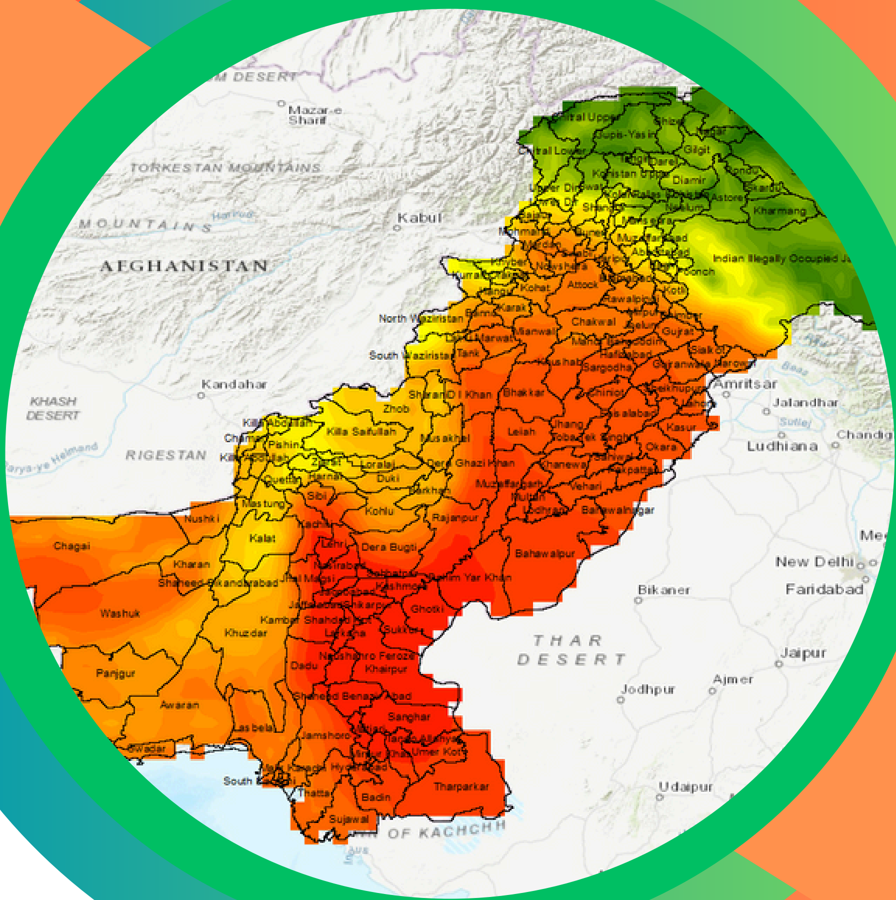
HEATWAVE GUIDELINES 2025



PREPARED BY

National Emergencies Operation Center (NEOC), National Disaster Management Authority (NDMA), Pakistan

Contents

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1. Overview

Humanity faces an existential threat from climate change and global warming, which has also given the healthcare system a new battlefield. Over 400,000 people have died globally in the last ten years due to climate and weather-related disasters, according to the International Federation of Red Cross and Red Crescent Societies' (IFRC) World Disasters Report[1]. According to the Intergovernmental Panel on Climate Change (IPCC), between 2030 and 2050, the number of fatalities from climate-related causes, such as heat stroke, is predicted to rise to 250,000, with poorer nations being especially at risk[2].

According to additional research, from 2030 to 2079, heat-related mortality will impact 200 out of every 100,000 individuals. The current heat monitoring plans and prevention efforts should be strengthened in light of the concerning rise in death trends brought on by high heat[3].
South Asian nations are at the forefront of this disaster because of their geographic location and financial limitations. Pakistan is one of the nations most affected by global warming, even though its share of carbon emissions is less than 1% of the total. According to the Global Climate Scale Index, this country is ranked eighth most affected[4]
In 2015, a devastating heatwave struck Karachi, killing over 1,200 people and injuring another 50,000. In just three days in 2018, a heatwave in the city claimed 65 lives. Pakistan saw the highest March temperature in the globe during a devastating heatwave that broke records last year[5].

According to Pakistan Meteorological Department, heatwave is the condition where the maximum temperature situation reaches to 40 ºC for the plain and 30 ºC for the hilly areas with a departure from normal 4.5 ºC to 6.4 ºC. June 2024 saw days temperatures that were 04–06 degrees Celsius above normal in southern and central Punjab, Islamabad, Gilgit-Baltistan, and Kashmir, and 02–04 ºC above normal in Sindh, South Punjab, and portions of Baluchistan, according to a number of forecasts and reports, including the Pakistan Meteorological Department.

The unique geographical and socio-economic characteristics of Pakistan render it particularly susceptible to the adverse effects of climate change, notably heat waves. The threshold for defining a heat wave is considerably higher in the southern urban centres compared to the northern regions.

Considering this analogy, Pakistan can be segmented into three main regions: (i) the Northern Mountainous Region, (ii) Central Pakistan, and (iii) the Southern Dry Plain, each with distinct vulnerabilities and potential impacts (Table 1)

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[1] https://www.ifrc.org/taxonomy/term/6542
[2] https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health
[3] Projections and patterns of heat-related mortality impacts from climate change in Southeast Asia 2024
[4] Heatwaves in South Asia: characterization, consequences on human health, and adaptation strategies 2022
[5] https://www.dawn.com/news/1758265

Table 1 Pakistan main climatic regions

Northern Mountainous Region	Central Pakistan	Southern Dry Plain
▪ The heat wave may trigger the hazard like; ▪ Rapid Glacier Melting ▪ Glacial Lake Outburst Floods (GLOFs) ▪ Land Sliding ▪ Episodic rainfall and high-speed winds	• The heat wave may trigger the hazards like; • Sudden Weather Local Phenomena • Sudden rise of the local winds • Winds(cyclones) • Increased River Flows (Indus& Kabul) • Forest Fire	• The heat wave may trigger the hazard like; • Drought • Sudden rise of the localwinds • Forest Fire • Winds

2. Methodology

2.1 Data Collection:

a. Monthly temperature and relative humidity data was obtained from high-resolution climate models using Coupled Model Intercomparison Project (CMIP) model developed by NASA at spatial resolution of 100 km on global scale

b. The dataset includes projected temperature and relative humidity values for January to July 2025, highlighting both maximum and minimum values.

2.2 Projected Temperature and Relative Humidity Trends and Implications

I. **Winter Months (January - February 2025):**

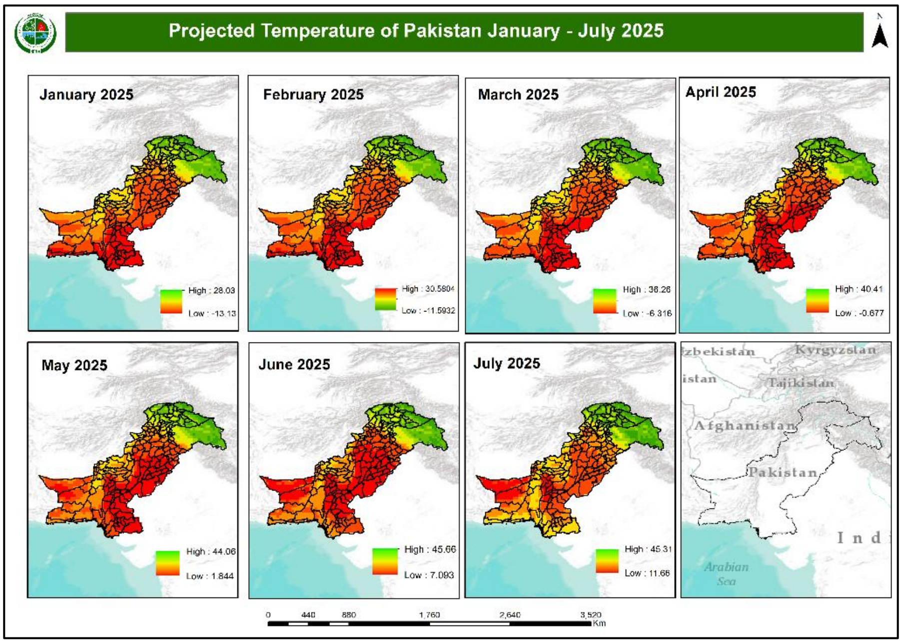
- Northern areas are projected to experience severe cold spells, with minimum temperatures dropping to -13°C in January and -11°C in February.
- Southern regions, particularly Sindh and Balochistan, remain relatively warm, reducing heating requirements but potentially disrupting winter crop cycles.

