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Role of Agricultural Mechanization in Conservation Agriculture in Pakistan

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Geographical Area 79.61 million ha

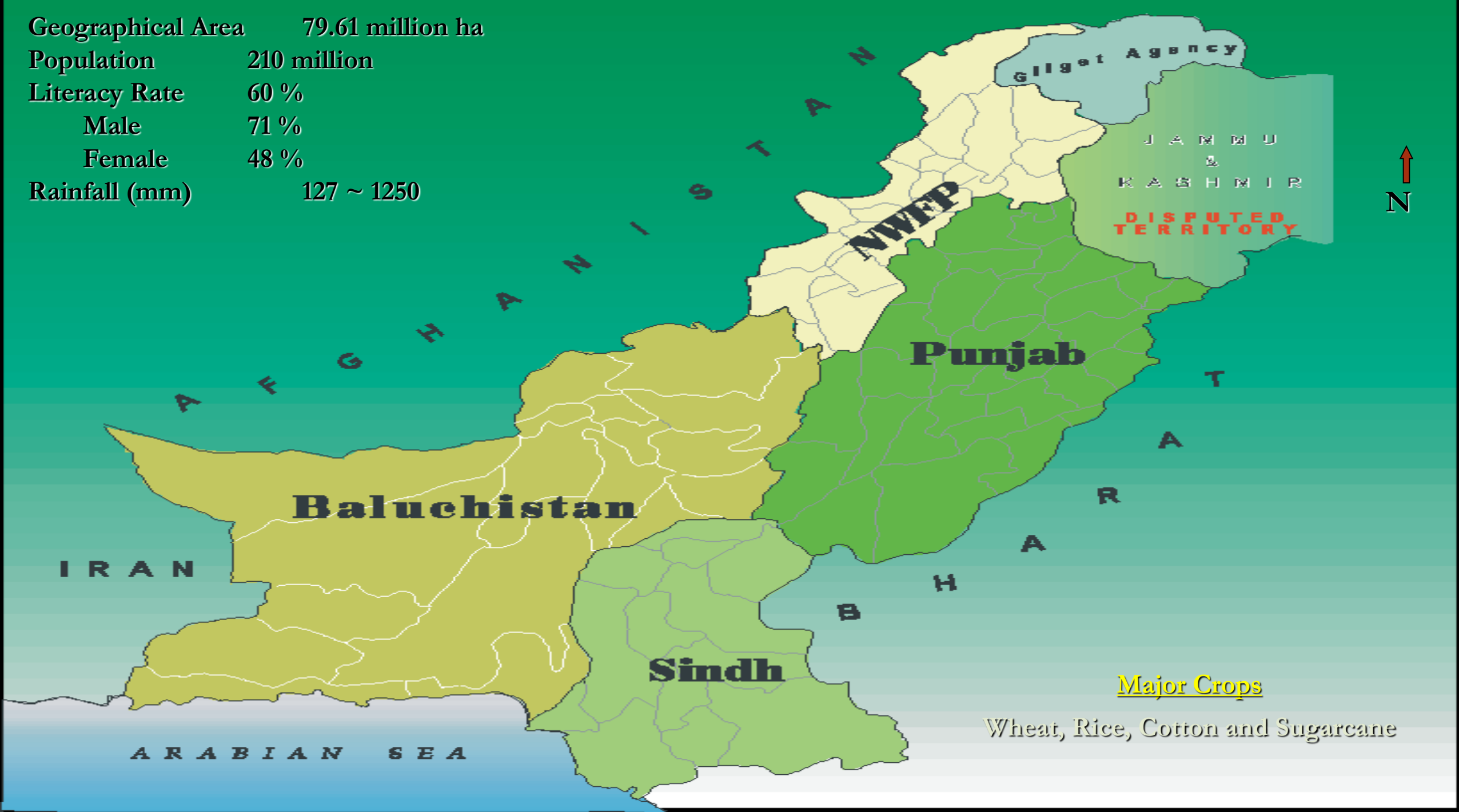
Population 210 million

Literacy Rate 60 %

Male 71 %

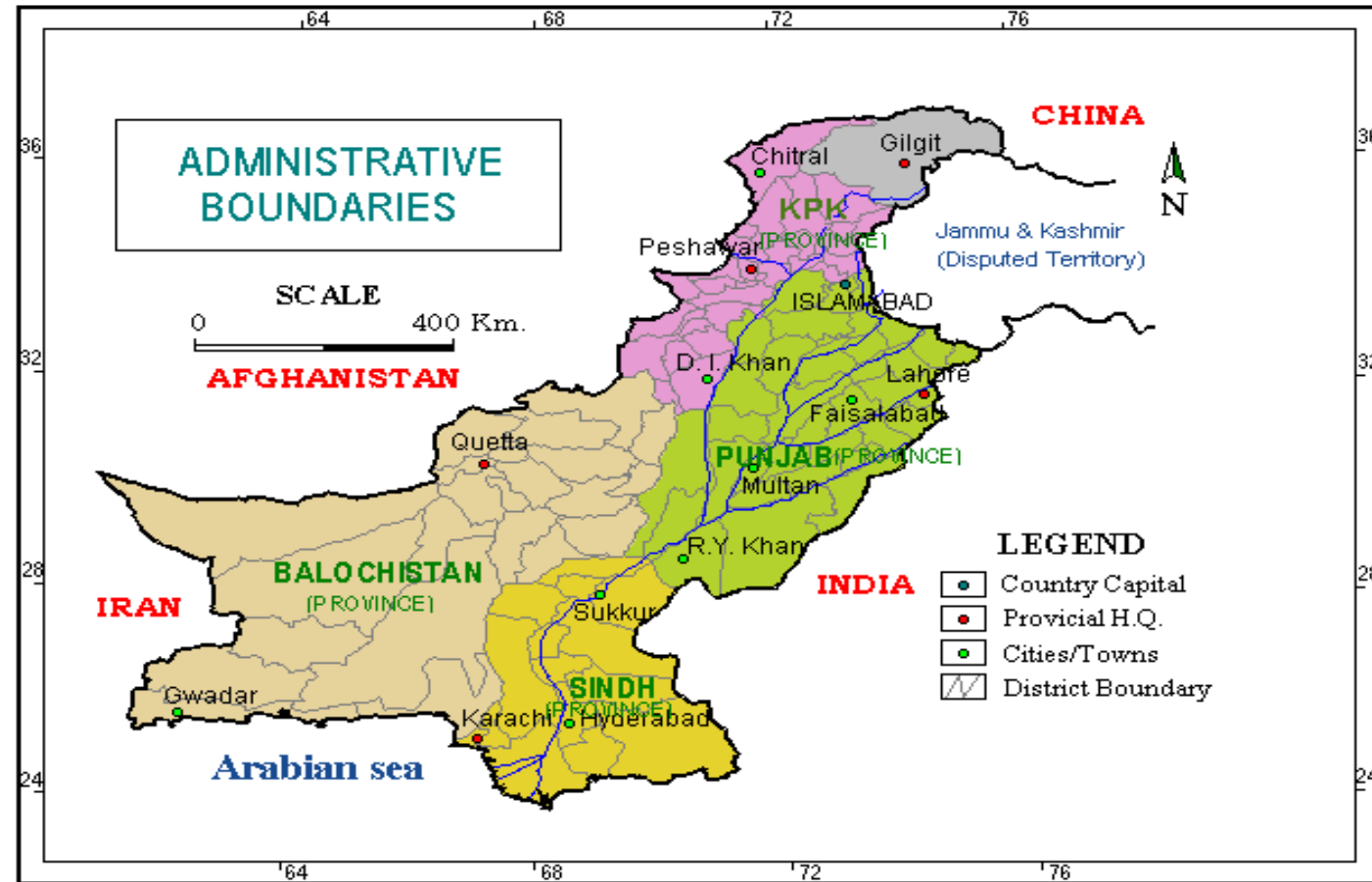
Female 48 %

Rainfall (mm) 127 ~ 1250



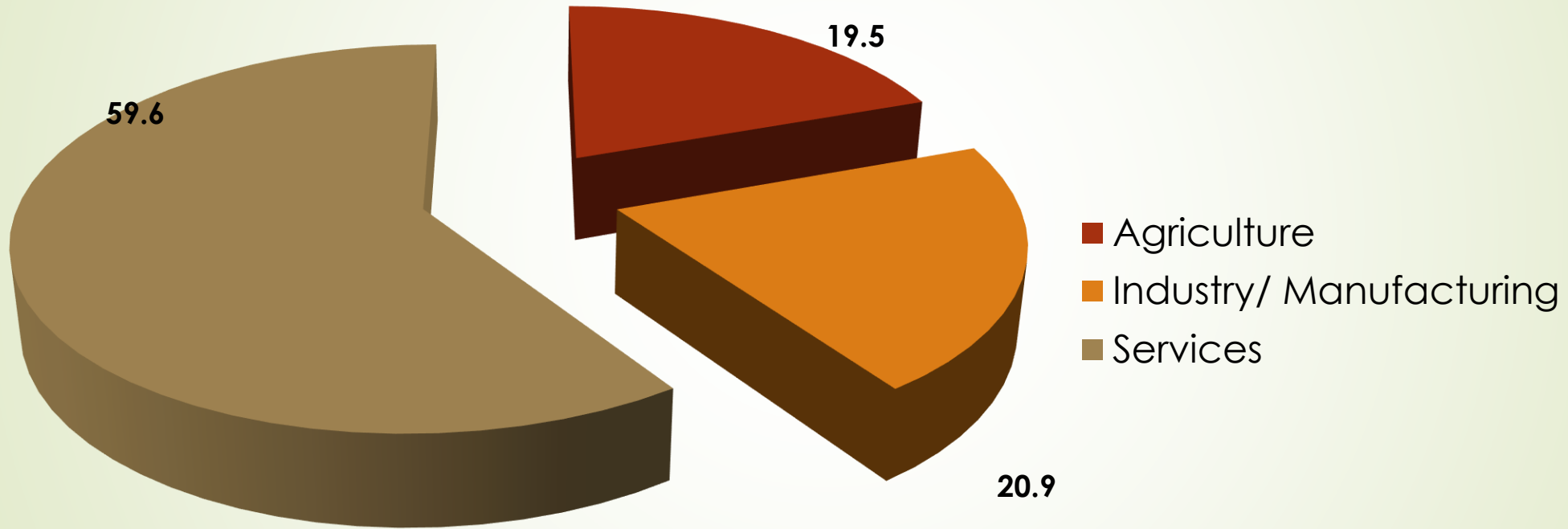
Facts About Pakistan Agriculture

- Population: 210 million
- Area:
 - Total: 79.61 m ha
 - Cultivated: 22.05 m ha
 - Irrigated: 18.92 m ha (86%)
 - Rain fed: 3.13 m ha (14%)
- Predominantly an arid and semi-arid country with 68 m ha (85%) where rainfall is less than 300 mm



