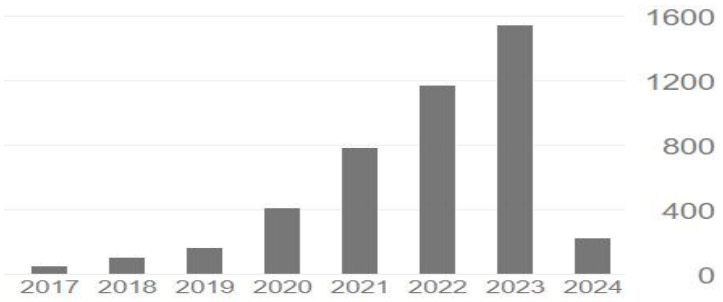
Climate Smart Agricultural Technologies; A way towards to combat drought and climate change

Implementation of Sustainable Development Goals (SDGs) for Environmental Sustainability and Ecosystem Restoration

Dr. Muhammad Habib ur Rahman
Associate Prof. IPBB
MNS-University of Agriculture Multan

Citations	4557	4340
h-index	37	36
i10-index	98	95



MNS University of Agriculture, Multan

Areas of Interest

Climate Change, Climate resilient agriculture systems
Crop production and precision resource management,
Agro-ecosystem modeling, climate smart agriculture, ESS and Environment protection

PhD specialization in Modleing and climate change (WSU-USA)

PostDoc- Institute of Crop Science and Resource Conservation (INRES), Crop Science Group**, University of Bonn, Germany**
Since: 2019-2022
Faculty member at MNS-University of Agriculture Multan-Pakistan 2016- till date

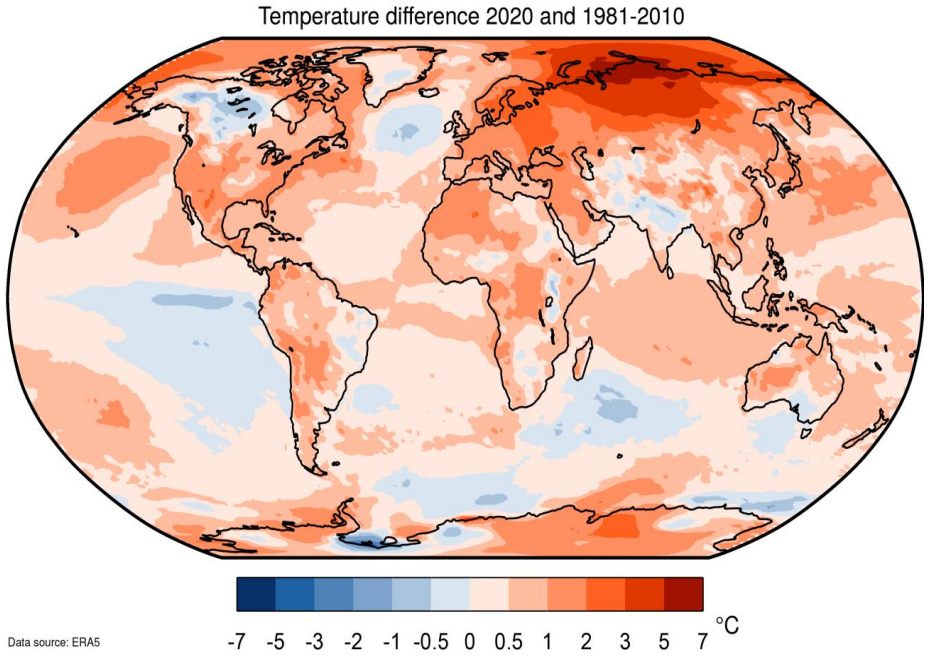
Peer reviewed Publications (2016-2024)
More than 110 h-index = 37

- Science of the total Environment (IF 10.75)
- Agricultural and Forest Meteorology (IF 6.42)
- Field Crops Research (IF 6.14)
- Atmospheric Research (5.96)
- Land Use Policy
- Environal Monitoring Assessment
- Agronomy Journal
- Journal of Environmental Management (IF 8.91)

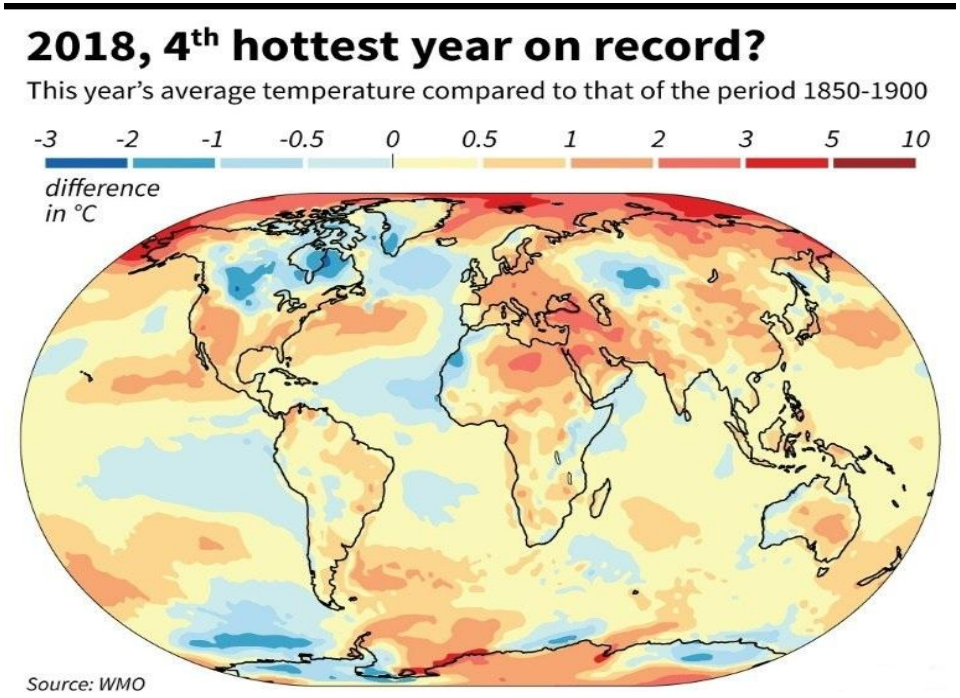
Research

My research aims to develop, integrated and apply innovative techniques like modeling, remote sensing, and real time simulation using UAVs multispectral images to improve resource use efficiency and sustainable soil and crop production under changing climate

Climate changes in past and recent trends



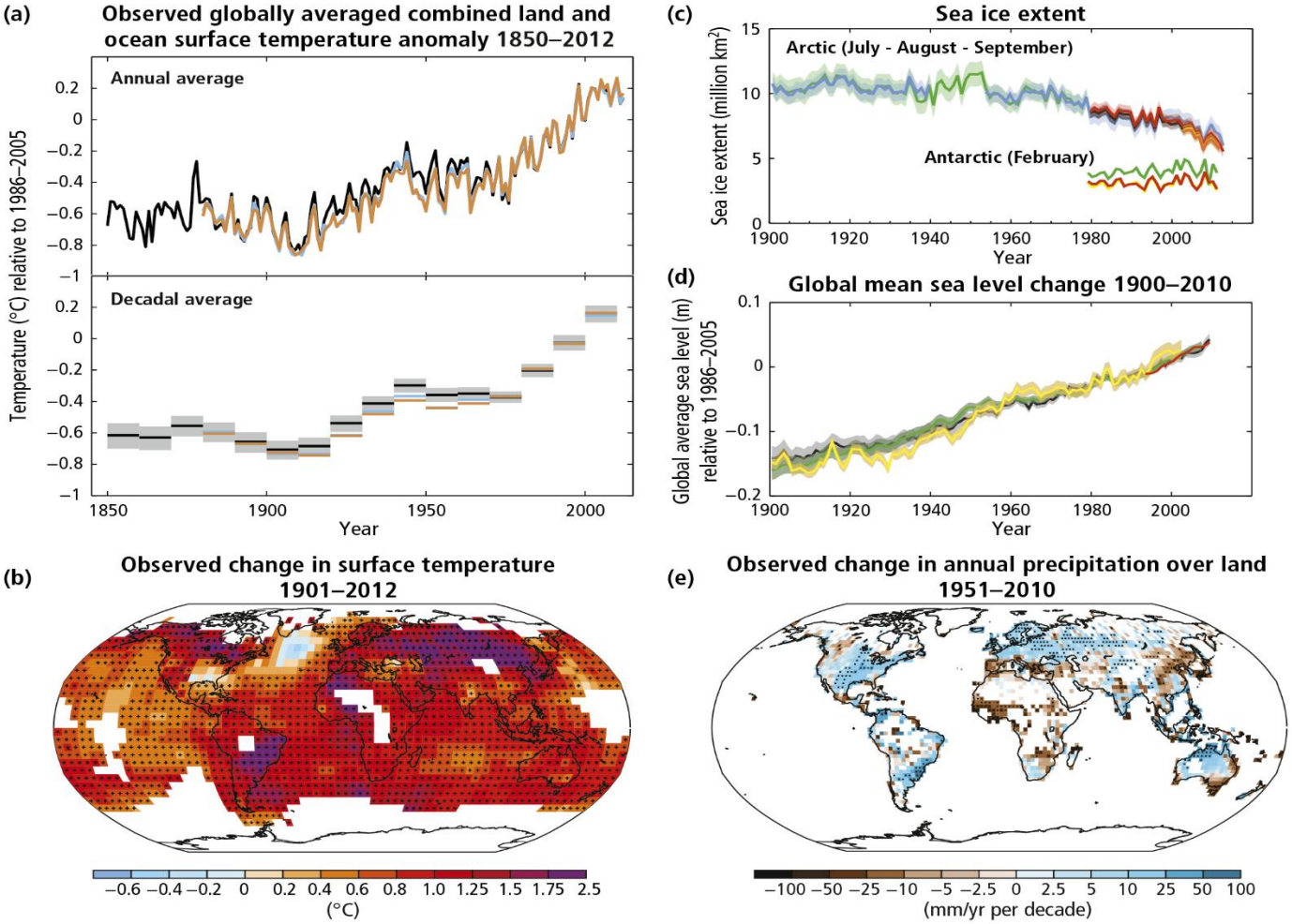
Recent global climatic data showed the increase and climate variability among years than past (1981-2010)



2018 found among the hottest year as 2016 on globe in comparison with (1850-1900) global climatic data

Climate changes in recent past

Recent climatic changes showed the increase in global temperature, and sea level rise while variability exists in precipitation patterns across the globe

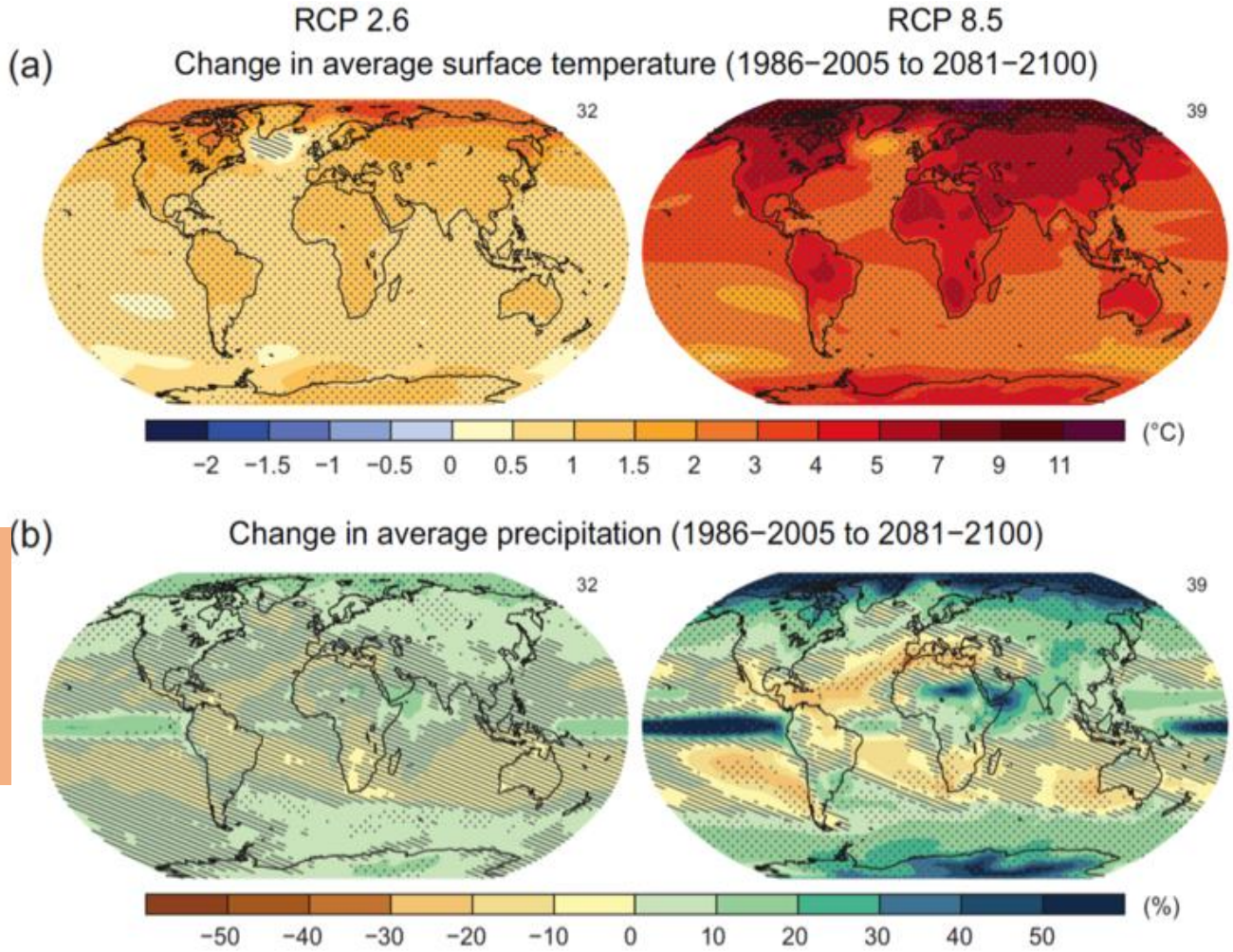


Future global climate change projections

There would an increase in temperature and rainfall variability across the globe in both emission scenarios