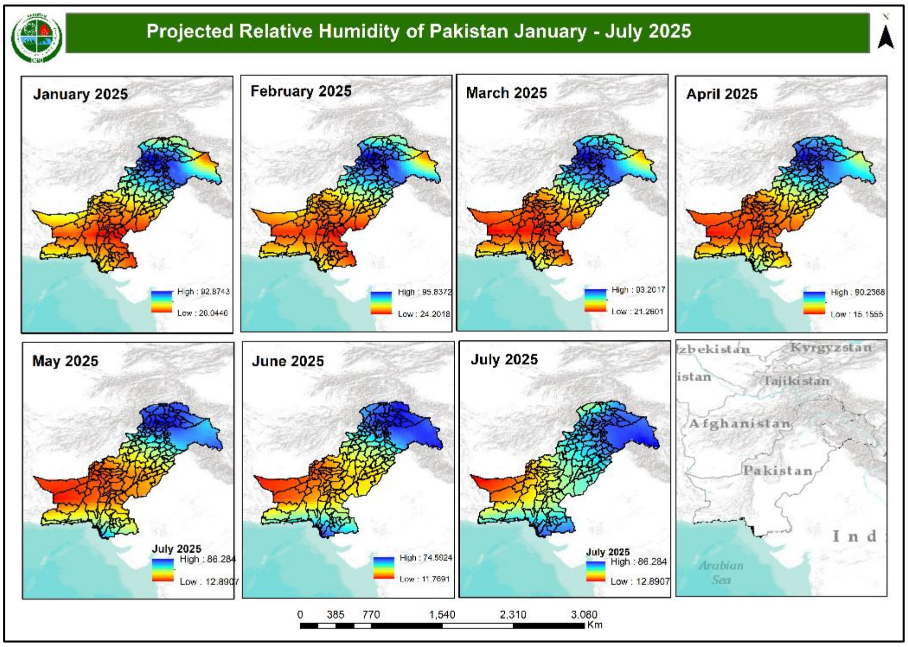
II. **Spring Transition (March - April 2025):**

- Temperatures rise steadily, with highs reaching up to 36°C in March and 40°C in April. This warming trend marks the onset of summer, increasing risks of early heatwaves in central Pakistan.

III. Summer Months (May - July 2025):

- Extreme heat intensifies, with maximum temperatures exceeding 45°C in June. High night-time temperatures exacerbate heat-related stress, especially in urban areas like Karachi, Lahore, and Multan.
- The southwestern region faces severe water stress as rising temperatures accelerate evaporation rates.





2.3. Heat Index

Heat index is the measure of how hot it is actually felt when the effect of relative humidity is coupled with actual temperature. The following table describes various scenarios taking into account actual temperature and relative humidity.

Relative Humidity %	Temperature °C																
	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
40	27	28	29	30	31	32	34	35	37	39	41	43	46	48	51	54	57
45	27	28	29	30	32	33	35	37	39	41	43	46	49	51	54	57	
50	27	28	30	31	33	35	36	38	41	43	46	49	52	55	58		
55	28	29	30	32	34	36	38	40	43	46	48	52	54	58			
60	28	29	31	33	35	37	40	42	45	48	51	55	59				
65	28	30	32	34	36	39	41	44	48	51	55	59					
70	29	31	33	35	38	40	43	47	50	54	58						
75	29	31	34	36	39	42	46	49	53	58							
80	30	32	35	38	41	44	48	52	57								
85	30	33	36	39	43	47	51	55									
90	31	34	37	41	45	49	54										
95	31	35	38	42	47	51	57										
100	32	36	40	44	49	56											

Caution | Extreme Caution | Danger | Extreme Danger

Table 2 Relationship of relative humidity and temperature

WARNING	HEAT INDEX	HEALTH IMPACT
Safe	<26	No adverse effects expected due to heat
Caution	27- 32	Fatigue possible with prolonged exposure and/or physical activity
Extreme Caution	33 - 40	Heat stroke, heat cramps or heat exhaustion possible with prolonged exposure and/or physical activity
Danger	41 - 51	Heat cramps or heat exhaustion likely and heat stroke possible with prolonged exposure and/or physical activity
Extreme Danger	52 - 92	Heat stroke highly likely
Beyond human threshold*	<93	Values beyond human resistance to heat

According to National Oceanic and Atmospheric Administration (NOAA) the computation of the heat index is a refinement of a result obtained by multiple regression analysis carried out by Lanes P. Rothfusz and described in a 1990. The regression equation of Rothfusz is

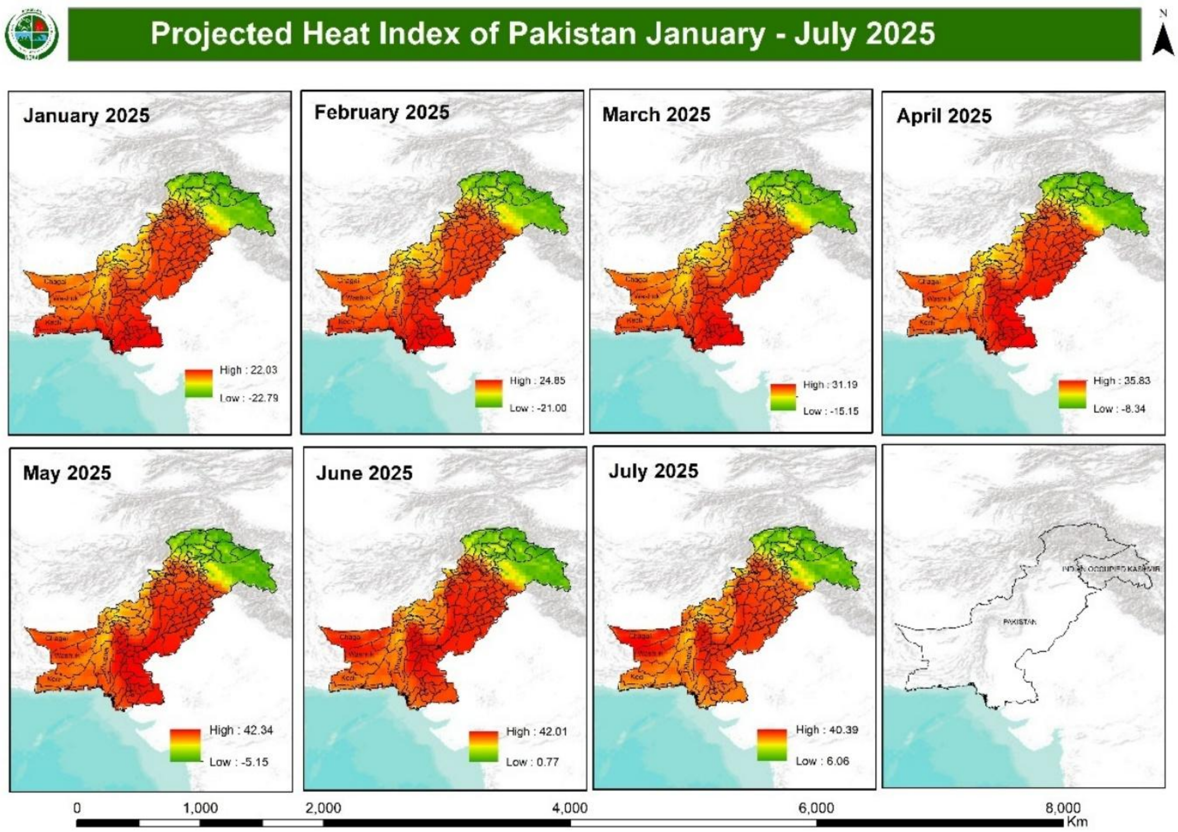
HI = -42.379 + 2.04901523*T + 10.14333127*RH - .22475541*T*RH - .00683783*T*T - .05481717*RH*RH + .00122874*T*T*RH + .00085282*T*RH*RH - .00000199*T*T*RH*RH …. (Eq 1)

