Rs/ha
- ❖ Total benefit of zero-till over farmers' practices = 6782 Rs/ha
- ❖ Number of drills in operation = 3600
- ❖ Annual cost-benefit = 1465 million Rs

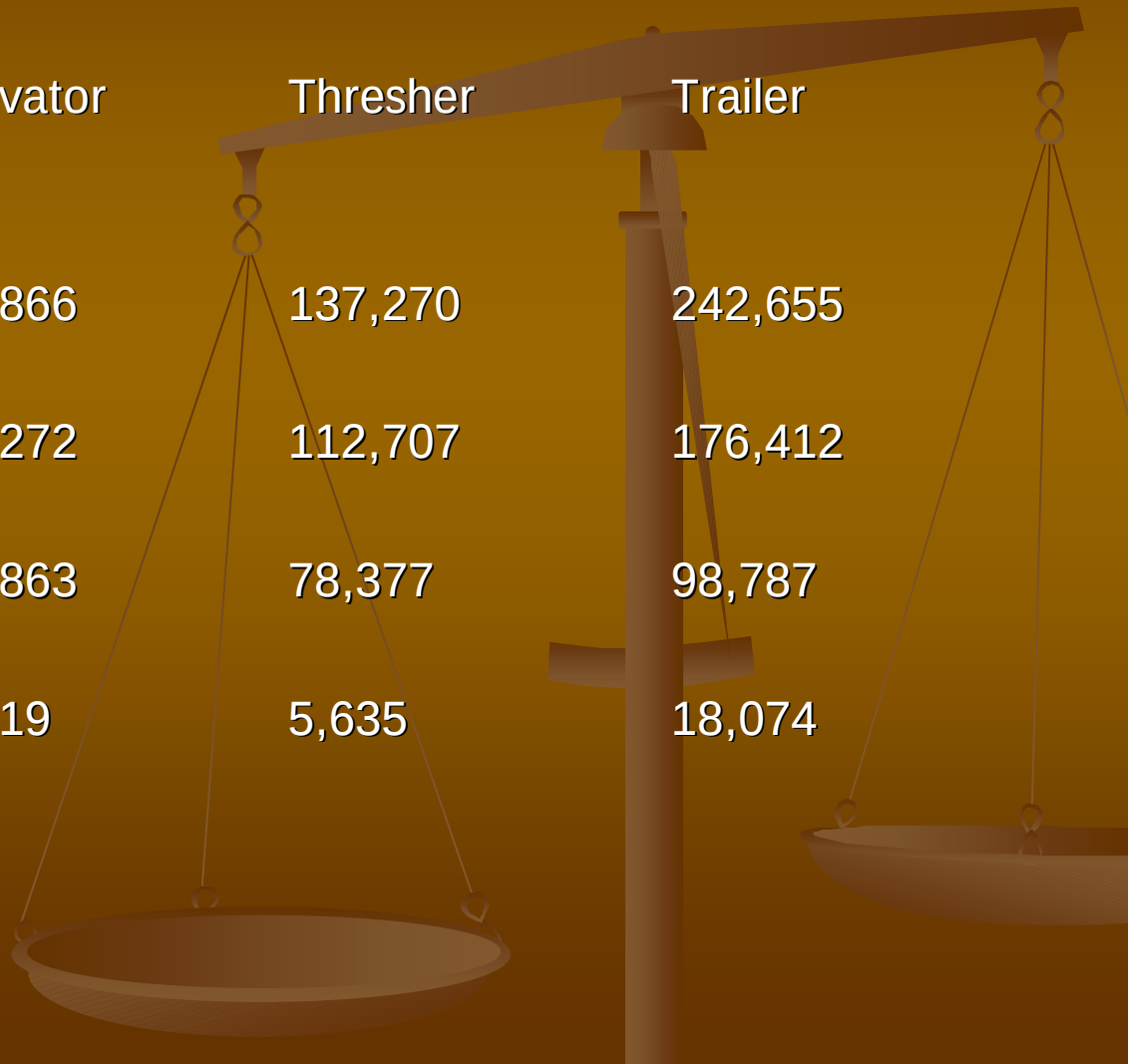


Role of Commercial Enterprises (Tractor Manufacturers)

- Tractor manufacturers have made significant efforts in indigenization of tractors by deleting substantial quantities of imported components
- They saved foreign exchange & provided employment opportunities to the skilled labor
- Two firms (Massey Ferguson and Fiat) are presently engaged in tractor manufacturing, and they have achieved over 80% deletion
- Total number of tractors in country are about 401,663
- New investors are being encouraged
- Federal Govt. has allowed one-time import of 10,000 tractors at zero tariffs