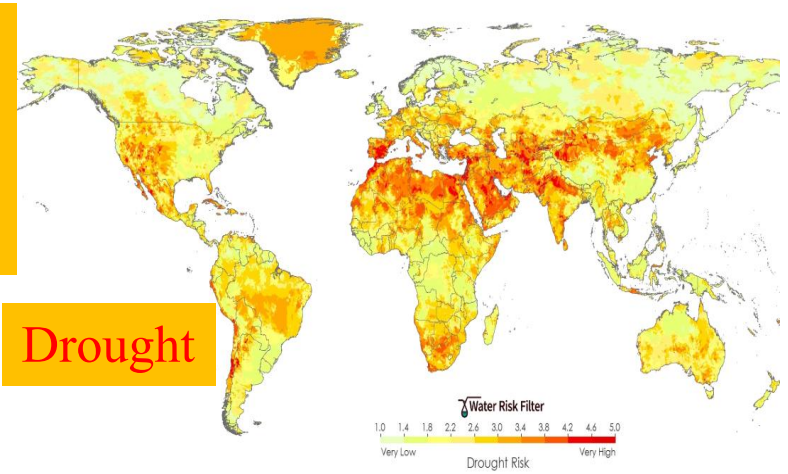
RCP2.6= Low emission scenario
RCP8.5= high emission scenario

The number of models used to calculate the multi-model mean is indicated in the upper right corner of each panel

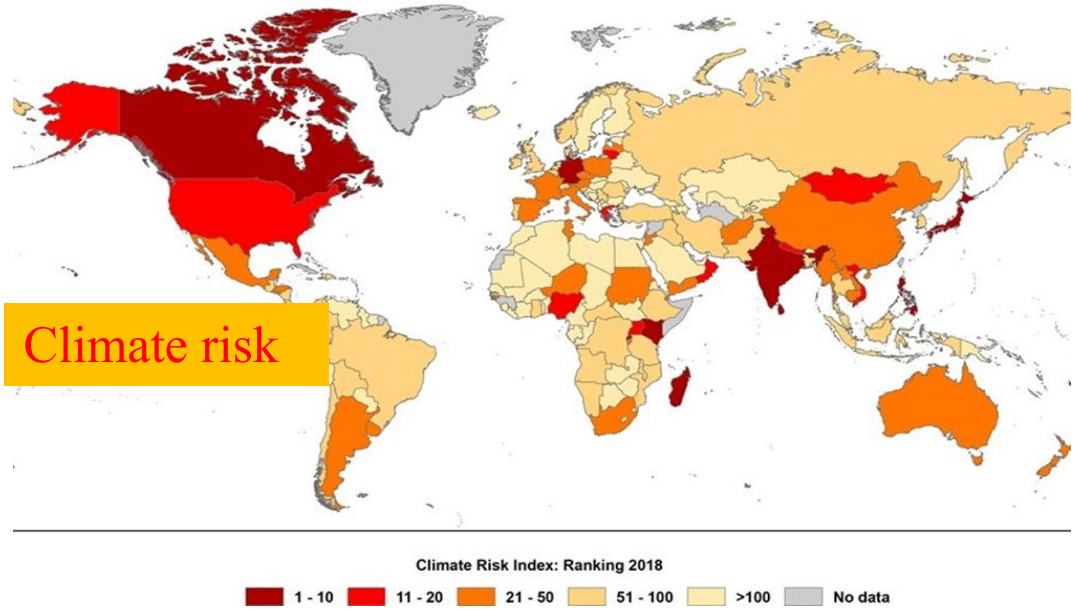


Climate risk, global drought and flood patterns

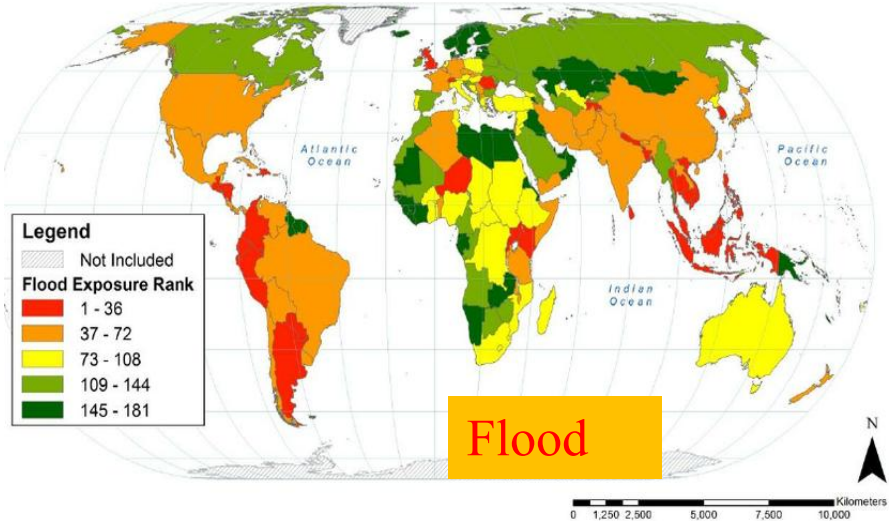
- ✓ South east Asia and Europe are prone to flood and drought and recent climatic extremes are examples of drought (2019) and foods (2021) in Germany
- ✓ Pakistan is also most vulnerable to climate change



Drought



Climate risk



Flood

Challenges and issues due to climate change

South Asia

Increase in flooding related to sea-level rise: **substantial increases in risk**

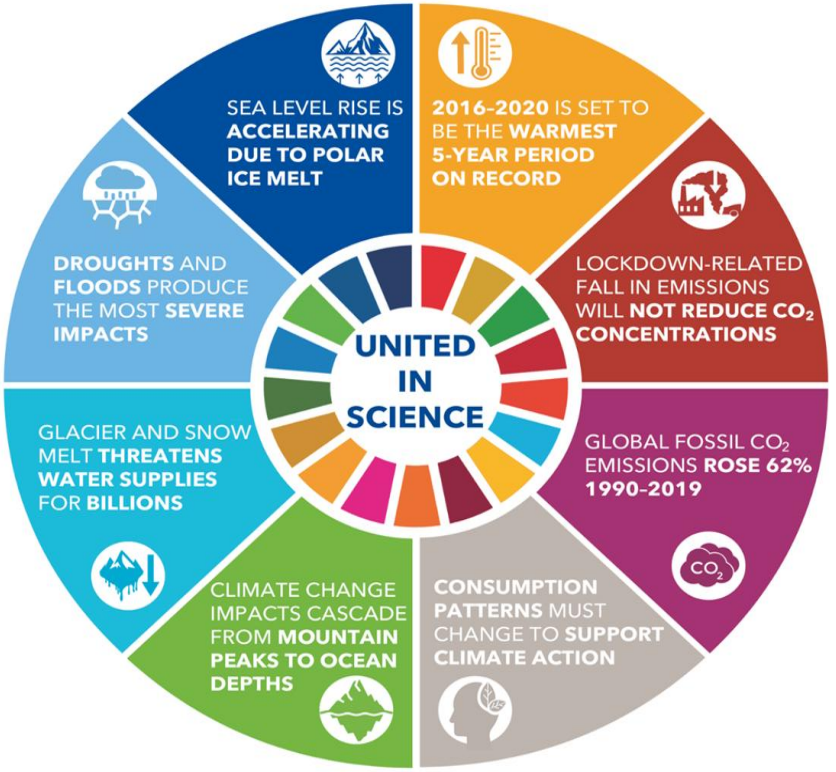
Asian monsoon: increase in precipitation intensity

Heavy precipitation: substantial increase

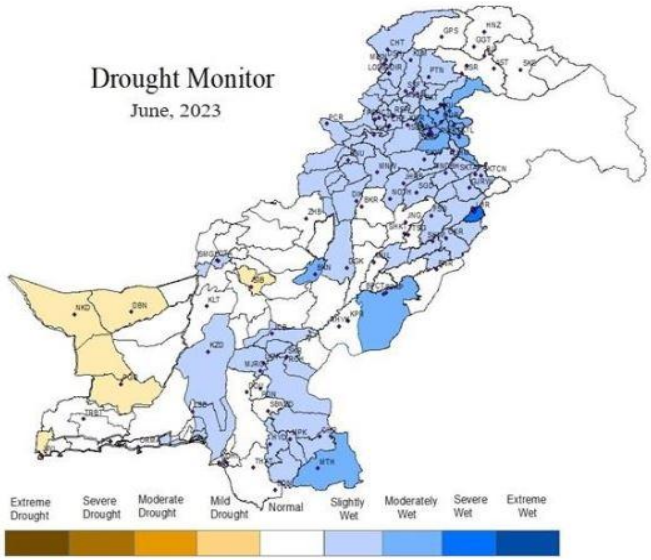
Crop yield reductions: one third decline in per capita; **substantial reduction**