However, the Rothfusz regression is not appropriate when conditions of temperature and humidity warrant a heat index value below about 80 degrees F. In those cases, a simpler formula is applied to calculate values consistent with Steadman's results:

HI = 0.5 * {T + 61.0 + [(T-68.0) *1.2] + (RH*0.094)} …… (eq 2)

Were,
HI = Heat Index
T = Temperature
RH = Relative Humidity

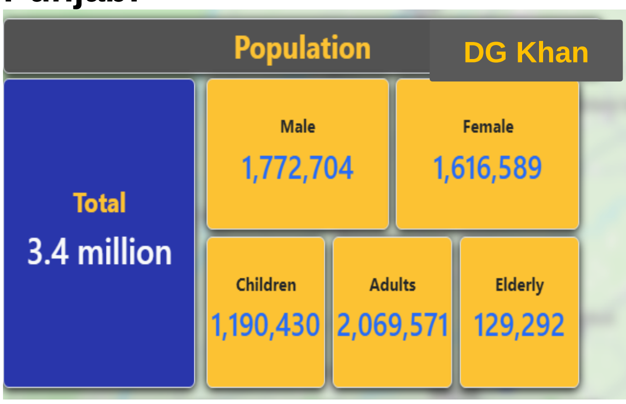
At the National Emergency Operations Center (NEOC), the Heat Index is calculated using Equation 2 show in figure (3). This calculation is particularly relevant for southern Pakistan, where temperatures during the months of May, June, July, and August consistently remain above 80°F. The Heat Index, depicted in Figure 4, provides a comprehensive visualization of the combined impact of temperature and humidity, offering valuable insights into the perceived temperature and potential health risks associated with heat exposure in these regions. As per projections, **Districts Karachi, Badin, Larhkana, Umarkot, Tharparkar, Matiari, Sukkur, Shikarpur, Tando Allahyar, Dadu and Sanghar in Sindh while Bahawalpur, Rahim Yar khan, Dera Ghanzi Khan, Lahore and surroundingds are incipitated to experience heatwave in 2025**.

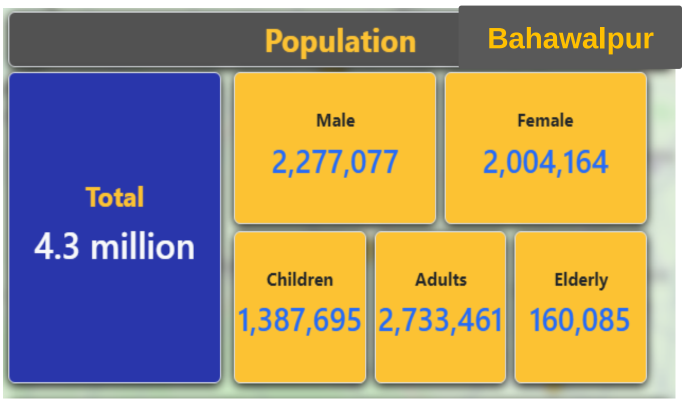


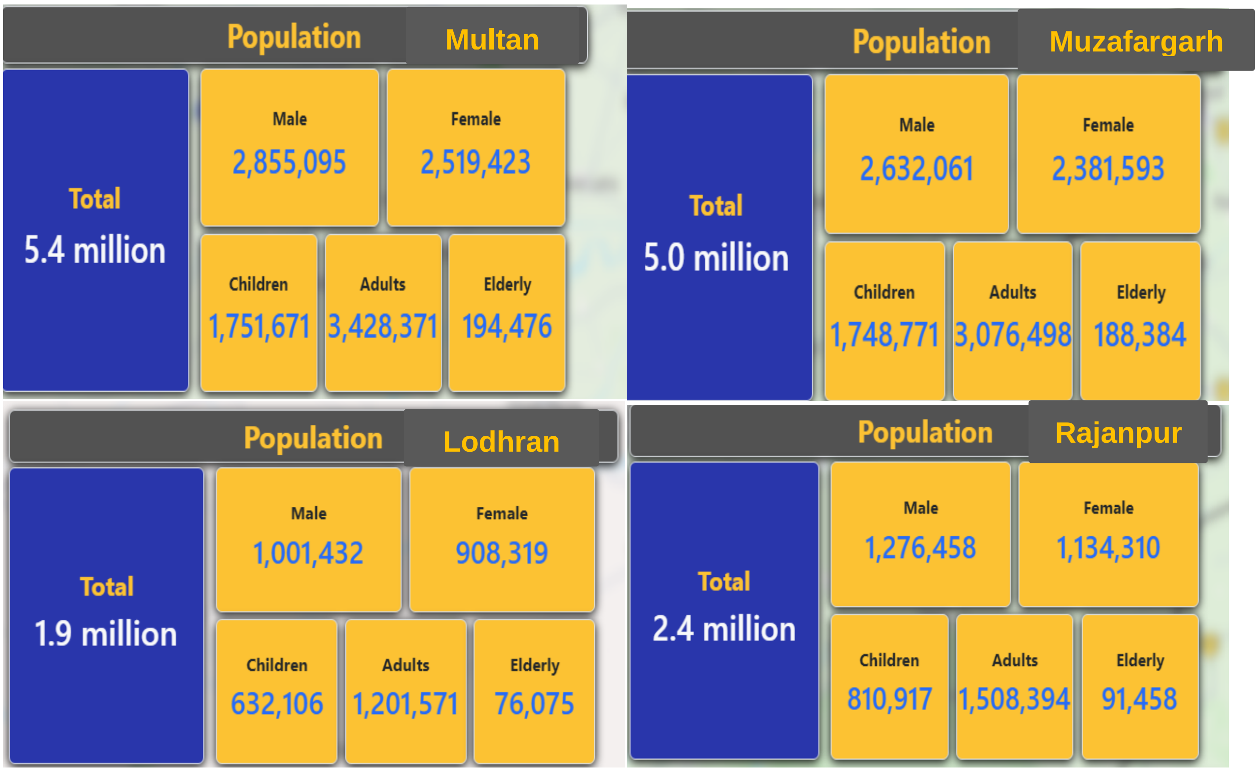
3. Exposure:

3.1. Population:

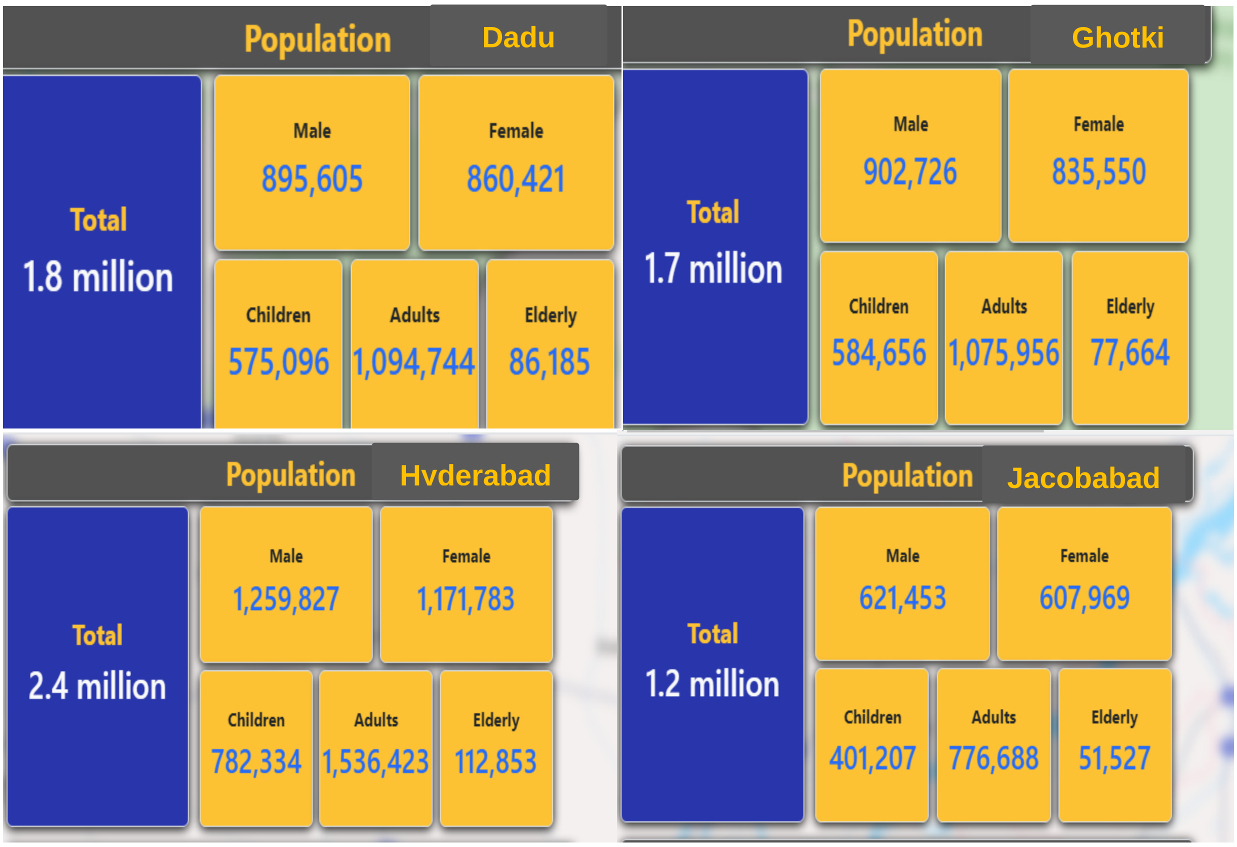
Punjab:



