

Sustainable Agricultural Mechanization Under Climate Change Scenarios in Pakistan



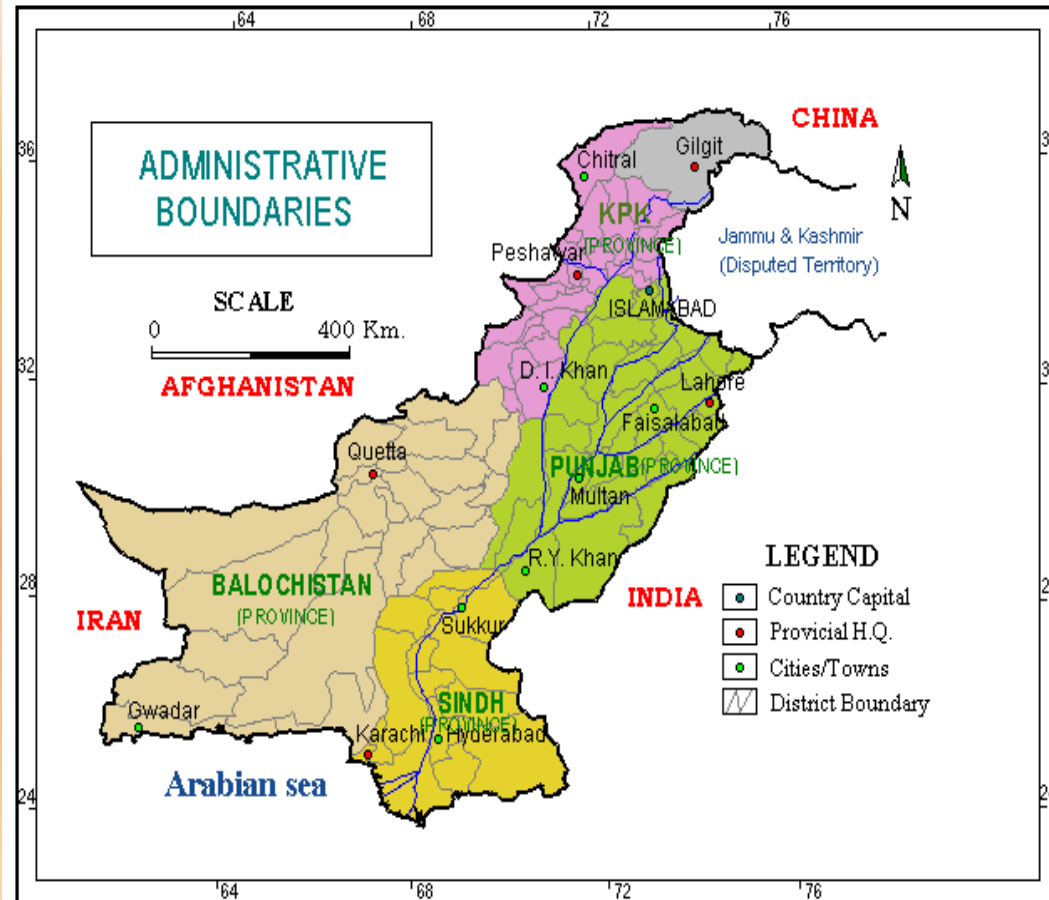
Pakistan

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Islamabad**

Agriculture Resource Base of Pakistan

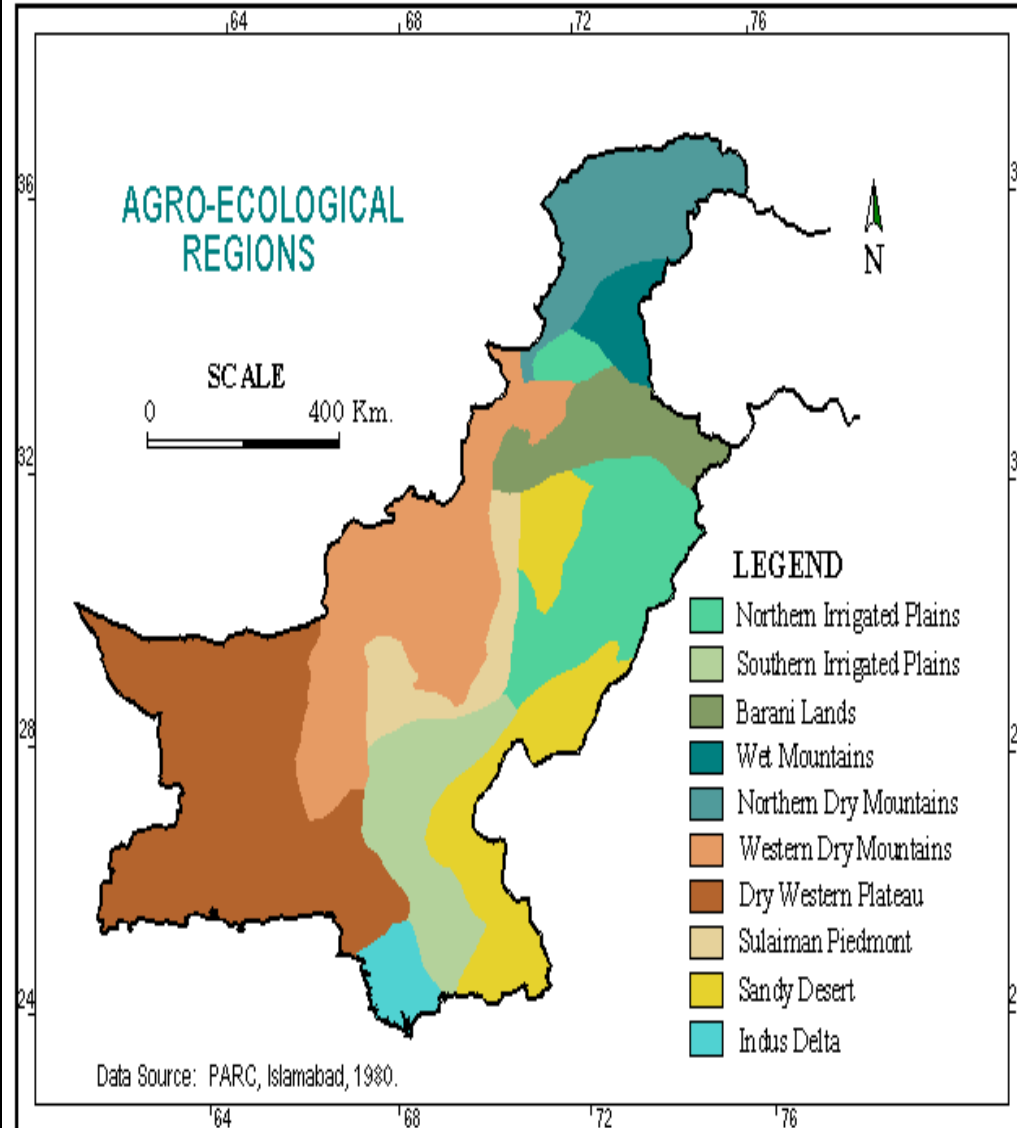
- **Population: 207 million**
- **Area:**
 - Total: 79.61 m ha**
 - Cultivated: 22.06 m ha**
 - Irrigated: 19.28 m ha (87%)**
 - Rainfed: 2.78 m ha (13%)**
- **Predominantly an arid and semi-arid country with 68 m ha (85%) where rainfall is less than 300 mm**



Agriculture Resource Base of Pakistan

Pakistan has diverse landscapes:

- **high mountain ranges of the Himalayas, Karakoram and Hindu Kush,**
- **snow-covered peaks, long lasting glaciers, and the intermountain valleys in the north,**
- **snow and glacier melt keeps the Indus Basin rivers perennial**
- **vast rich irrigated plains in the Indus basin**
- **undulating highly vulnerable agri. areas of rainfed Pothwar**
- **stark deserts and rugged rocky expanse of plateaus in the south-west of Baluchistan**



Number and Area of Farms By Size of Farm

Size of Farm (Hectares)	Farms		Farms Area		Avg. size of Farm Area (Hectares)
	Number	%	Hectares	%	
< 5.0 (Small)	7,398,100	89	10,280,352	47	1.4
5.0 to 10.0 (Medium)	562,206	7	3,793,730	18	6.7
> 10 (Large)	304,225	4	7,338,440	35	24.1
Total	8,264,480	100	21,412,545	100	2.6