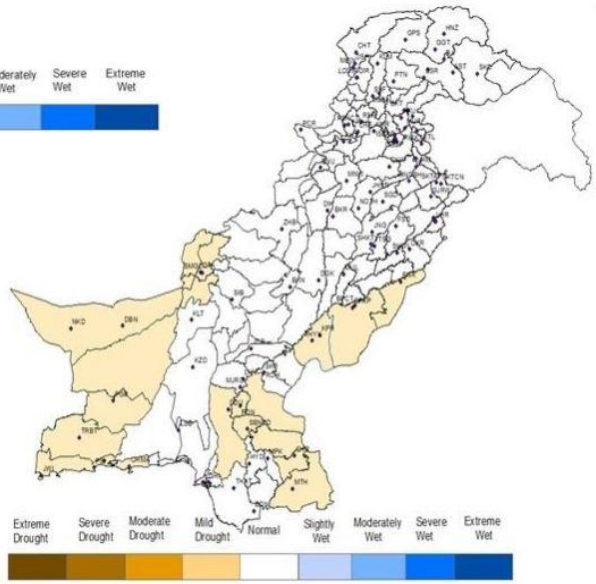
Source: IPCC SR1.5

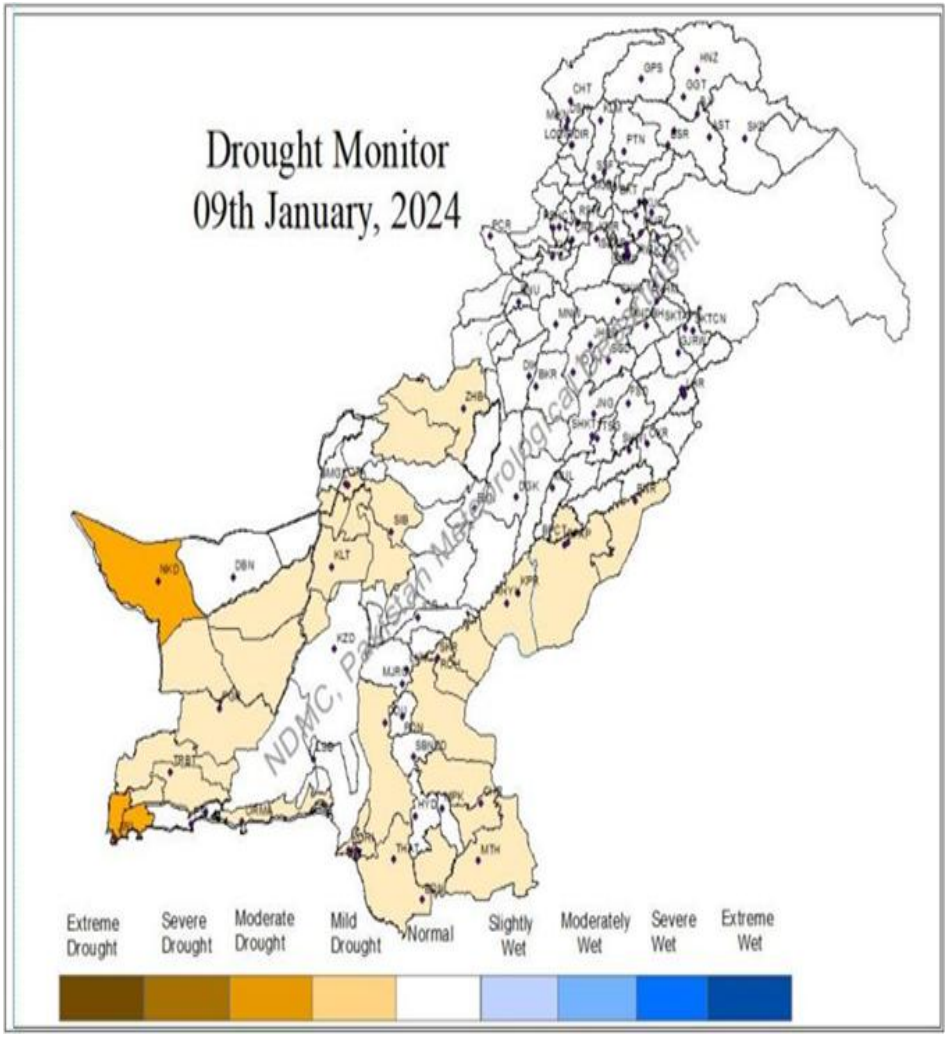
Other challenges and issues due to climate change



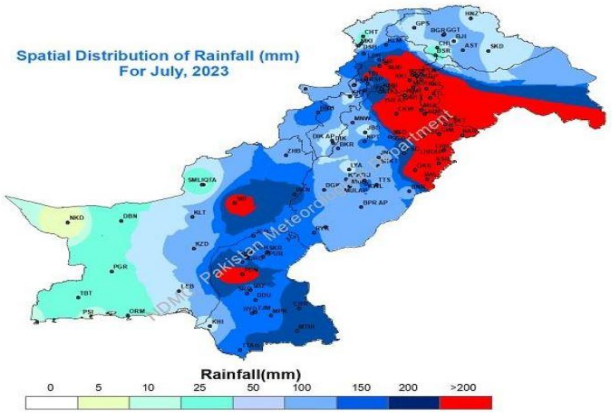
Drought and Climate Change

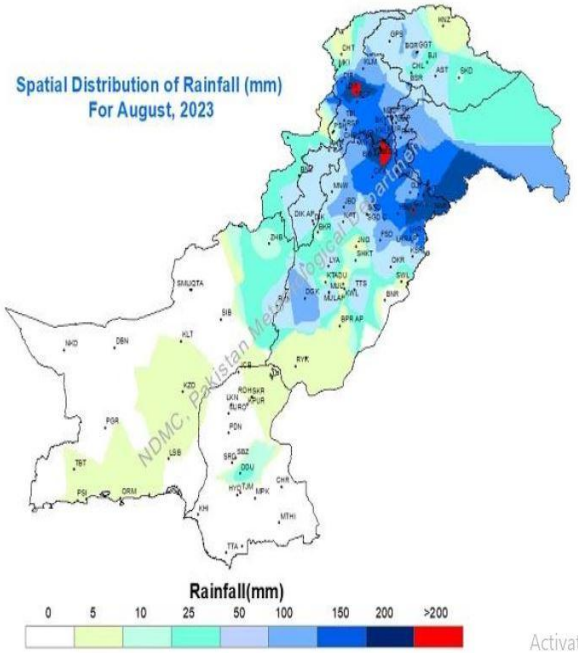


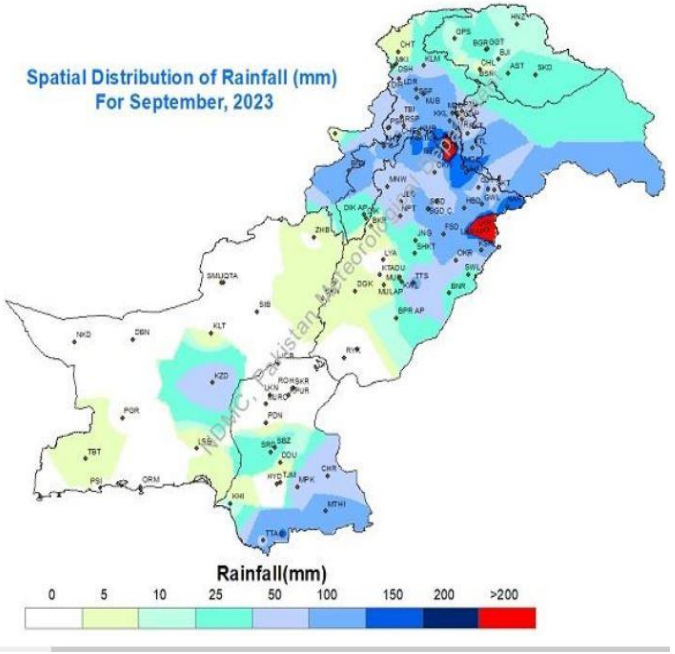


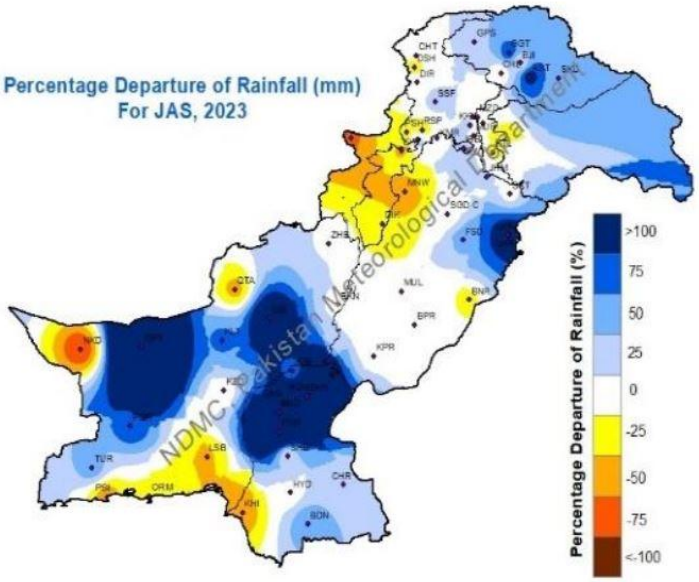


Spatial Distribution of Rainfall in Pakistan



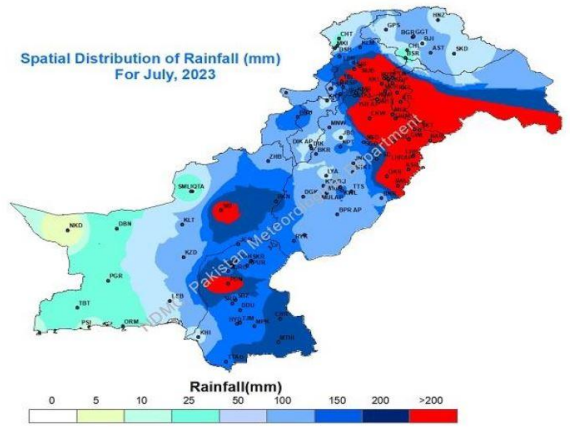


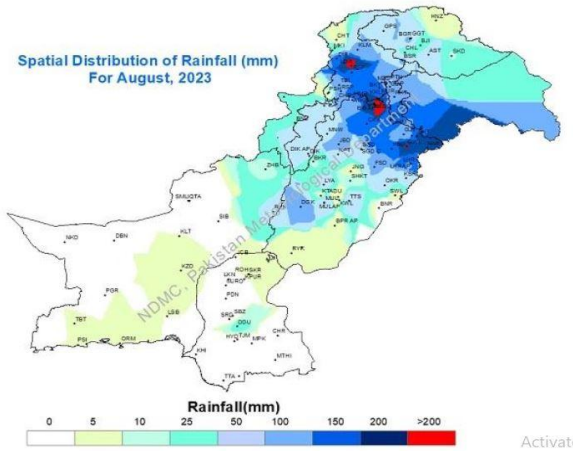


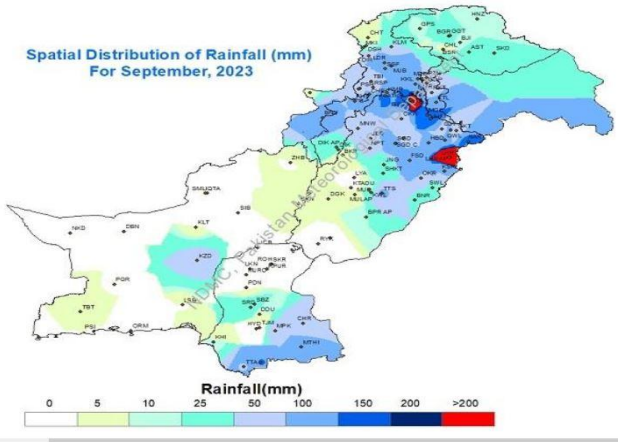


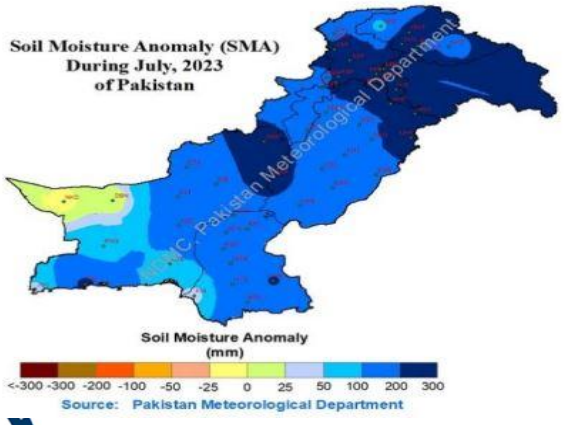
Source: PMD

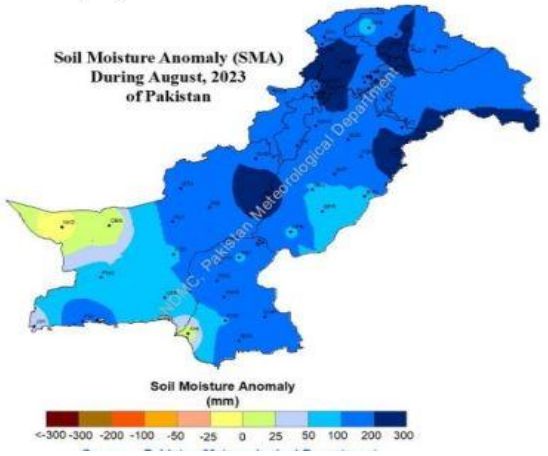
Distribution of Rainfall vs Soil Moisture Anamoly