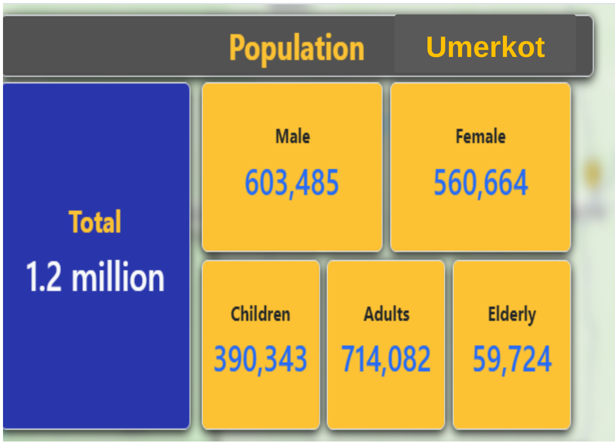


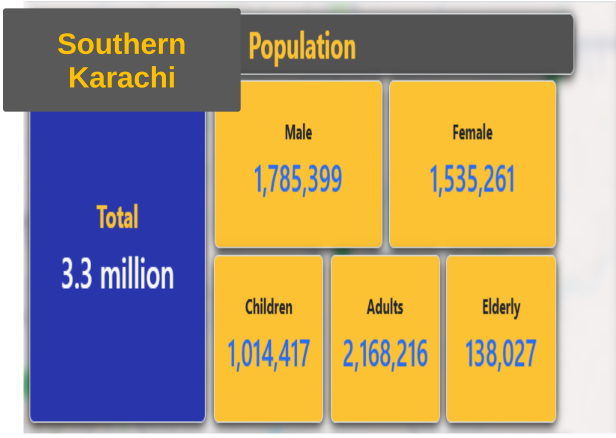

Population
Multan
Total
5.4 million
Male
2,855,095
Female
2,519,423
Children
1,751,671
Adults
3,428,371
Elderly
194,476
Population
Muzafargarh
Total
5.0 million
Male
2,632,061
Female
2,381,593
Children
1,748,771
Adults
3,076,498
Elderly
188,384
Population
Lodhran
Total
1.9 million
Male
1,001,432
Female
908,319
Children
632,106
Adults
1,201,571
Elderly
76,075
Population
Rajanpur
Total
2.4 million
Male
1,276,458
Female
1,134,310
Children
810,917
Adults
1,508,394
Elderly
91,458

Sindh:

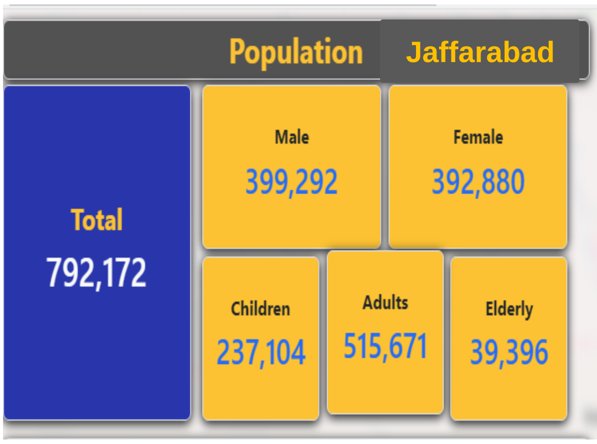

Population
Dadu
Total
1.8 million
Male
895,605
Female
860,421
Children
575,096
Adults
1,094,744
Elderly
86,185
Population
Ghotki
Total
1.7 million
Male
902,726
Female
835,550
Children
584,656
Adults
1,075,956
Elderly
77,664
Population
Hyderabad
Total
2.4 million
Male
1,259,827
Female
1,171,783
Children
782,334
Adults
1,536,423
Elderly
112,853
Population
Jacobabad
Total
1.2 million
Male
621,453
Female
607,969
Children
401,207
Adults
776,688
Elderly
51,527

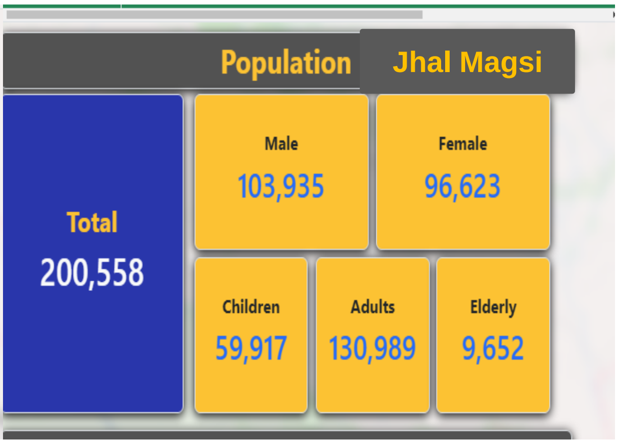
District	Total	Male	Female	Children	Adults	Elderly
Kashmore	1.1 million	588,017	545,314	362,796	726,634	43,901
Mirpur Khas	2.6 million	1,317,767	1,236,116	878,815	1,556,278	118,791
Khairpur	1.6 million	845,194	804,576	548,895	1,023,607	77,268
Sanghar	2.3 million	1,193,981	1,117,536	764,631	1,433,483	113,404
Shaheed benazirabad	1.9 million	946,186	908,165	615,419	1,151,682	87,250
Shikarpur	1.4 million	716,979	691,447	468,589	876,810	63,027
Sukkur	1.7 million	880,319	793,858	553,640	1,048,129	72,408
Tando Allahyar	932,615	477,283	455,332	309,246	578,861	44,509