Agriculture: Contribution to GDP

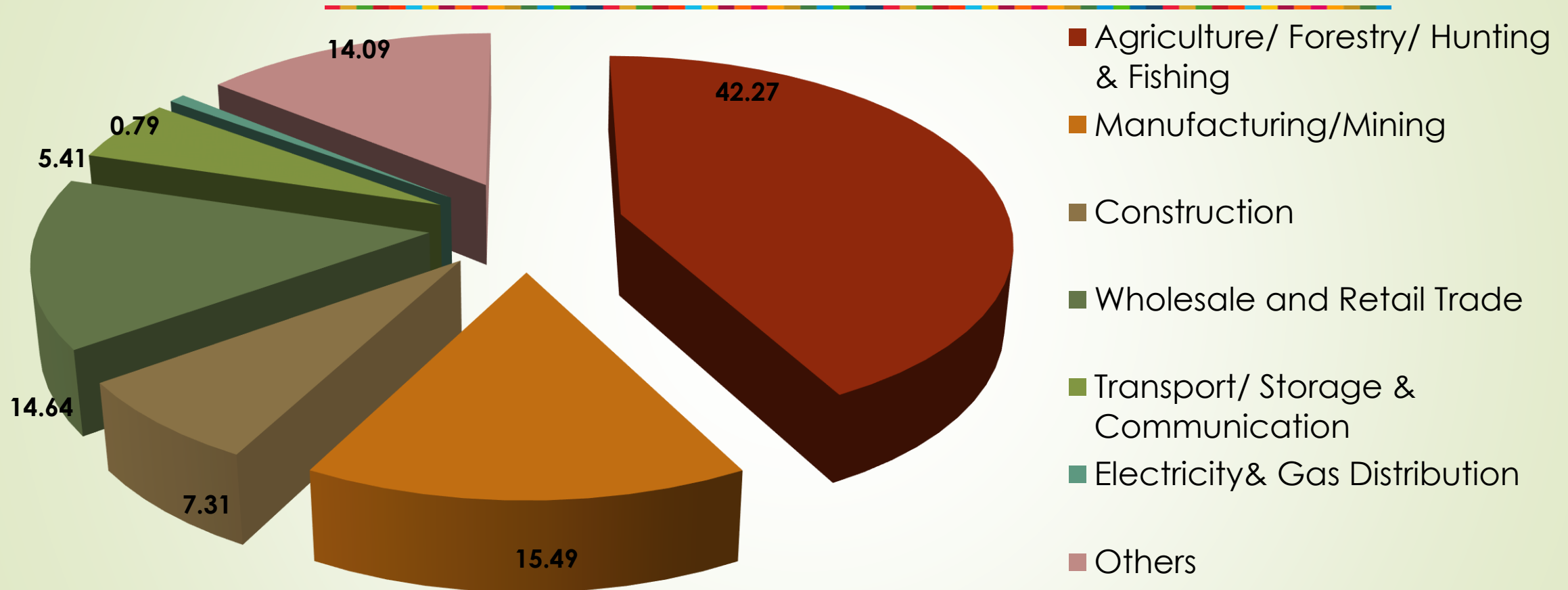
GDP Share



Contributes 19.5 percent to GDP

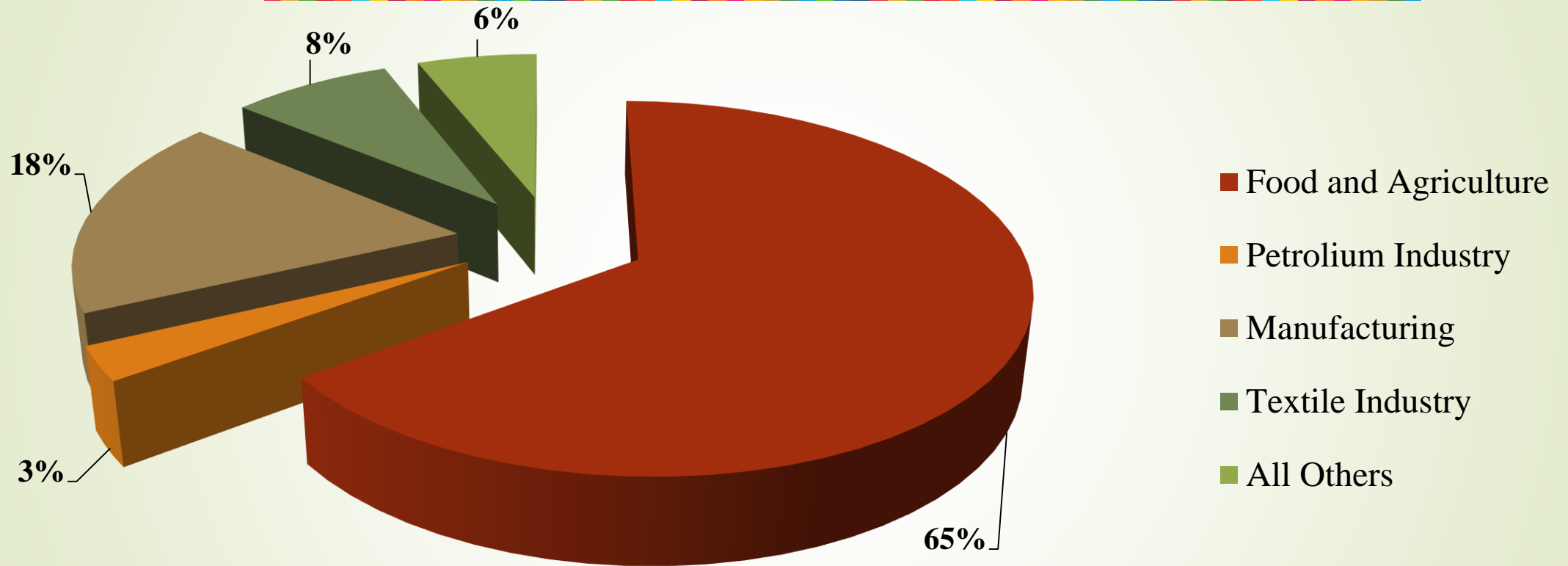
Agriculture: Employment Share

Sectorwise Employment Share



Employs 42.27% of the country's labour force and 60% of rural population depends upon this sector for livelihood