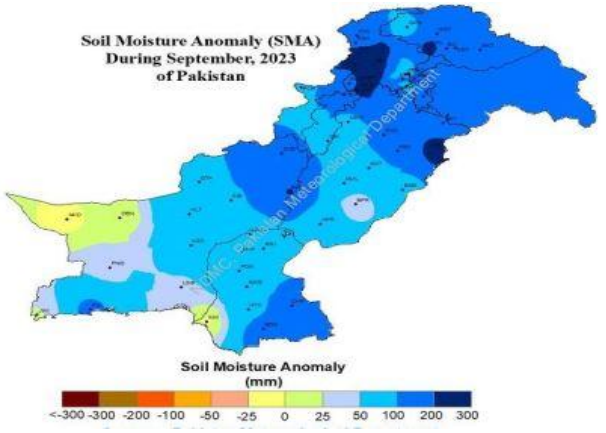






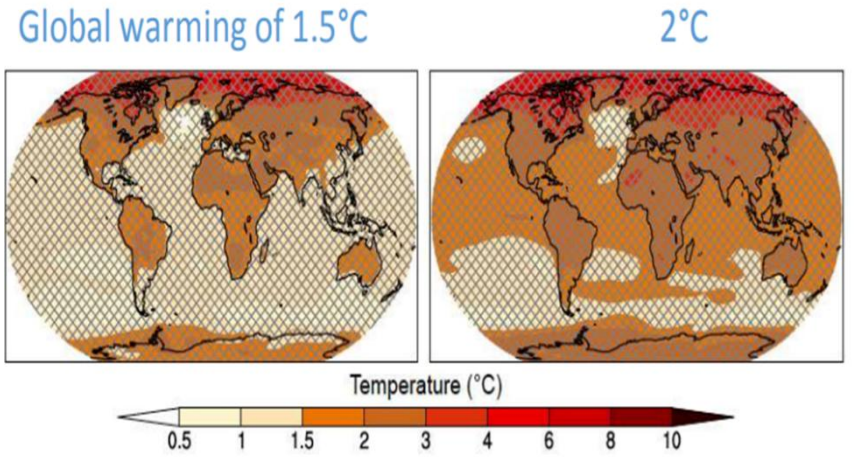




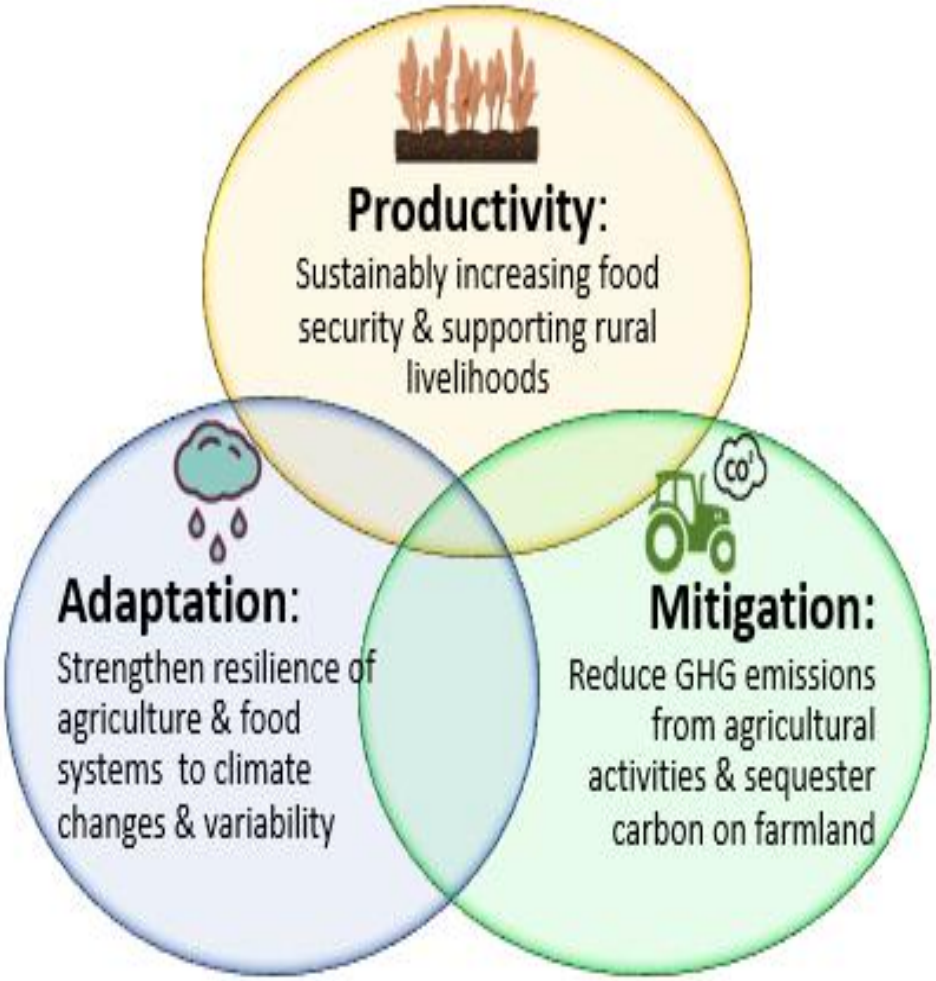


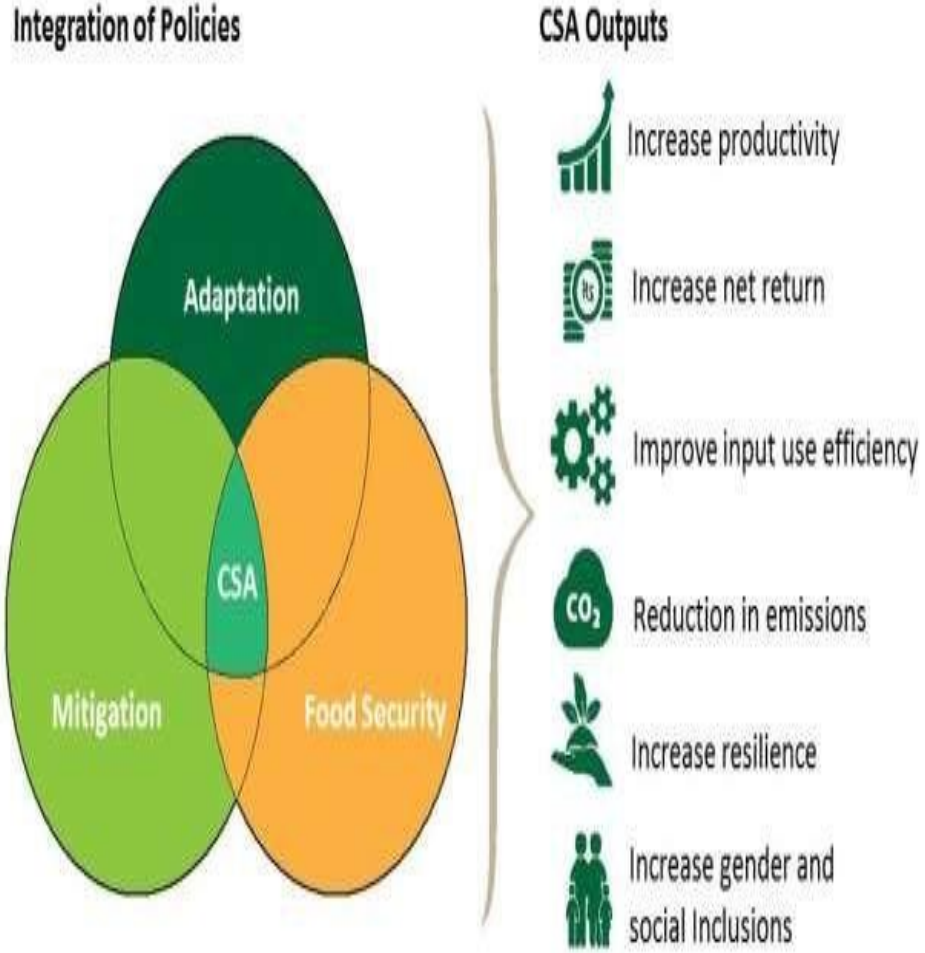
Climate action for future survival

- ✓ United Nations Climate Change (SDGs)
- ✓ COP21 (Paris-2015) - COP28 (UAE, 2023)
- ✓ The Paris Agreement limit global warming to well below 2°C and pursuing efforts to limit it to 1.5°C



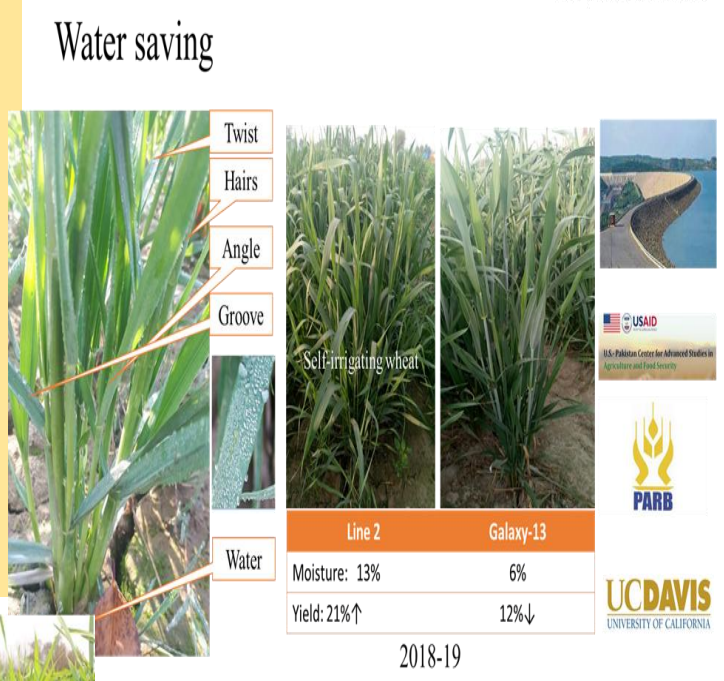
Climate-Smart Agriculture (CSA)

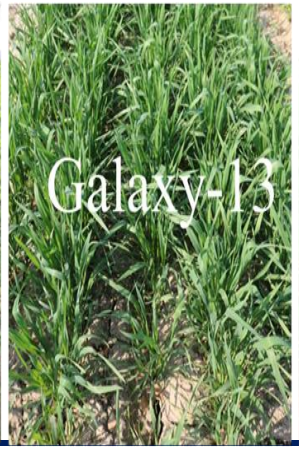




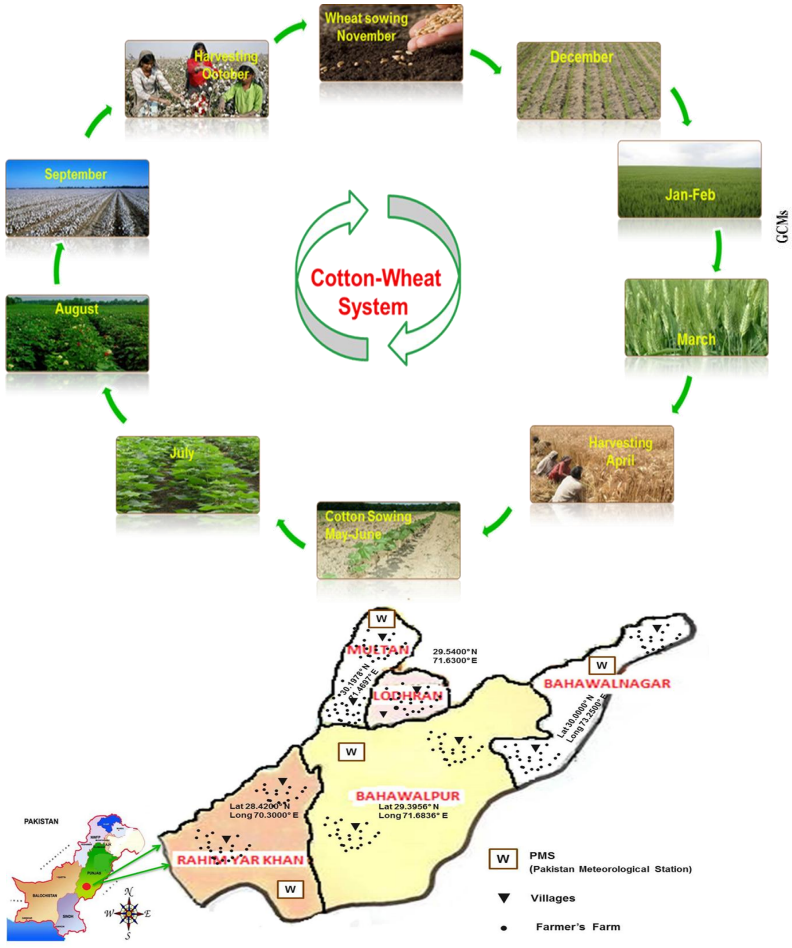
Climate Resilient system for food production