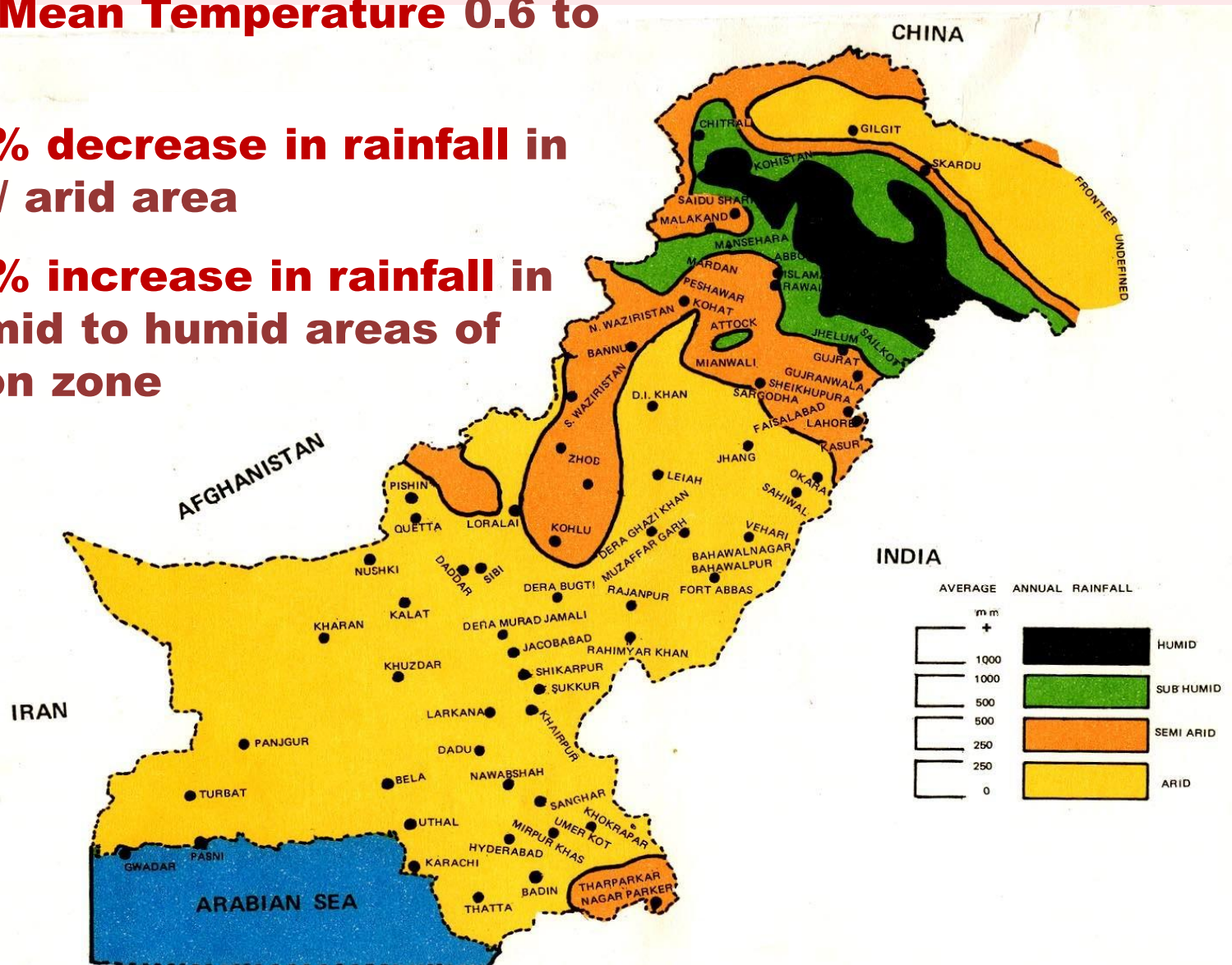
Relative Status of Power Available in Pakistan - 2013

Country	4W Tractors (000's)	2W Tractors (000's)	Irrigation Pumps (000's)	Combine harvesters (units)	Power Kw/ha
Bangladesh	60	700	1729	130	1.83
Cambodia	9.5	152	256	4580	1.32
China	5270	17523	22068	1421000	5.7
India	5430	440	28000	38000	2.02
Indonesia	2.8	71	-	-	-
Rep. Korea	278	640	350	78854	10.6
Malaysia	8	35	N/A	1700	0.2
Nepal	30	12	550	-	-
Pakistan	573	2	1050	9000	1.1
Philippines	-	-	-	-	-
Russia	260	N/A	5.2	67900	1.48
Sri Lanka	15	2.8	-	1099	-
Thailand	334	1750	2320	15000	2.5
Vietnam	170	380	2170	20000	1.7