Agriculture: Exports Share



Contributes around 65% to exports of the country

Major Crops

Crop	Area (‘000 ha)	Production (‘000 tones)	Yield (kg/ha)
Wheat	9,052	25,750	2,845
Cotton	2,489	10,671*	730**
Rice	2,724	6,849	2,514
Sugarcane	1,217	73,607	60,428

P: Provisional * '000 bales ** Lint

Source: Economic Survey Pakistan: 2016-17

Farm Mechanization: National Perspective

- ▶ Practicing selective mechanization
- ▶ Mechanized operation for which there was shortage of labour power or both
- ▶ Popular forms of mechanization are:
 - ▶ Bulldozers
 - ▶ Power rigs
 - ▶ Tractors with cultivator, wheat thresher, and sprayers
 - ▶ Tube wells



Agricultural Mechanization

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1. Mechanization in Pakistan is growing rapidly with the introduction of farm machinery in last three decades
2. There are five makes of tractors, which are manufactured in the country
3. Most of the farm implements and machines are manufactured in the country
4. Tillage implements, reaper-windrower, threshers, combine harvesters, seeders, band placement drill, zero tillage drill, wheat straw chopper, dryers, etc. are the major technologies which have brought positive change in the field of agricultural mechanization

S.No	Deletion achieved in tractor manufacturing (%)	85
1.	Working number of tractors (Million)	0.57
2.	Tractor annual production capacity (Million)	0.065
3.	Total farm power in the country (Million kW)	35.5
4.	Available farm power (kW/ha)	1.53
5.	Hectares of cultivated area for which, a 50 hp tractor is available	37

Mechanization Extent of Crop Production Operations

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Crop	Land Preparation	Sowing	Irrigation	Spraying	Inter-culture	Harvesting	Threshing
Wheat	Highly mechanized	Low mechanized	Semi-mechanized	Low mechanized	Nil	Semi-mechanized	Highly mechanized
Cotton	Highly mechanized	Semi-mechanized	Semi-mechanized	Highly mechanized	Highly mechanized	Nil	-
Rice	Highly Mechanized	Nil	Semi-mechanized	Low mechanized	-	Semi-mechanized	Semi-mechanized
Sugarcane	Highly mechanized	Simi-mechanized	Semi-mechanized	Semi-mechanized	Semi-mechanized	Nil	-
Potato	Highly mechanized	Semi-mechanized	Semi-mechanized	Highly mechanized	Highly mechanized	Semi-mechanized	-

Conservation Agriculture

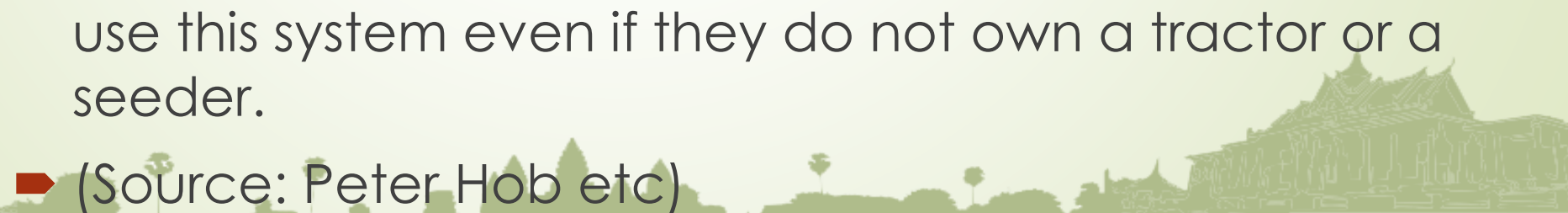


- Conservation agriculture (CA) defined) as minimal soil disturbance (no-till, NT) and permanent soil cover (mulch) combined with rotations, is a recent agricultural management system that is gaining popularity in many parts of the world.
- (Source: FAO)





Equipment for CA

- The main requirements of equipment in a CA system are a way to handle loose straw (cutting or moving aside), seed and fertilizer placement, furrow closing and seed/soil compaction. There is also a need for small-scale farmers to adapt direct-drill seeding equipment to manual, animal or small tractor power sources (reduced weight and draft requirements) and reduce costs, so equipment is affordable by farmers, although use of rental and service providers allows small-scale farmers to use this system even if they do not own a tractor or a seeder.
 - (Source: Peter Hob etc)
- 



Conservation agriculture (CA): situation analysis

The base natural resources of soil and water play a critical role in agriculture. With the fast development of urbanisation has exhausted fertile agricultural land and deforestation has led to soil erosion and decreased quality and availability of soil and water.