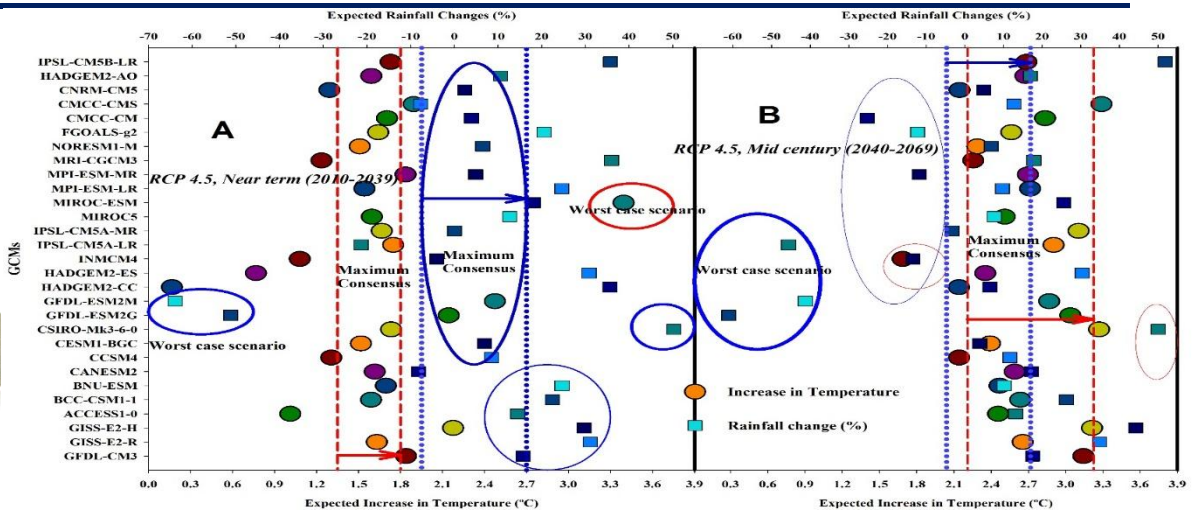
- ✓ Global Agriculture would face unprecedented pressure during 21st Century (IPCC, 2014)
- ✓ CC presents a challenge to developing countries and their ability to end poverty through investment in agriculture
- ✓ Farmers need scale-up innovation (mitigation and adaptation) to make farming more resilient

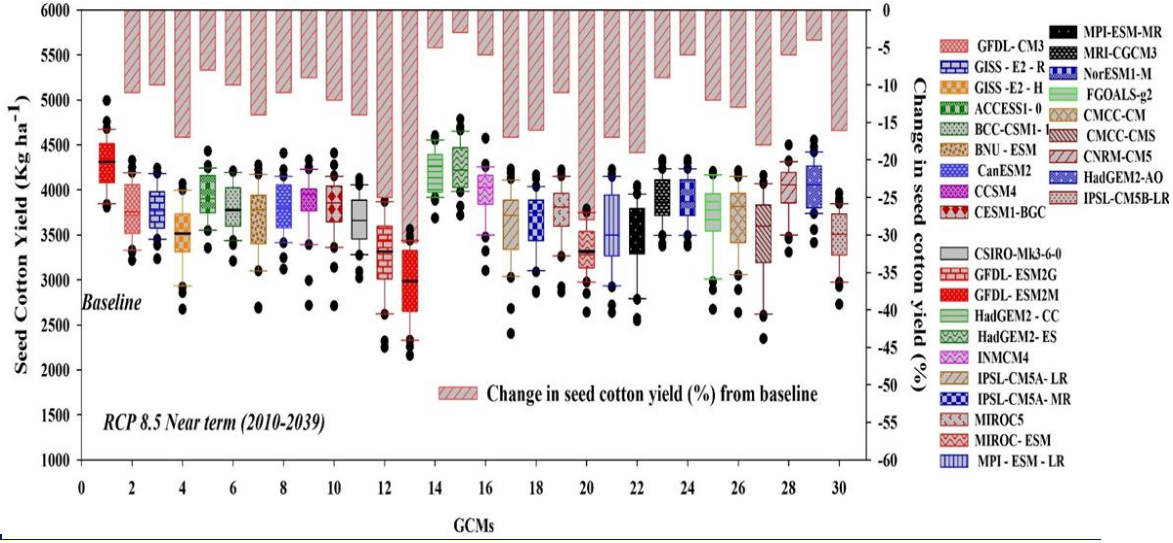




Impact of climate change on cotton-wheat cropping system and adaptation technology development for sustainable cotton production Punjab-Pakistan





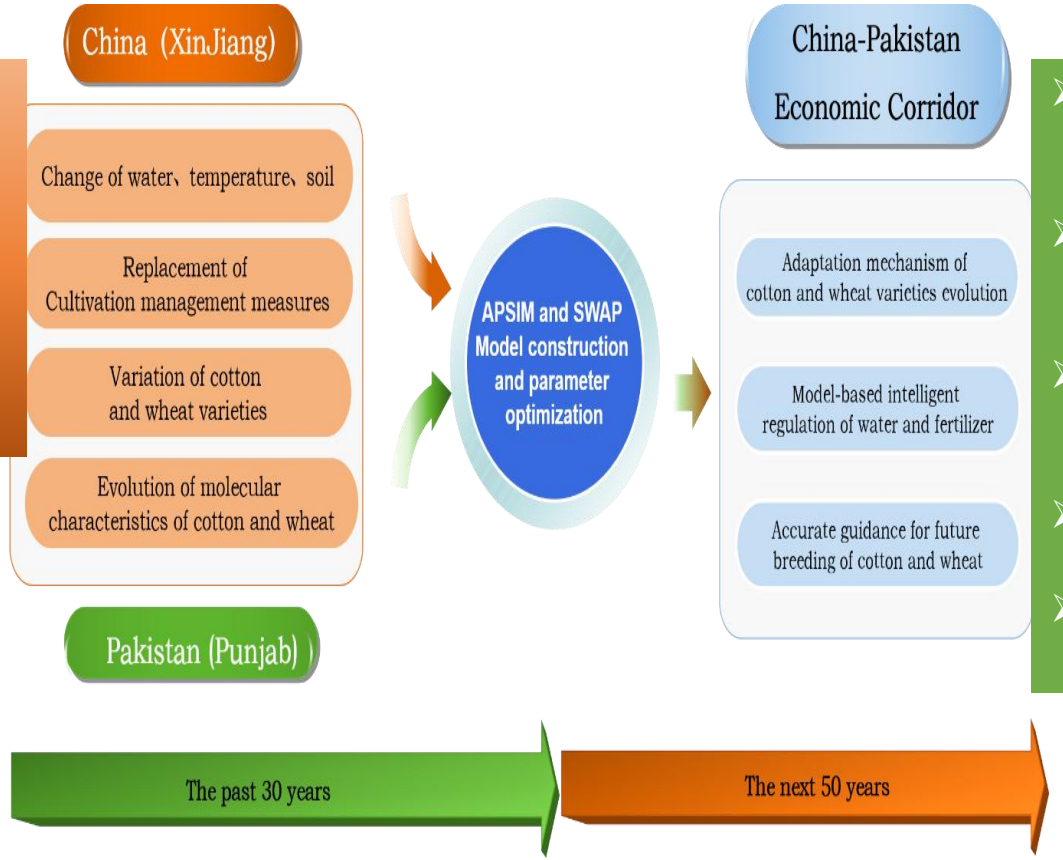


Genetic Adaptability and Water-fertilizer Intelligent Regulation Mechanism of Climate Smart Varieties (PSF-NSFC)

Technical Route

Issues to be addressed

- Affects of Climate Change on Wheat and Cotton Crop
- Drought, heat and salinity
- Water and fertilizer use efficiency
- Low yield and productivity
- Sustainable cotton-wheat cropping system



Expected Outcomes

- Promising genetic resource of cotton and wheat under changing climate
- Cotton and wheat adaptability to drought, heat and salinity
- Sustainable cotton-wheat cropping system for Punjab and Xinjiang
- Long-term SINO-PAK collaboration
- Data resources and capacity building

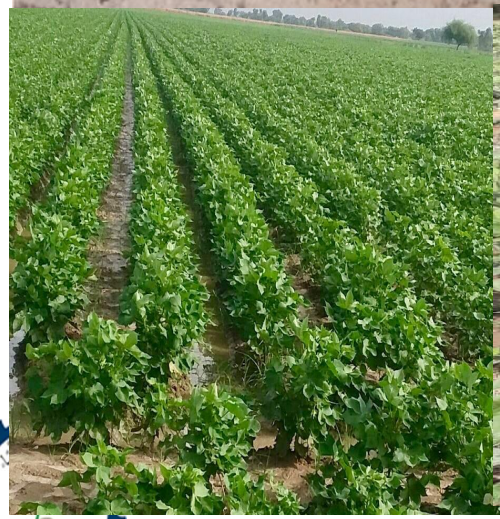
Climate Smart Practices and Technologies for Climate Resilient Agriculture System








Soil carbon sequestration to fix the carbon and improve the resource use efficiencies for water and fertilizer (biochar and slow release fertilizer)



Potential of biochar, carbon fertilizer and slow release nitrogenous fertilizer to reduce the GHGs emission

Climate smart practices, zero tillage planting in different cropping system to reduce the carbon footprint and GHGs emission

Zero-till *Flat Planting* (Cotton)

Zero-till *Flat Planting* (Wheat)

Climate smart practices, zero tillage planting in different cropping system to reduce the carbon footprint and GHGs emission

Zero-till Flat Planting

Zero-till Bed Planting

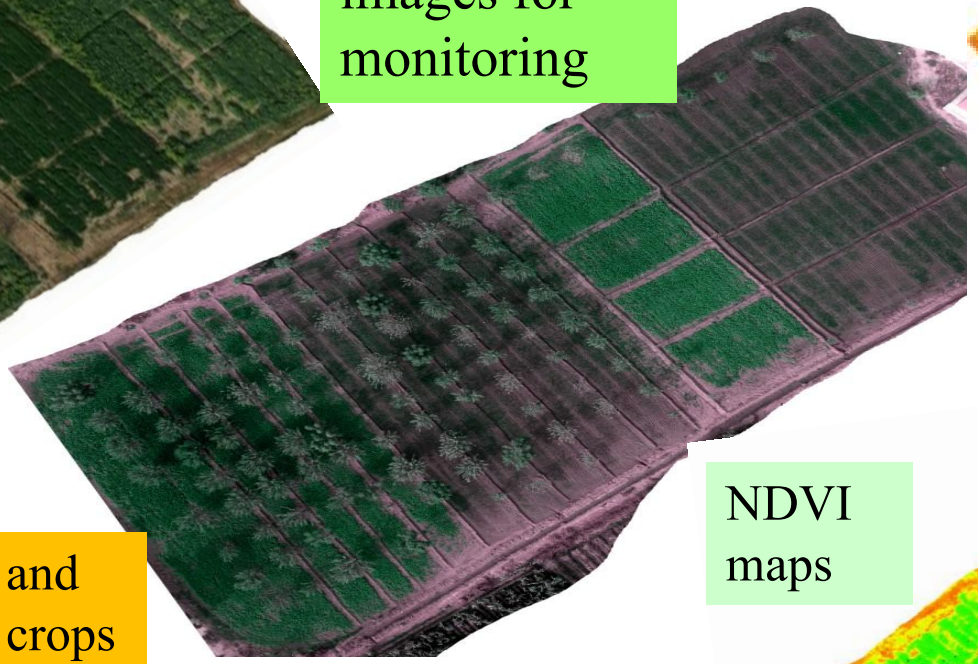
Climate smart practices, zero tillage and mulching in different cropping system to reduce the carbon footprint and GHGs emission