Source: Participants to Regional Meetings organized by CASM-UNESCAP

Recent Climate Change Trends

- **Rise in Mean Temperature 0.6 to 1.0 °C**
- **10 – 15% decrease in rainfall in coastal/ arid area**
- **18 – 32% increase in rainfall in sub-humid to humid areas of monsoon zone**



Recent Climate Change Trends

- **5% decrease in relative humidity in Baluchistan**
- **26-57% increase in winter rains in sub-mountain, central & southern Punjab, and north-eastern Balochistan**
- **0.5 to 0.7% increase in solar radiation over southern half of the country**
- **1.2 mm/year rise in sea level**
- **2-4 mm/year ground subsidence in the Indus deltaic region due to reduced sediment flux & excessive groundwater extraction**
- **Occurrence of 19 extreme climatic events during 1992 – 2011**
(heavy rains causing floods, droughts, cyclones, heat waves, etc)

Impacts of climate change on agriculture

- **Reduced productivity of crops and livestock due to severe water-stressed and heat-stressed conditions in arid and semi-arid regions**
- **Crop failures or decreased production caused by extreme events (floods, droughts and cyclones)**
- **Reduced agricultural productivity due to natural resources degradation (land, water, rangeland, forests)**
- **Productivity of cereals would decrease (due to increase in temperature and decrease in water availability).**
- **Crop failures or decreased production caused by extreme events (floods, droughts and cyclones)**
- **Global reports indicate a loss of 10-40% in crop production by 2100.**
- **Greater loss expected in Rabi. Every 1°C increase in temperature reduces wheat production by 4-5 million* tons in South Asia.**

** Source: International Water Management Institute (IWMI), Colombo*

Impacts of climate change on agriculture

Very high vulnerability due to:

- **Geographical location (high temperature zone)**
- **Greater dependence on climate sensitive sectors (agriculture and natural resources)**
- **Low adaptation capacity**
- **Knowledge and technology gaps**
- **Resource constraints**

Policy Initiatives

- **Pakistan contributes very little to the global GHG emissions, even then adopting pro active policy at National level.**
- **GOP has constituted a high power alternate energy board to advise the Government on cleaner forms of energy**
- **Government has established a separate Ministry on Climate Change**

Options in Agricultural Mechanization for Climate Change Adaptation

- **Resource Conservation Technologies**
- **Improving Efficiency of Agricultural Machinery**
- **Using Renewable Energy Resources for Agricultural Operations**

**Major Success Stories of
PARC Related to
Mechanization and Use
of Renewable Energy
Resources**

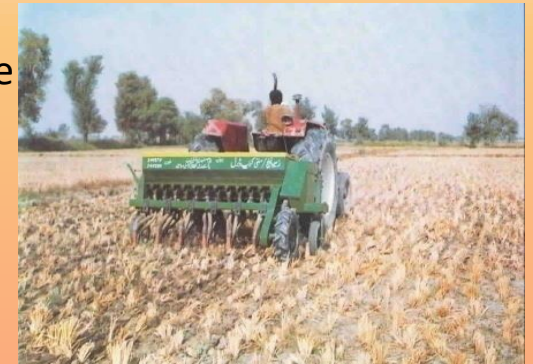
Adoption of Zero Tillage

Scale of Adaptation

- Area covered by Zero-Till Drills for wheat – 100,000 hectares
- Presently there are more than 5,000 Zero Tillage drills operated by farmers

Benefits

- Saves cultivation costs to the tune of US\$ 25- 37 per hectare in the case of small farmers and US\$ 48- 70 per hectare in the case of medium to large farmers.
- Assists early sowing of the wheat crop.
- Saves 30-50 percent irrigation water in the case of first irrigation after sowing and 15-20 percent in subsequent events.
- Reduces weed germination up to a certain extent.
- Improves soil fertility.
- Enhances water and fertilizer use efficiency.
- Accelerates decay process of rice stubble, which improves soil microbial activities.
- Increases wheat productivity in the range of 15-20 percent, if property implemented.



Solar Dates Drying

Issue: Dates worth of Rs. 5.0 billions (47 million US\$) are wasted every year because of unavailability of proper drying and storage technologies

Achievements: PARC developed and introduced solar dates dryer in Sindh Province

Impact: Date growers became capable to produce high quality dates

Way Forward: Solar dates drying technology will be promoted in other Provinces (Balochistan, KPK and Punjab). This technology may also be promoted for apricot, grapes etc.