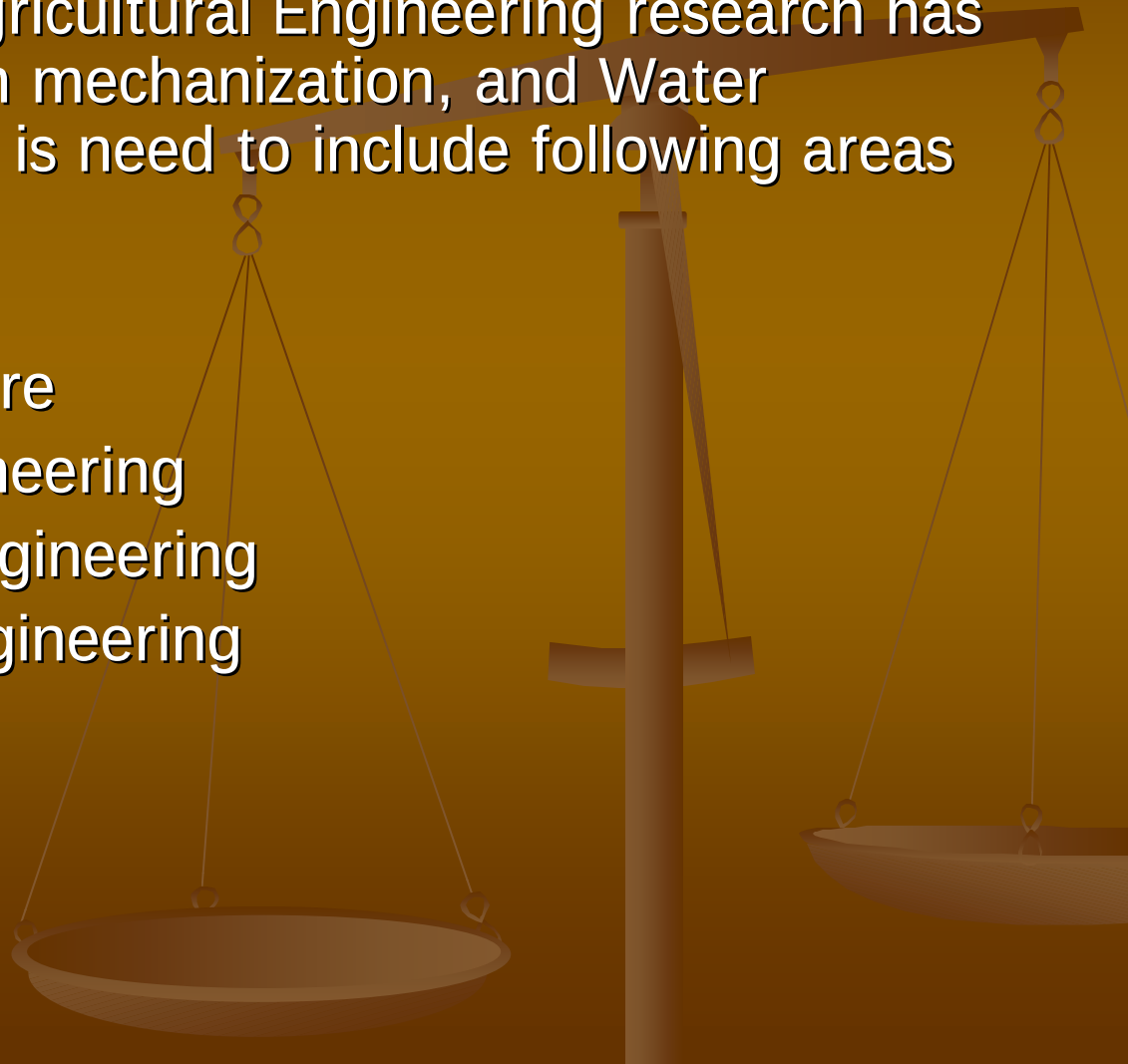
Role of Agricultural Machinery & Implements Manufacturers

Census Year	Tractor	Cultivator	Thresher	Trailer
2004	401, 663	369,866	137,270	242,655
1994	252,861	236,272	112,707	176,412
1984	157,310	146,863	78,377	98,787
1975	35,714	31,619	5,635	18,074



Restructuring of Agricultural Engineering Research

- So far in Pakistan, Agricultural Engineering research has been focused in Farm mechanization, and Water management. There is need to include following areas too.
  - Precision agriculture
  - Post harvest Engineering
  - Energy System Engineering
  - Environmental Engineering



Conclusions and Recommendations

- The research institutes have developed and introduced a number of technologies
- The research institutes and universities are contributing a lot in developing/disseminating innovative equipment, and imparting training/education in agricultural engineering
- The research funding to research institutions/universities is available through non-development funding, PSDP funding, and ALP (Agricultural Linkages Program) on competitive basis

Conclusions and Recommendations (Cont..)

- The impact of introducing new farm mechanization technologies on Pakistan's economy is tremendous, and credit of this goes to research institutes, and commercial enterprises
- There is need to restructure research in agricultural engineering with more emphasis on fruit, vegetables, and grain preservation, precision agriculture, developing environmentally sound agricultural practices, and utilization of renewable energy resources

Thank You Very Much