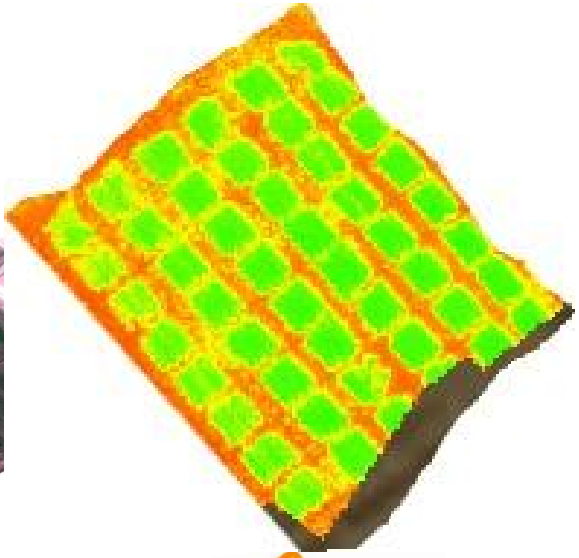
Zero-till Flat Planting

Zero-till Bed Planting

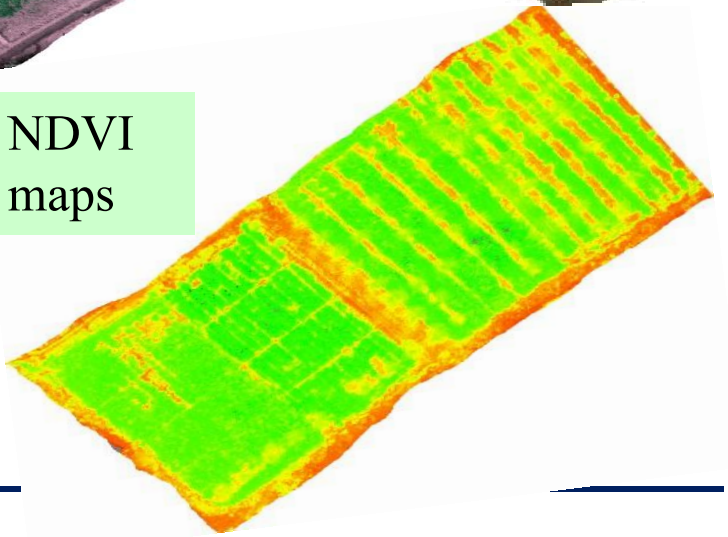
Application of UAVs for monitoring of crops and ecosystem services under agro-forestry system

RGB, and Multispectral images for monitoring



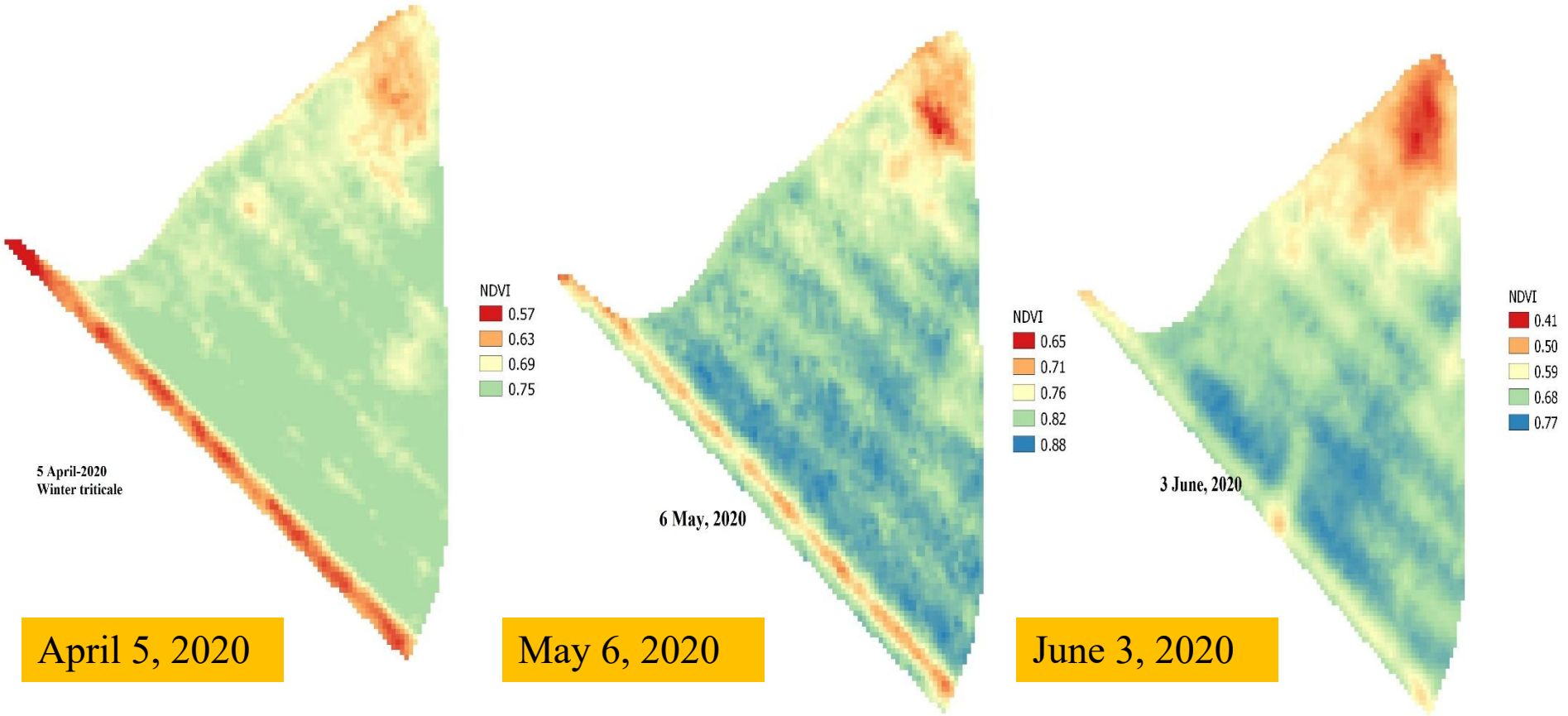


NDVI maps



Wheat and canola crops in sole and agroforestry system

NDVI maps to detect Sub-field heterogeneity in winter triticale crop



April 5, 2020

May 6, 2020

June 3, 2020

Weather forecasting and crop based agro-advisory for early warning and early action for fifteen districts of south Punjab (example of climate adaptation to tackle the climate extremes)

Joint Project of

Pakistan Meteorological Department & MNS-University of Agriculture, Multan

South Punjab

Bahawalnagar | Bahawalpur | Bhakkar | D.G. Khan | Jhang | Khanewal | Layyah | Lodhran | Mianwali | **Multan** | Muzaffargarh | Rahimyar Khan | Rajanpur | Sahiwal | Vehari |

Seven Days Weather Forecast (Multan)

	20 Feb, 2024 Tuesday	21 Feb, 2024 Wednesday	22 Feb, 2024 Thursday	23 Feb, 2024 Friday	24 Feb, 2024 Saturday	25 Feb, 2024 Sunday
Weather						
Temp °C (Min/Max)	12 / 22	9 / 21	8 / 22	9 / 21	8 / 22	9 / 21
Wind Speed(km/h)/Direction	up to 14 / N	up to 9 / N	up to 10 / N	up to 9 / N	up to 10 / SE	up to 11 / N
Relative Humidity (%) Morning / Noon / Night	80 / 70 / 75	80 / 70 / 75	80 / 70 / 75	80 / 70 / 75	80 / 70 / 75	80 / 70 / 75

Morning = 8AM, Noon = 2PM, Night = 8PM

Agro-advisory for different crops in fifteen districts of South Punjab (example of climate adaptation to tackle the climate extremes)

گندم

گوبھ اور دانےکی دودھیا حالت میں آبپاشی ضرور کریں ۔چند مقامات پر گندم میں کنگی کا حملہ ظاہر ہو رہا ہے ۔ اس سلسلے میں محتاط رہیں اور محکمہ زراعت کے عملہ کی سفارشات پر عمل کریں۔

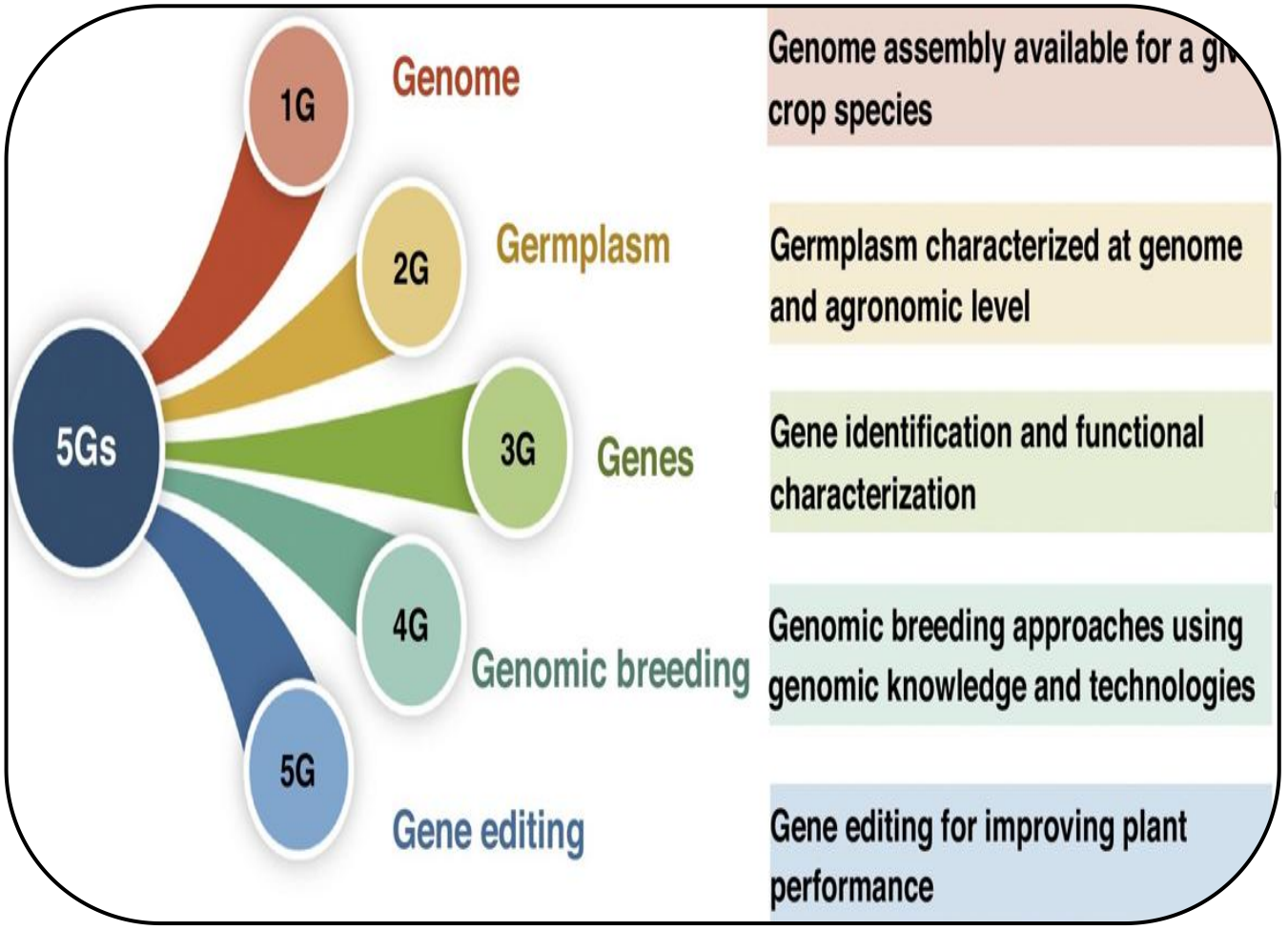
گنا

کماد کی بہاریہ کا شت کے لئے زمیں تیارکرتے ہوئے گہرا ہل ضرور چلائیں ۔ کماد کی کاشت کے لئے موزوں وقت وسط فروری سے آخر مارچ ہے۔ کا شت کے لئے بیج ایسے کھیت سے ہرگز نہ لیں جہاں رتا روگ سے متاثرہ کما د ہو۔مزید برآں گری ہوئی اور کورے سے متا ثرہ فصل سے بیج مت لیں ۔ کاشت کے لئے منظور شدہ اقسام کا بیج استعمال کریں جن میں سی پی ایف 250،سی پی ایف 251، سی پی ایف 253 قابل ذکر ہیں ۔ سی پی ایف 250 غیر سیلابہ رقبہ کے لئے زیادہ موزوں ہے۔ اس کے علاوہ سی پی 77-400 گڑ بنانے کے لئے اور سی پی ایف 247 ریتلے رقبے کے لئے زیادہ موزوں ہے۔ کما د کی بجائی 4 فٹ کے فاصلے پربنائی گئی گہری کھیلیوں اور کھلے سیاڑوں میں کریں اوربر کھیلی میں سموں کی دو قطاریں لگائیں ۔ کاشت کے لئے 2 آنکھوں والے سمے 30 بزار اور 3 آنکھوں والے سمے 20 بزار استعمال کریں ۔ اس کے لئے 12 سے 16 مرلہ کماد درکار ہو گا۔ بیج کے لئے کماد کا اوپر والا ایک تہائی حصہ استعمال کریں ۔