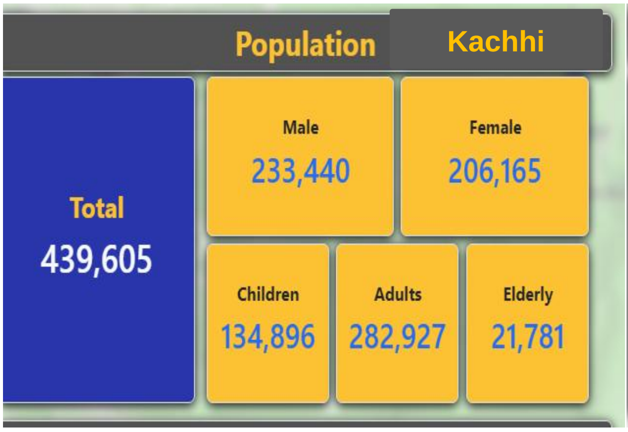


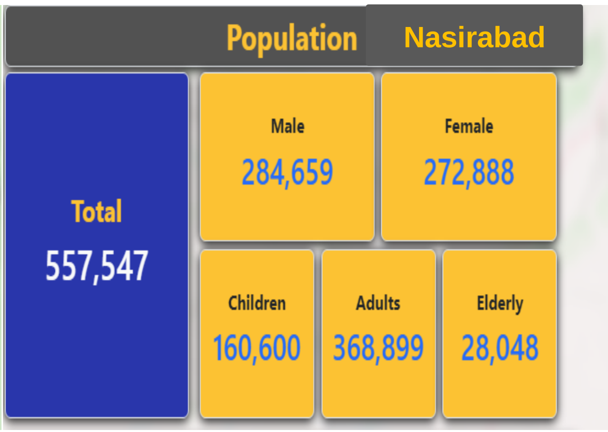


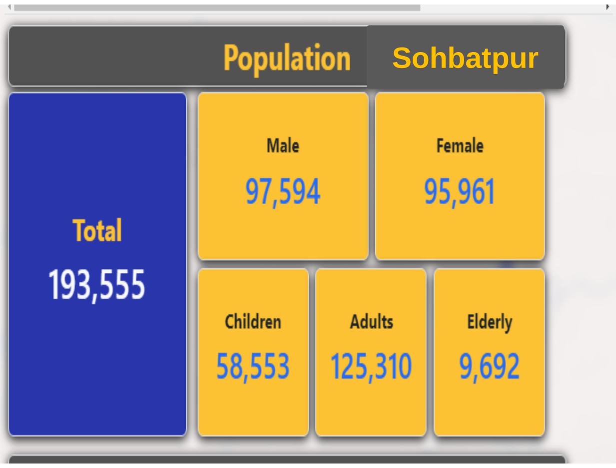
Balochistan:

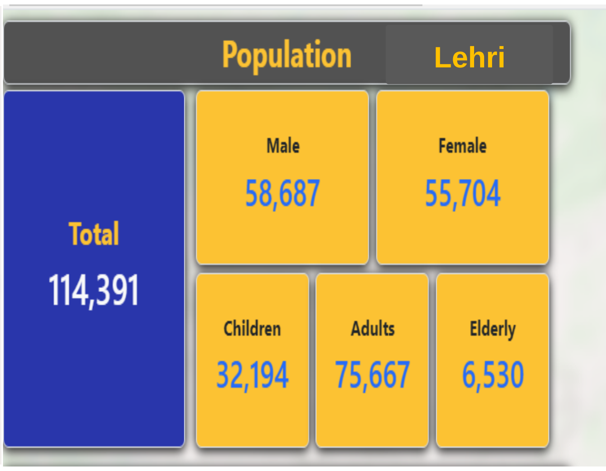




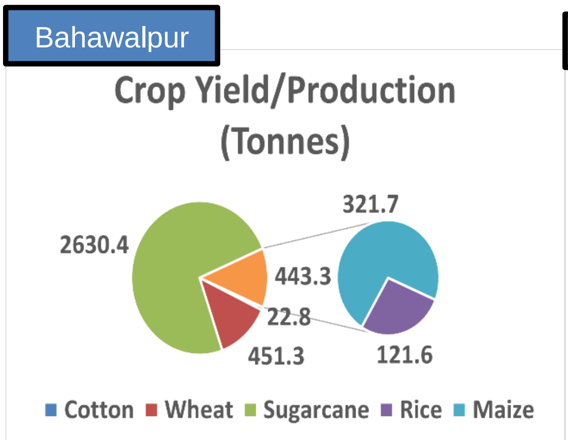


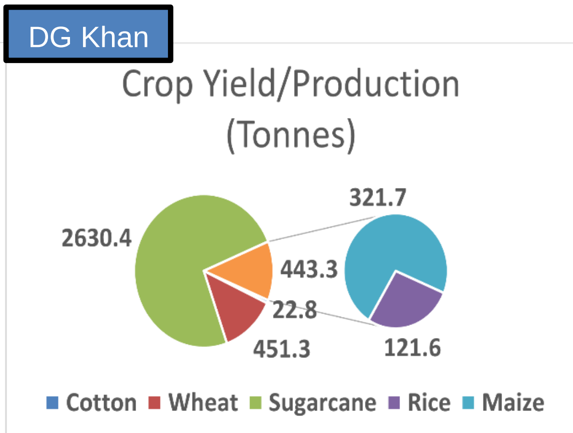


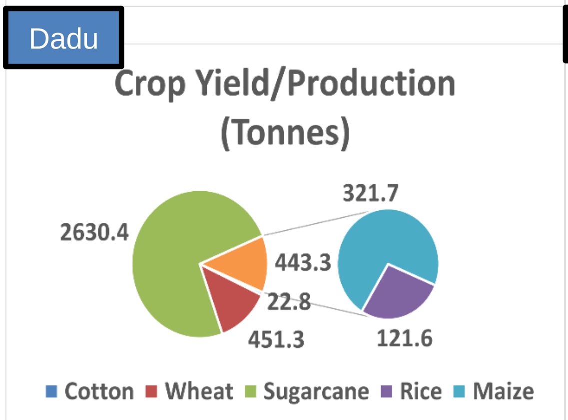


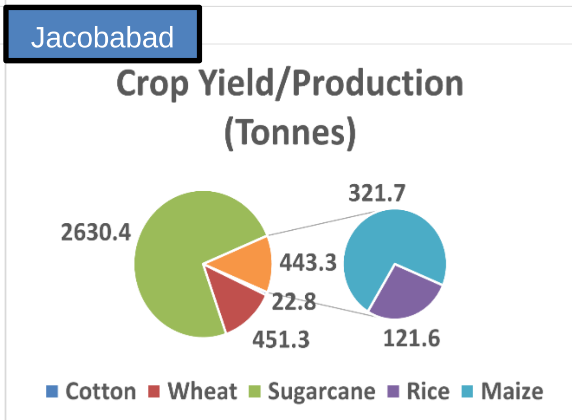


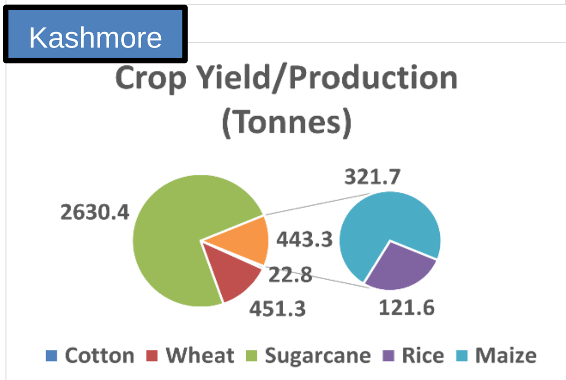
3.2. Exposed Agriculture:

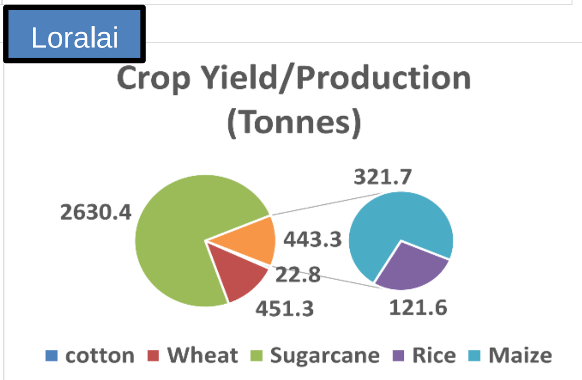


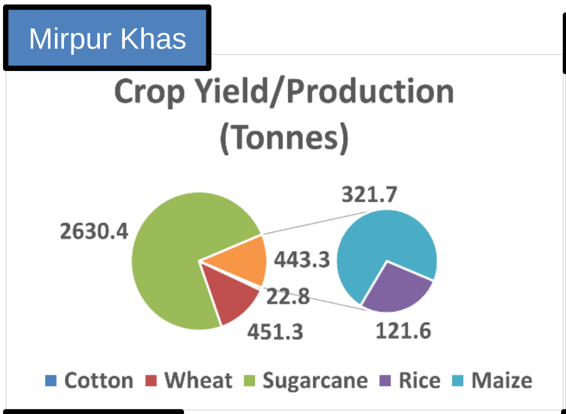


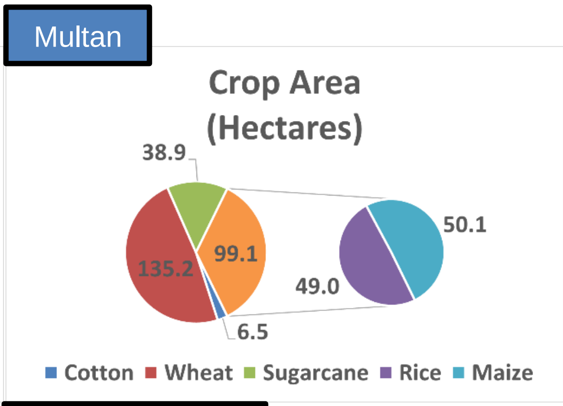


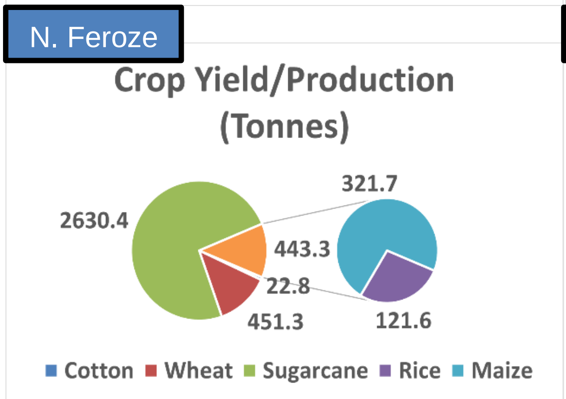


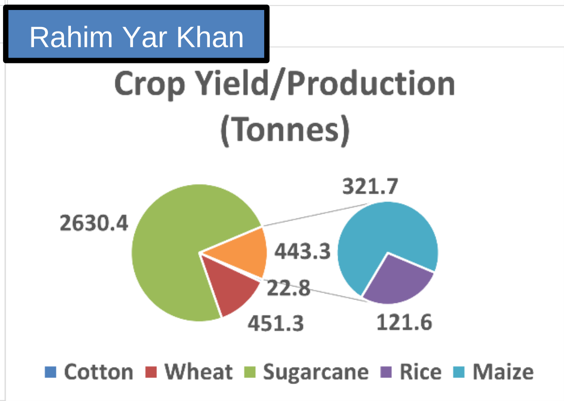


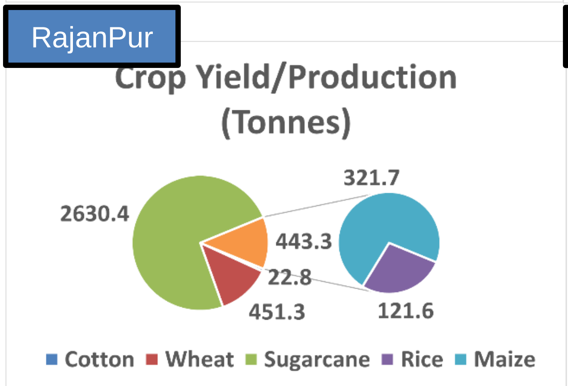


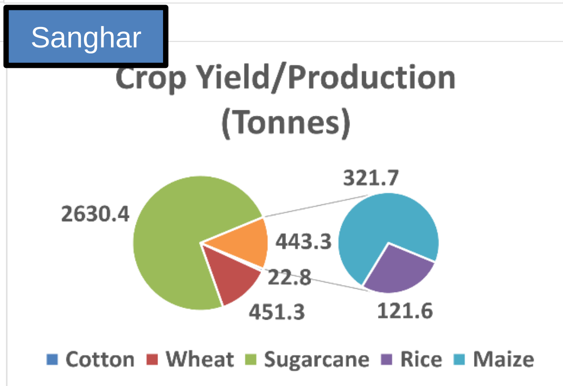

Mirpur Khas
Crop Yield/Production (Tonnes)
2630.4
321.7
443.3
22.8
451.3
121.6
Cotton Wheat Sugarcane Rice Maize

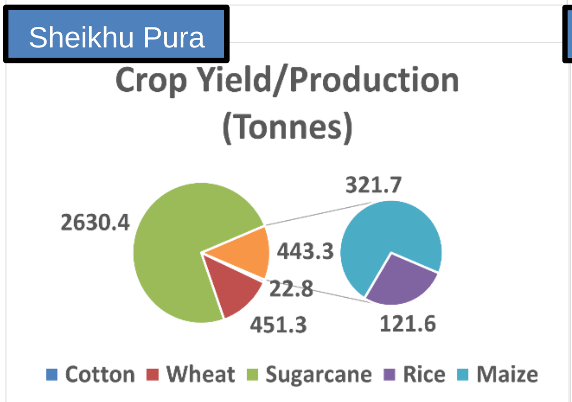

Multan
Crop Area (Hectares)
38.9
135.2
99.1
6.5
50.1
49.0
Cotton Wheat Sugarcane Rice Maize

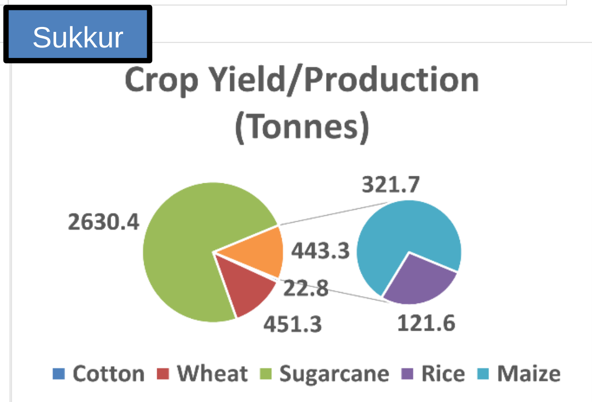

N. Feroze
Crop Yield/Production (Tonnes)
2630.4
321.7
443.3
22.8
451.3
121.6
Cotton Wheat Sugarcane Rice Maize

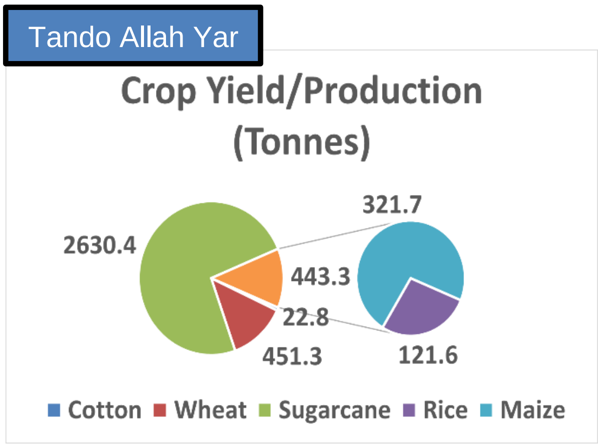

Rahim Yar Khan
Crop Yield/Production (Tonnes)
2630.4
321.7
443.3
22.8
451.3
121.6
Cotton Wheat Sugarcane Rice Maize

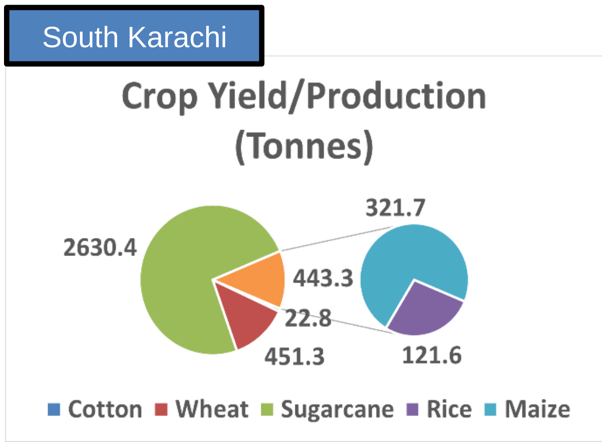

RajanPur
Crop Yield/Production (Tonnes)
2630.4
321.7
443.3
22.8
451.3
121.6
Cotton Wheat Sugarcane Rice Maize


Sanghar
Crop Yield/Production (Tonnes)
2630.4
321.7
443.3
22.8
451.3
121.6
Cotton Wheat Sugarcane Rice Maize

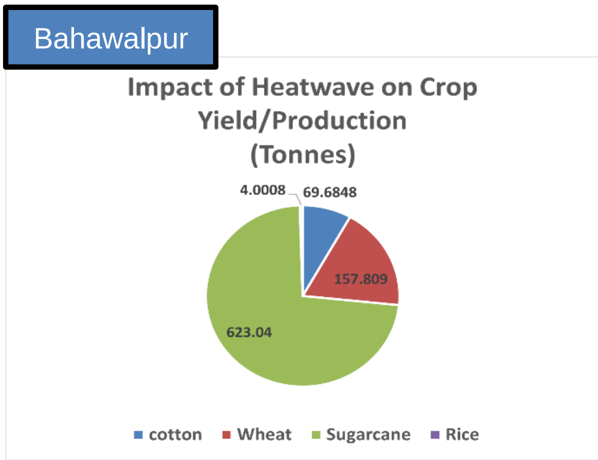

Sheikhu Pura
Crop Yield/Production (Tonnes)
2630.4
321.7
443.3
22.8
451.3
121.6
Cotton Wheat Sugarcane Rice Maize