Conservation agricultural or smart agricultural technologies include zero tillage technology, laser land levelling, bed and furrow irrigation, improved irrigation infrastructure, irrigation scheduling and irrigation advisory services. The benefits of conservation agriculture are being advocated by the experts since many years. In Pakistan, the first attempt towards conservation agriculture was the introduction of zero tillage technology. Zero tillage technology was introduced in the country in 1980s to conserve soil moisture and soil resources for sowing of wheat crop in the rice stubbles. This was very successful approach, which was being practiced by farmers for many years of the rice-wheat belt of the Punjab and Sindh provinces.

TYPES OF FARM MACHINERY for Conservation Agriculture

- Deep Tillage
- Moisture Conservation Machinery
- Erosion Control Machinery
- Weeds and Insects Control
- Residue Management Machinery
- Direct Seeding Machinery

Harvesting and Threshing
Post Harvest Processing



SOIL MOISTURE CONSERVATION IMPLEMENTS

- Chisel Plow
- Sub-soiler
- M.B. Plow



PRECISION LAND LEVELLING MACHINERY

- Tractor Front Blade
- Tractor Rear Blade
- Laser Leveller



LAND DEVELOPMENT AND LEVELLING



Bulldozer



Front blade



Rear blade



Laser land leveller

INTER CULTURE IMPLEMENTS

- Row Crop Weeder
- Sweep Cultivator





Zero Tillage (ZT) Technology

- Time window between rice harvesting and wheat sowing is less than two weeks, especially in Basmati growing areas.
- Therefore, about 70% of wheat sowing in rice-wheat based cropping system gets late.
- Delayed planting of wheat in rice based farming system was resulting in 15% reduction of wheat yield.
- Challenge was to develop a technology for timely sowing of wheat, thus reducing its yield losses.

About 7,000 drills are being used by the farmers. Estimated 43 billion rupees saving due to timely sowing of wheat, yield increase and savings in production cost.



PAK SEEDER



ISSUE



FARMERS CURRENT PRACTICES OF LAND PREPARATION





PAK SEEDER PERFORMANCE



FERTILIZER BAND PLACEMENT DRILL



FERTILIZER BAND PLACEMENT DRILL

- ❑ Fertilizer broadcast method is a wasteful method of fertilizer application
- ❑ Fertilizer use efficiency is less and high rate of ammoniated phosphate fertilizer (like DAP) affects the seed germination and crop yield.
- ❑ ABEI NARC designed and developed a fertilizer band placement drill. This drill places fertilizer 5cm away and 5cm deeper than the seed.
- ❑ Currently 8000 units in operation



BENEFITS

- ▶ This drill saves 50% phosphate fertilizer compared with broadcast method.
- ▶ It saves One DAP bag (Rs 4300) per acre.
- ▶ About 10% more grain yield by using this drill for wheat sowing.
- ▶ By up scaling this technology, country will benefit Rs. 15000 million/annum



WHEAT STRAW CHOPPER



Wheat Straw Chopper-cum-Blower

ISSUES

- Straw collection
- Wastage of wheat straw in combine harvested field
- Straw burning & related field hazards
- Environmental pollution

TECHNOLOGY HIGHLIGHTS

Field Capacity : 0.0.4 ha/h

Economic Benefit : \$ 190/ha (2400 kg straw not burned and saved for cattle feeding)

Operating units : 5000



Wood Chipper Shredder

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Processing capacity : 900 kg/h

Raw material : Top tree Trimmed waste material

Operational cost : Rs 564/h
Rs 627/ton

Uses : As a fuel in brick factories
organic matter for marginal land



CROP RESIDUE MANAGEMENT

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Wheat Straw Chopper Blower



Wheat Straw Chopper Blower



Mobile Bhoosa Baler

WHEAT: RESIDUE MANAGEMENT MACHINERY

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Straw Rake: is used to collect only loose / trampled wheat straw after operation of combine harvester to form windrows for subsequent collection with the help of straw baler or manual labourers.