Description of Weather Symbols

			
Sunny	Mostly Sunny	Cloudy	Partly Cloudy
			

National Crop Genomics and Speed Breeding Center for Agriculture Sustainability

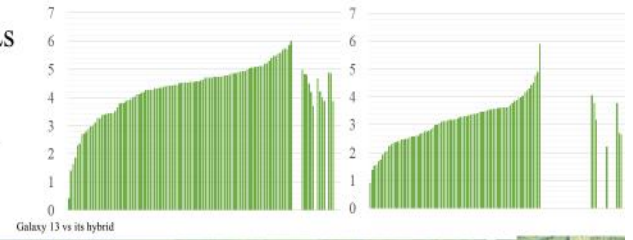


Project Activities

Climate resilient genotypes development: Hybrid wheat for food security

2018-19

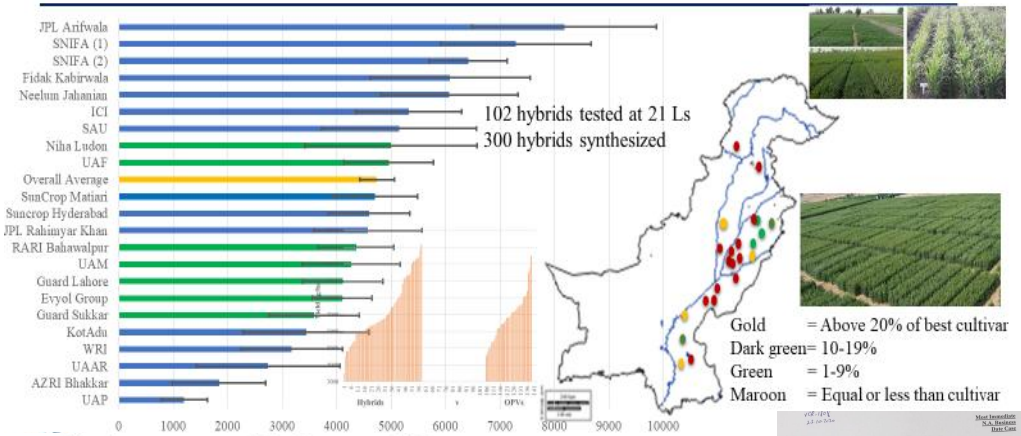
107 hybrids tested at 2 Ls
Gain: 20 – 46%
100 hybrids synthesized



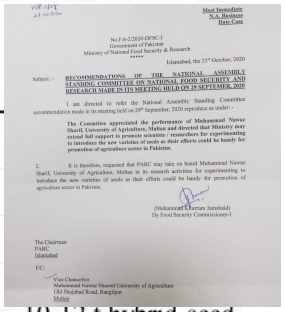
2020-21

Hybrid trials
224H at 2 Ls
140H at 2 Ls
09H at 12 Ls
1080 new hybrids
Color Sorter installation

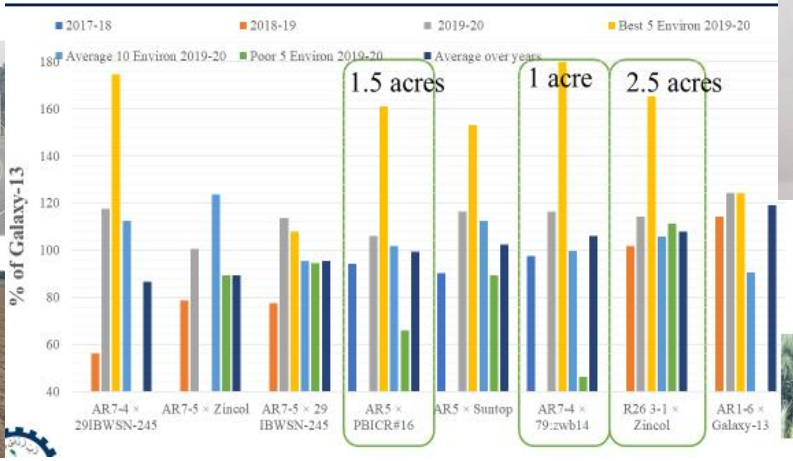
2019-20



Gain over Galaxy-13

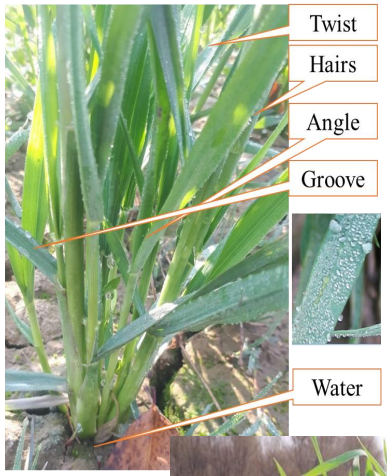


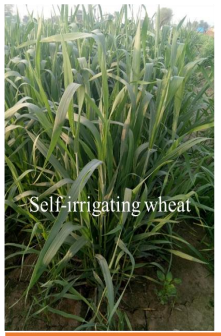
10-12 t hybrid seed

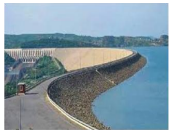


Fog capturing and high nutritional wheat genotypes

Water saving







USAID
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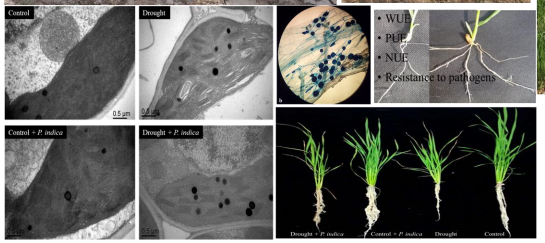
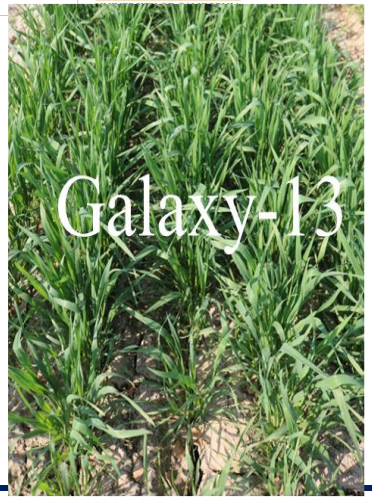
PARB

Line 2	Galaxy-13
Moisture: 13%	6%
Yield: 21%↑	12%↓

UCDAVIS

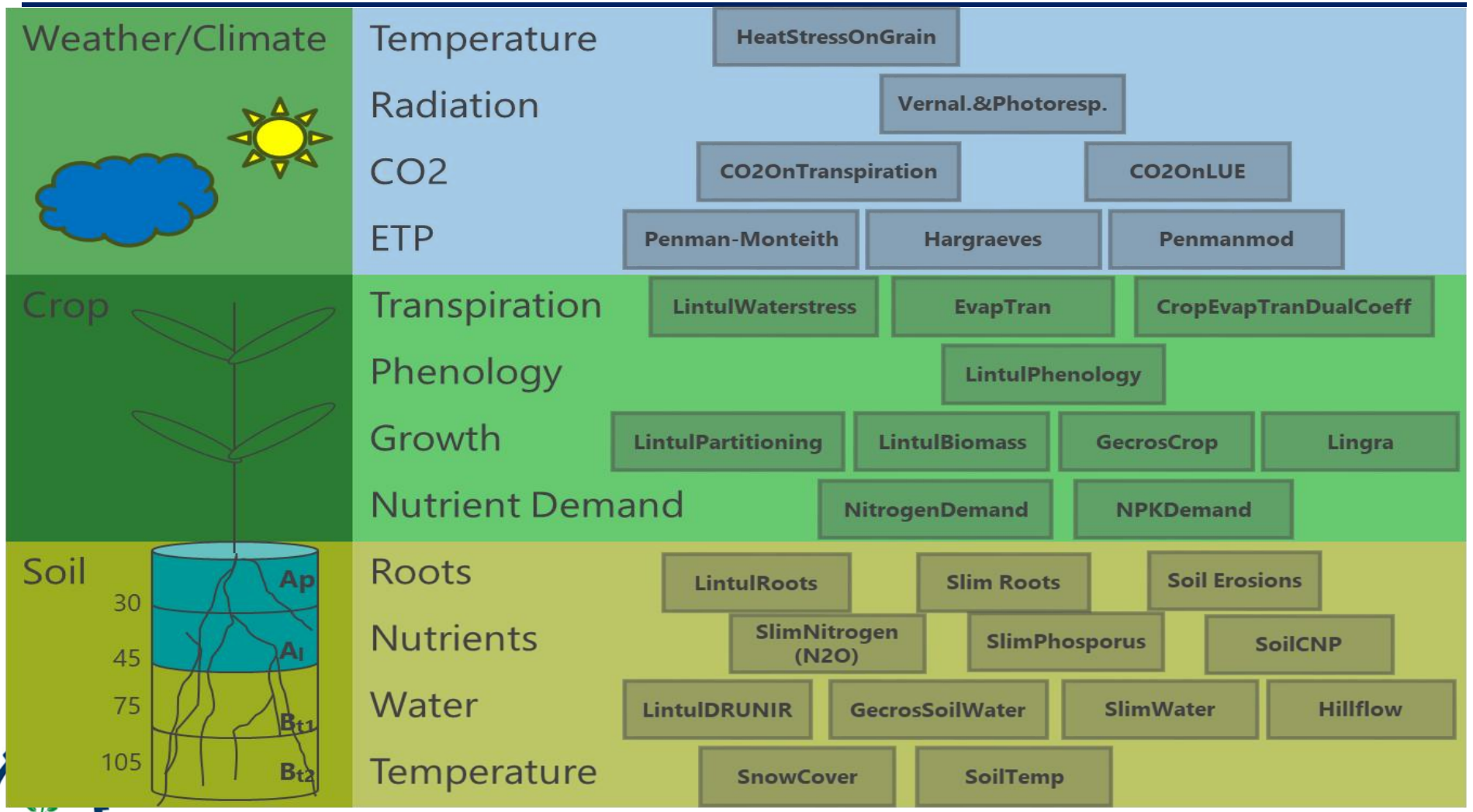
Nutrition use efficiency





Climate smart crop diversification

Decision support system/Crop Models

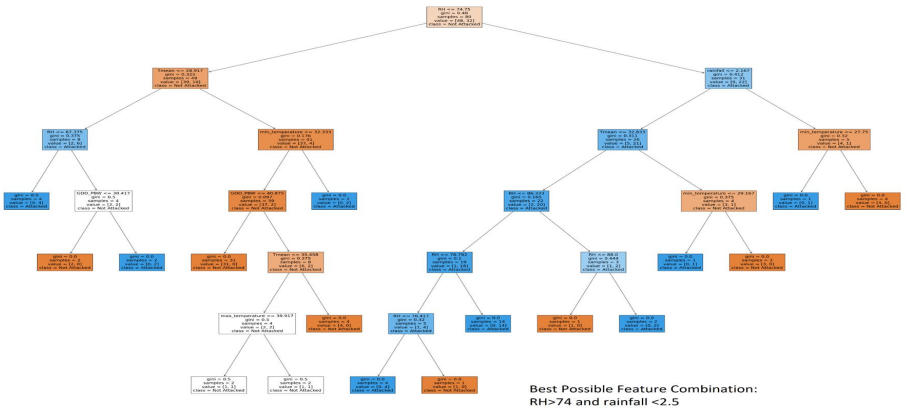


Modeling Soil Erosion and other ESS

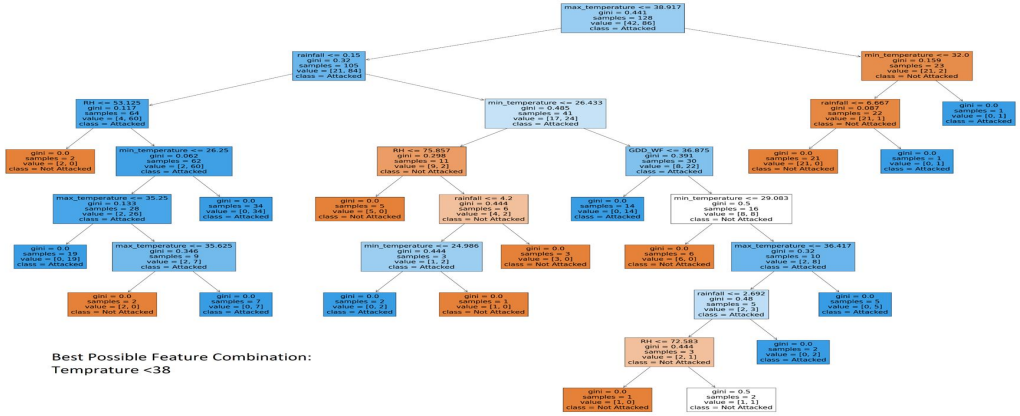
Explore the interaction of different factors (OM, slope, soil cover, texture and field practices) to the soil erosion and further contribution of each factors into the soil erosion process under heterogeneous field conditions.