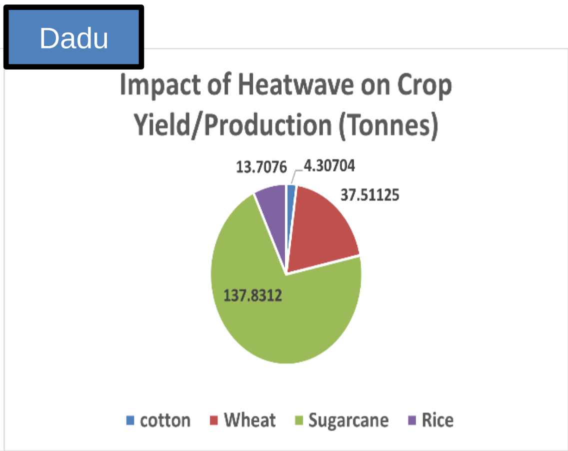

Sukkur
Crop Yield/Production (Tonnes)
2630.4
321.7
443.3
22.8
451.3
121.6
Cotton Wheat Sugarcane Rice Maize

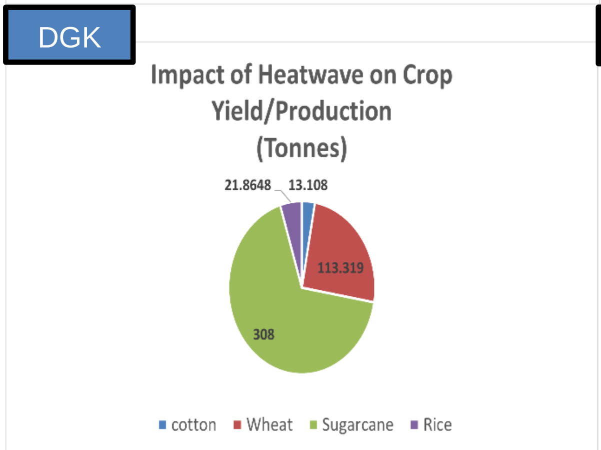


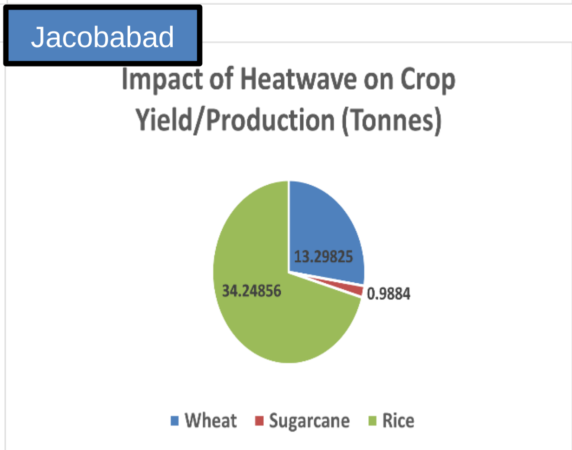


3.2.1. Likely Impact on agriculture:

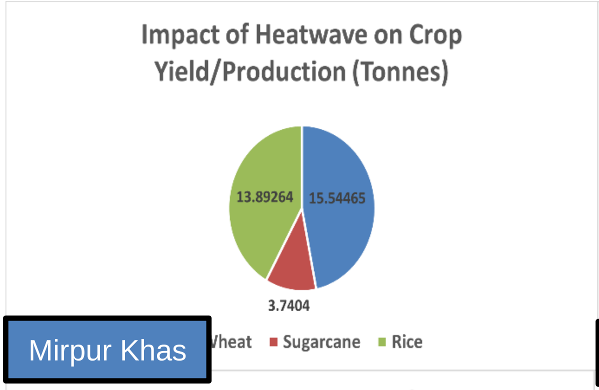




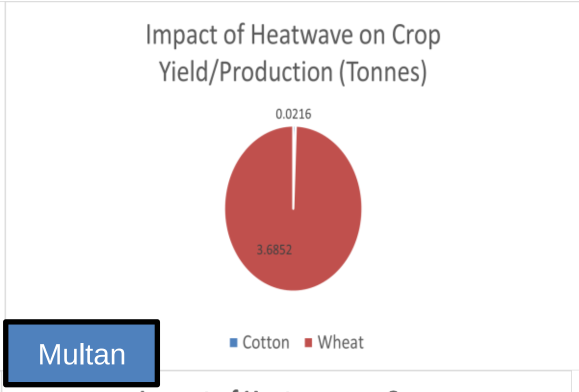




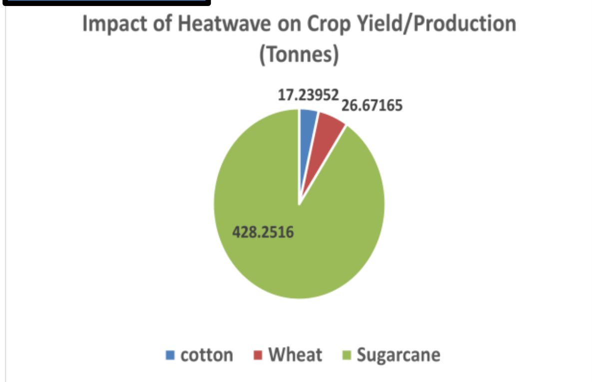
Kashmore



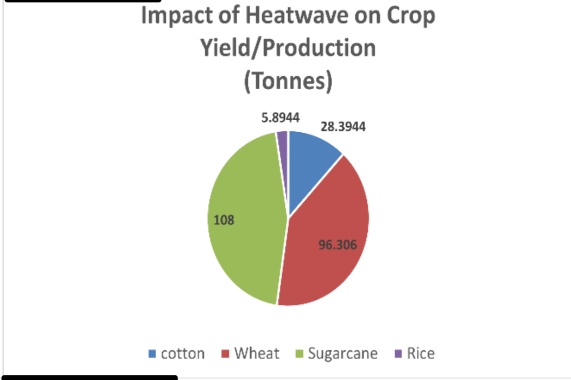
Loralai



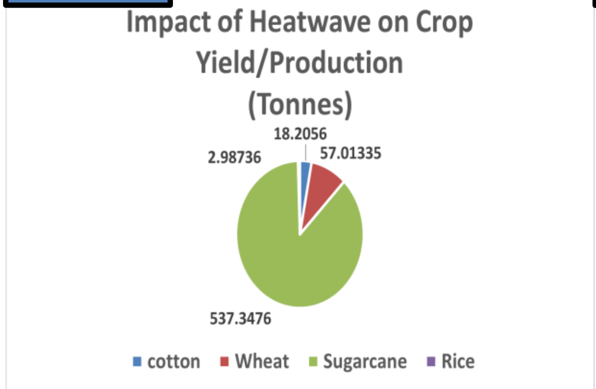
Mirpur Khas



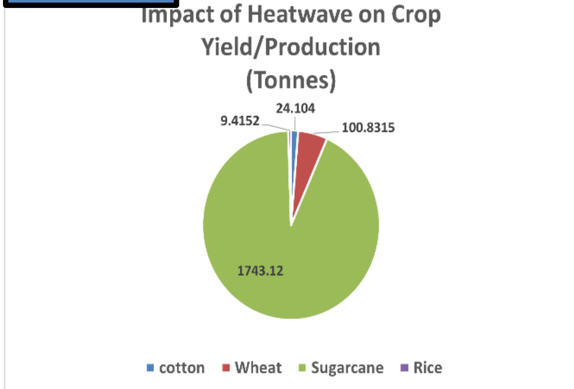
Multan



N Feroze



Rajanpur



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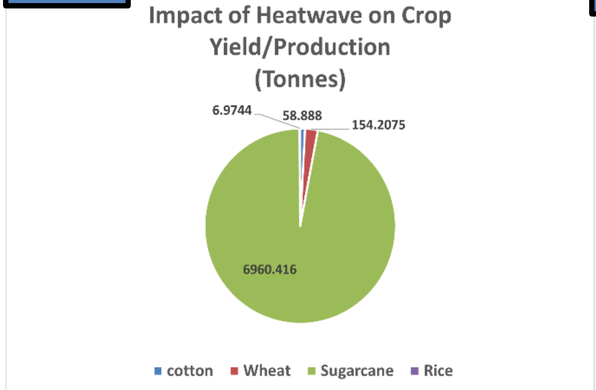