Technology: Solar Dates Dryers

- PARC has developed Solar-cum- gas fired dates dryers and Solar tunnel dates dryers of 600 kg capacity/batch and 1200 kg capacity/batch respectively.
- Solar-cum-gas fired dates dryer also works under cloudy conditions and night time.
- They remove 80% moisture level up to 20 % moisture level in three days.
- These dryers protect dates against rain, insects and other animals during drying process.
- It increases shelf life and ensures its hygiene.



Solar-Cum-Gas Fired Dates Dryer



Solar Tunnel Dates Dryer

Dates Dried in July-August, 2016

Sr. No.	Site	Dryer	Dates dried (Kg)
1.	Village Bagh Pai, District Sukkur	Solar-cum-gas fired date dryer	2,600
		Solar tunnel date dryer	5,600
2.	Pir Jo Goth, District Khairpur	Solar-cum-gas fired date dryer	2,000
		Solar tunnel date dryer	6,000
3.	Village Preyalo, District Khairpur	Solar-cum-gas fired date dryer	1,500
		Solar tunnel date dryer	4,000
4.	Tehrhi, District Khairpur	Solar-cum-gas fired date dryer	2,500
		Solar tunnel date dryer	5,800
5.	Village Ali Baksh Hajano, District Khairpur	Solar tunnel date dryer	5,000
6.	Village Muhammad Hayat, District Khairpur	Solar-cum-gas fired date dryer	2,200
Total:			37,200



Value Addition Through Solar Dates Dryers

Types of Dryer	No. of Dryers Installed	Seasonal Capacity (tons)	Value Addition per ton (Rs)	Total Value Addition of dates per season (Rs)
Solar-Cum-Gas-Fired Dates Dryer	08	06	74,168/-	3.56 million
Solar Tunnel Dates Dyer	17	12	60,555/-	12.35 million
Total benefit to farming community per season				Rs15.91 million

Mini-dam's Command Area Development through Integration of Solar Pump and Irrigation Technologies

Issues; Less command areas (20 %) of mini/small dam and inefficient water use

Interventions; Integration of solar pump with high efficient irrigation systems

Adaptation; 200 mini dams by ABAD (Punjab), More than 200 Progressive farmers in rainfed areas

Way Forwards; Up scaling in regions; Rainfed areas where mini/small dams
100 dams' command in Balochistan, Riverine area of Pakistan, Shallow fresh water zones of Pakistan



Drip System for Orchard



PV Modules for Solar Energy



Drip System in Tunnels



Sprinklers Irrigation



Solar Pumping



Micro Sprinklers



Bubblers for Fruit Plants



Water Storage Tank



Furrow Bed System

Alternate Energy use in Agriculture_ Biogas

Issue: energy crises in the country have seriously affected the affordability of farmers to meet their energy requirement by using conventional sources (fossil fuel and electricity)

Intervention: Biogas digesters were designed, developed and tested in different agro-ecologies of the country. Dual fuel systems (biogas and diesel) developed for pumping ground water and generating electricity. The bio-gas purification system was also developed.

Impact: Punjab government proposed a mega project for shifting diesel operated Tubewells on biogas. Farming communities specifically in Punjab and KPK are adopting PARC biogas model to operate dual fuel engines for pumping groundwater for agriculture.

Way Forward: Up-scaling the capacity building of farmers in each region through R & D activities and enhancing the capacity of local industries to develop biogas purification system



Alternate Energy use in Agriculture - Solar water Pumping

Issue: The energy crises have severely affected the ability of farmers to meet their energy requirements from conventional sources (diesel and electricity).

Intervention: PARC developed a physical model of integration of solar pump and efficient irrigation technologies on 20 acres land at Fatehjang for high value crops.

Technical support to ABAD for up scaling of solar pumping for command area development of mini dams. ABAD is giving subsidy for solar pumping on 200 mini dams

Impact: National policy for solar pumps announced under PM Scheme; 30000 solar pumps will be installed. The policy based on physical model developed by CAEWRI-PARC-USDA/ICARDA at Thatti Gujran, Fatehjang Field station.

Way Forward: Piloting is required for resilience in climate vulnerable areas throughout the country



South-South Cooperation Needs

- **Pakistan has vast potential for renewable energy development like hydropower, wind and solar energy. Pakistan requires specific assistance in climate friendly technologies and renewable energy development both technical and financial.**

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THANKS