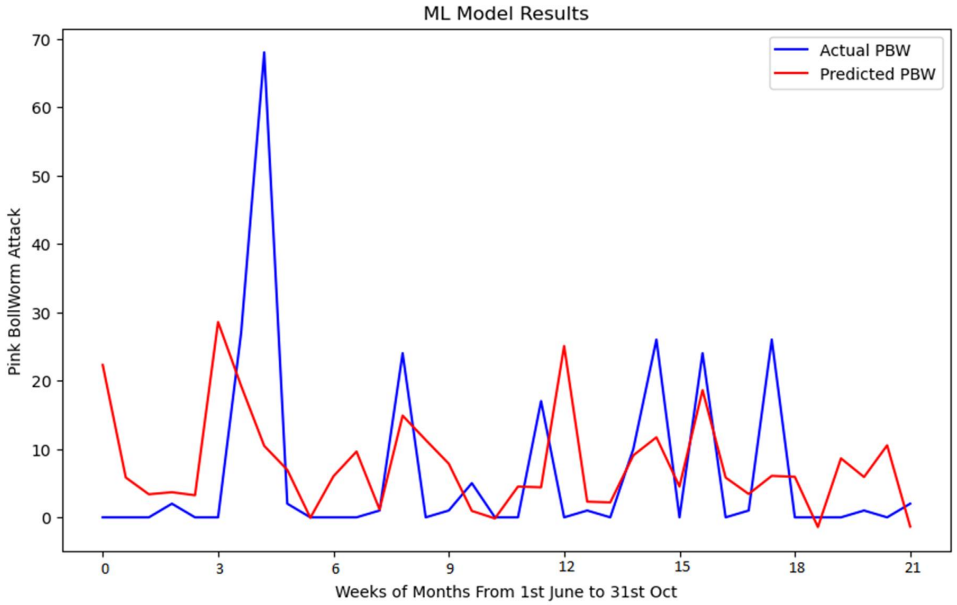

Pest Prediction Modeling for Whitefly and Pink Bollworm in Cotton

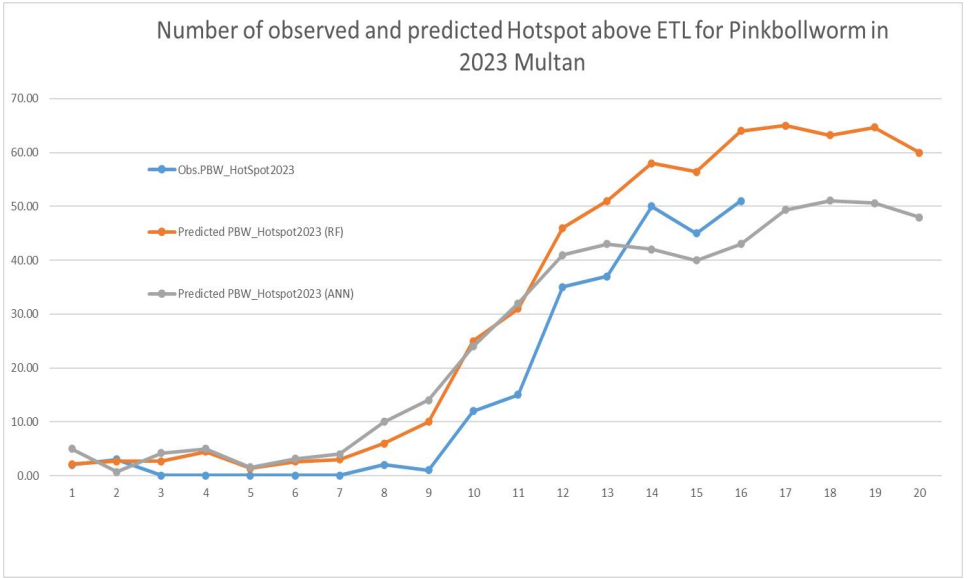


Best Possible Feature Combination:
RH>74 and rainfall <2.5



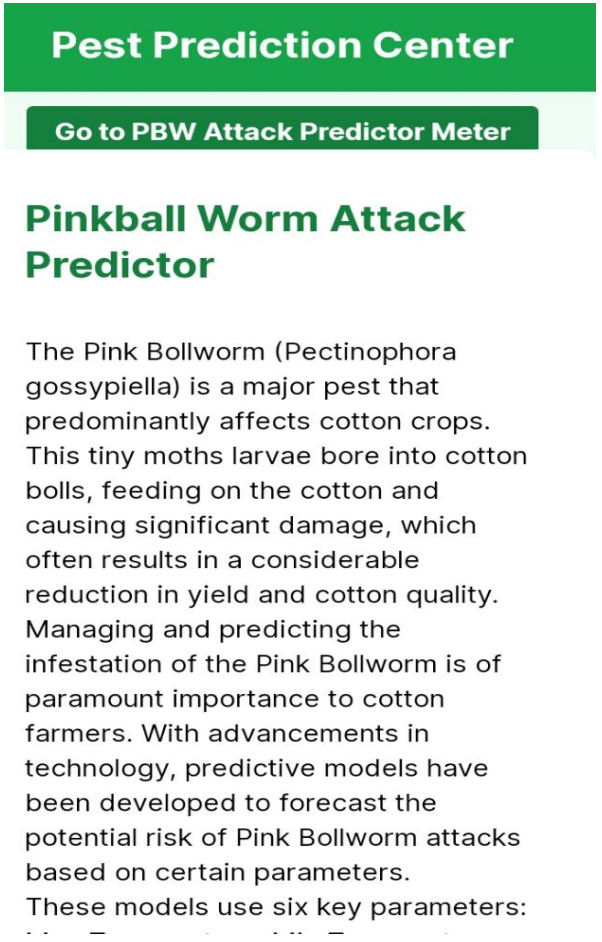
Best Possible Feature Combination:
Temprature <38

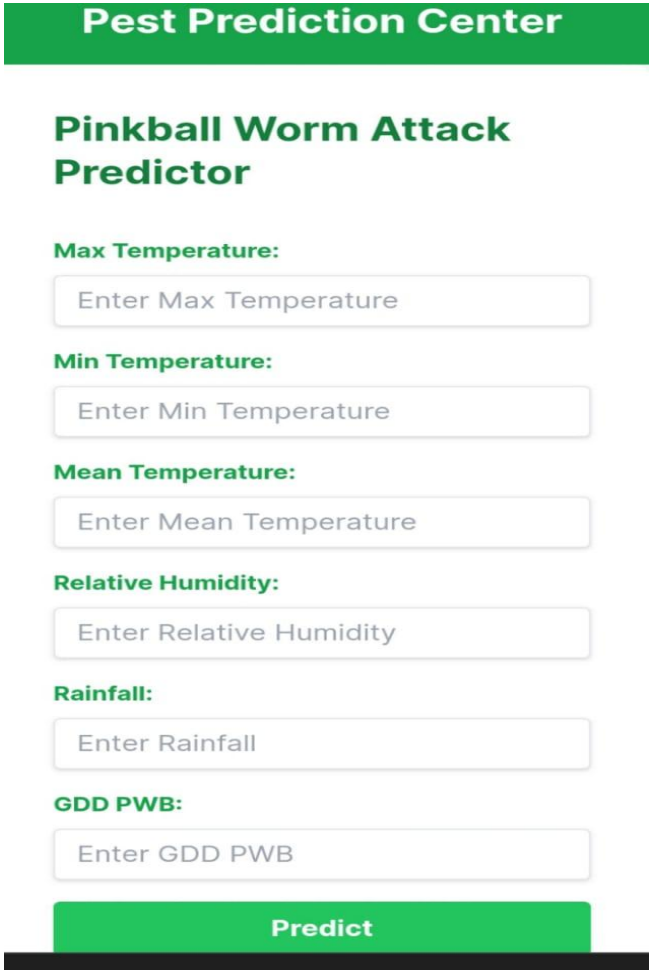


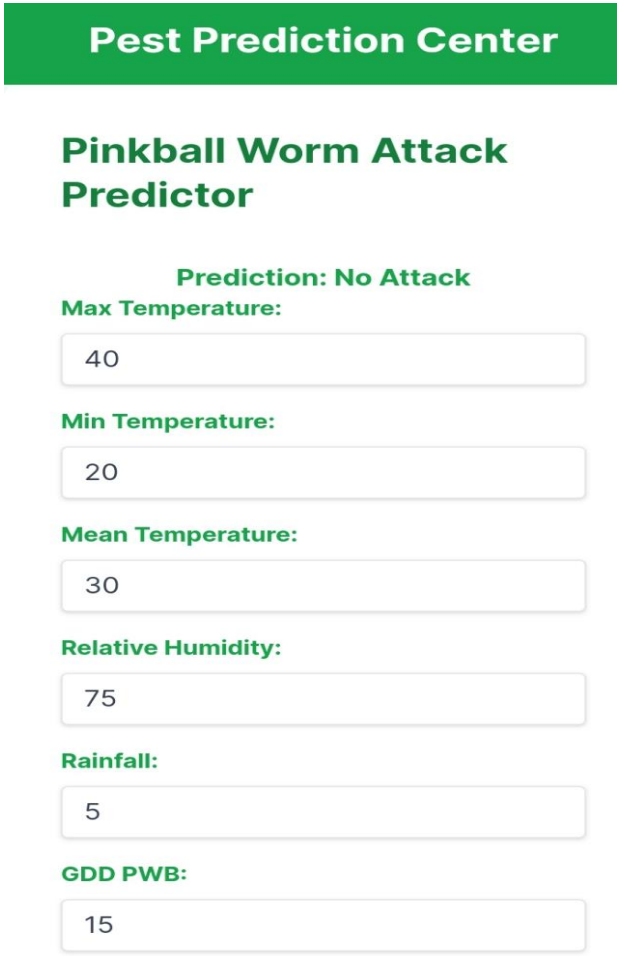


PBW Prediction

- https://mnsuam.vercel.app/







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THE Impact Rankings 2022

Among Pakistani Universities under 'Agriculture and Forestry' Category

Overall Rank

2nd in Pakistan (Agriculture Universities)
5th in Pakistan (Overall)
601-800 Worldwide

601–800 | MNS University of Agriculture, Multan | Pakistan | 4: 58.1 – 61.9 | 13: 45.8 – 54.6 | 7: 49.6 – 55.1 | 17: 50.2 – 58.7 | SDG Descriptions | 57.3–64.9

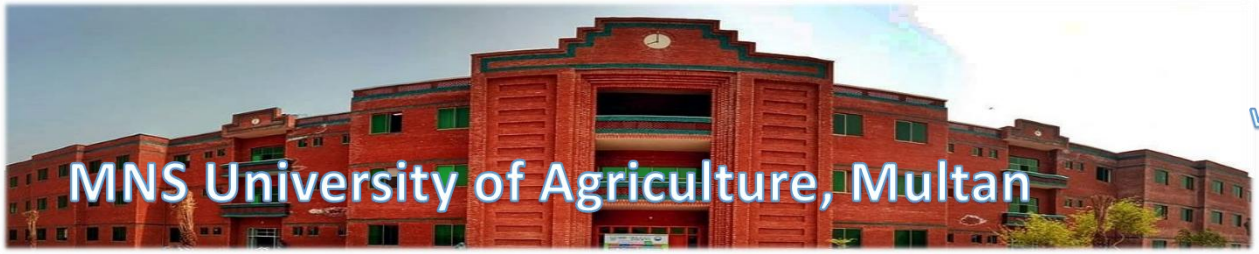
SDG-wise Rank

7 AFFORDABLE AND CLEAN ENERGY
1st in Pakistan (Agriculture Universities)
4th in Pakistan (Overall)
301-400 Worldwide

13 CLIMATE ACTION
2nd in Pakistan (Agriculture
)
3rd in Pakistan (Overall)
201-300 Worldwide

4 QUALITY EDUCATION
2nd in Pakistan (Agriculture Universities)
4th in Pakistan (Overall)
301- 400 Worldwide
Improved 500 Ranks

17 PARTNERSHIPS FOR THE GOALS
2nd in Pakistan (Agriculture
s)
7th in Pakistan (Overall)
601-800 Worldwide
Improved 200 Ranks



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Precision Agriculture 23, 912–938 (2022) | Cite this article

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