Straw Baler: is used to collect only loose / trampled wheat straw after it had been raked into windrows. Two types of balers are available i.e. the one which makes rectangular bales and the other which makes round bales. The rectangular baler also ties the bundles automatically using sisal string while round bales are left untied as these are compact enough to stay without tying with a string. Alternatively, round bales are wrapped in polythene sheets for their prolonged storage.



Straw rake



Rectangular baler



Round baler (untied)

MAIZE: FLAT BED SOWING

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Seed Planter: is used to sow seed by maintaining seed to seed distance. Most common types of seed planters are a) horizontal plate type, b) inclined plate type, c) vertical plate type, d) pneumatic and e) hill type. Each planter has its own merits and demerits. Horizontal plate type planter is cheaper but creates problem of seed crushing. Inclined plate type planter is better than horizontal plate type as it pick few seeds per cell and drops the same without crushing but is expensive. Vertical plate type is very accurate as it pick one or two seeds per cell and drops the same without crushing but is quite expensive. Pneumatic planter is precise as it picks only one seed at a time through air suction and drops it precisely but requires seed having almost 100% germination rate. Hill planter drops few seeds (3 to 5) at one place in the form of a hill in saline sodic soils which may crust in case rains come in before germination. The collective force of emergence of several seeds helps break the crust to facilitate germination.



Seed planter (Horizontal plate)



Seed planter (Inclined plate)



Seed planter (Vertical plate)



Seed planter (Pneumatic)



Seed planter (Hill)

MAIZE: BED AND FURROW SOWING

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Bed and Furrow Former: is used to form beds and furrows in well prepared soils for sowing of cotton manually. In some versions, fertilizer application attachment is also provided. Bed shaping attachment can also be used to shape and stabilize the beds and furrows (B&F) specially in sandy and loose soils. The herbicides application, if required is done through manually operated sprayer

Bed and Furrow Drill / Planter: consists of bed and furrow former with seed drill or planter to sow seed in one go. In some versions, the machine is also equipped with fertilizer a sprayer to spray herbicides alongwith planting.



B&F former



Manual planting



Manual herbicides application



B&F planter with fertilizer & herbicides attachments

MECHANICAL WEED CONTROL

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Row Crop Cultivator: is used for weed control and interculture purpose in cotton crop grown on flat land. Both, spray loaded tine and rigid tines cultivators are used. Generally shovels or sweeps are used for weeding and interculture between crop rows.

Cotton Ridger: is a rigid tine row crop cultivator with which attachments for earthing up and fertilizer application are used. The implements is used for weeding and interculture in cotton crop grown in flat land.



Row crop cultivator (Spring tines)



Row crop cultivator (Rigid tines)



Cotton ridger with earthing-up attachment



Cotton ridger with earthing-up and fertilizer attachment

COTTON CROP MECHANIZATION



Bed & furrow planter



Multi-crop planter



Multi-crop planter

COTTON CROP MECHANIZATION



Cotton bed & furrow planter



Interculture ridger



Rotary hoe



Intercultural cultivator

CROP RESIDUE MANAGEMENT



Compost shredder



Chipper shredder



Corn stover shredder



Cotton stick Shredder

TUNNEL TECHNOLOGY

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NEED FOR CROP RESIDUE MANAGEMENT MACHINERY

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Cotton Stalk Puller Shredder (Imported)



Cotton Stalk Puller Shredder (Local)



Briquetter



Briquetter

WATER SAVING IRRIGATION SYSTEMS

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Drip system



Row crops drip



Orchards drip

Issues

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- Under-utilization of tractor horse power
- Shortage of irrigation water
- Lack of required machinery and equipments for Mechanized farming
- Low level of knowledge of farmers

Constraints

- Increasing cost of inputs
- Non-availability of capital / funds
- Lack of standard and quality products
- Small land holdings and poor economic condition of farmer
- Inadequate custom hiring services
- Lack of coordination among researchers, machinery manufactures and farmers
- Lack of awareness of farmers

Future Focus



- Precision Agriculture
 - To optimize the use of inputs like fuel, water, seed, fertilizer, chemical etc. by the use of energy efficient and environment friendly mechanical technologies.
 - Development of seeding machinery which can work in heaving residue without chopping of residue to save energy cost and requirement of big tractor to operate it.
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THANKS