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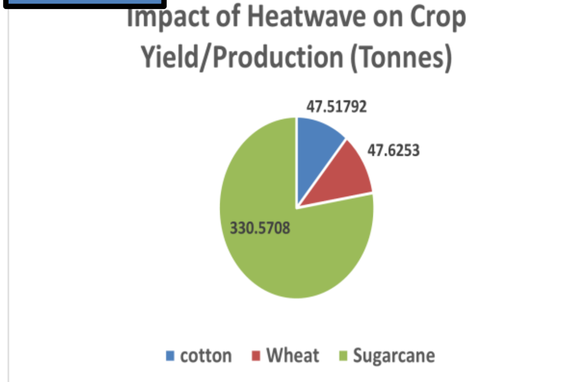

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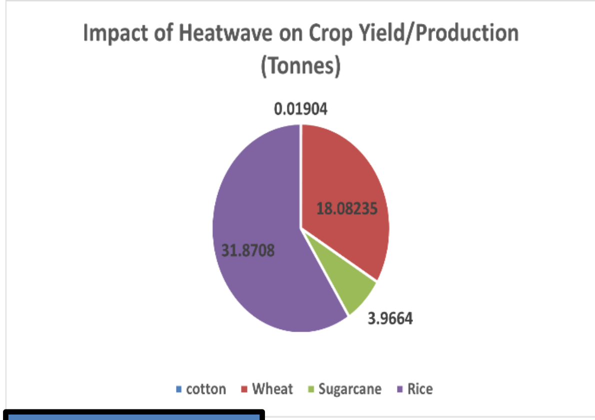

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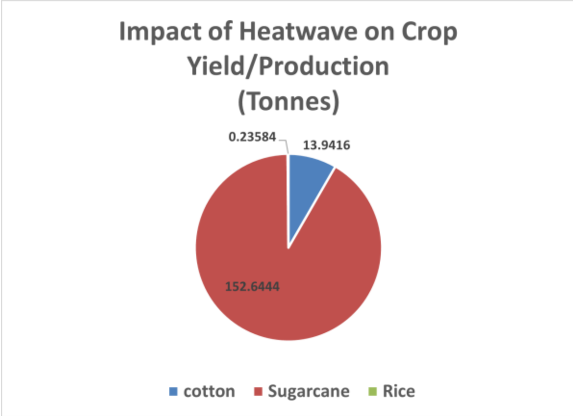

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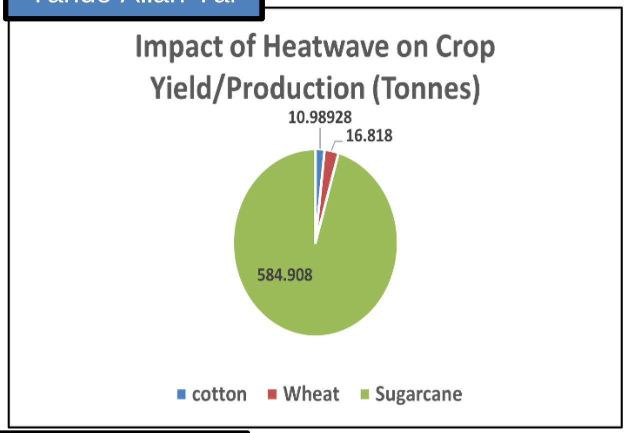

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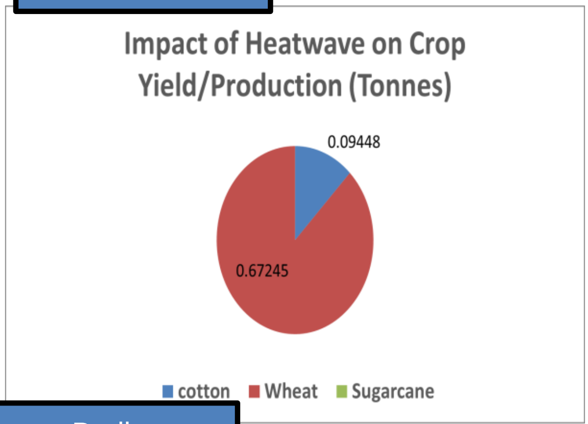

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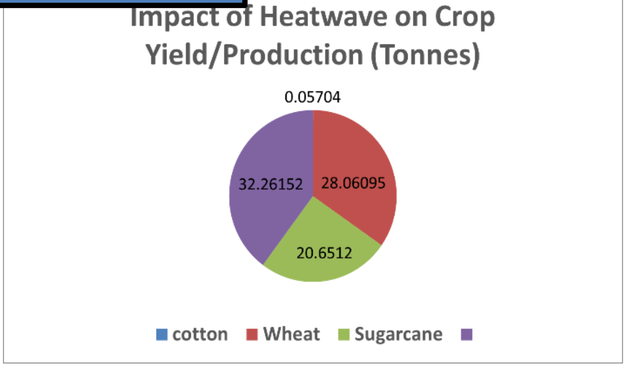

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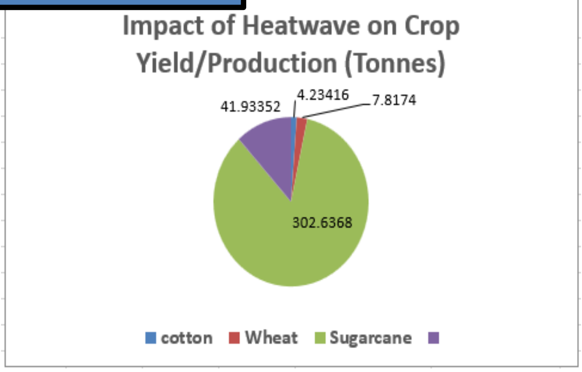
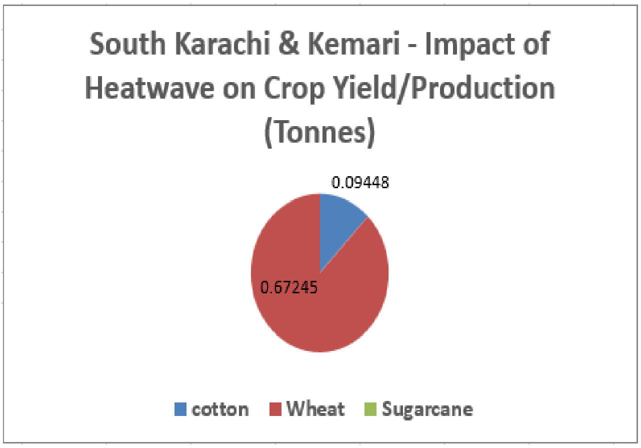




4. National & Global Best Practices. (NIDM Dte)

4.1. Prevention Strategies

a) Community Awareness & Education

I. Launch public awareness campaigns to educate communities on the risks of heatwaves, including staying hydrated, avoiding the sun during peak hours, and using heat-resistant building materials.

II. Promote local government programs aimed at improving urban cooling, such as increasing green spaces and planting trees in cities to reduce heat islands.

b) Monitoring and Early Warning Systems

I. Use meteorological data, satellite-based observations, and Geographic Information Systems (GIS) to monitor and forecast heatwave conditions.

II. Establish early warning systems that deliver heatwave alerts to communities, especially vulnerable populations like the elderly and those with pre-existing health conditions.

c) Legislation & Policy

I. Enforce regulations that mandate the development of heat action plans in urban areas, ensuring measures to reduce indoor and outdoor temperatures.

II. Implement urban planning policies that prioritize energy-efficient buildings, cool roofs, and the integration of green spaces to combat urban heat islands.

d) *Sustainable Urban Design*

I. Encourage designs that integrate shading and cooling techniques, such as the use of reflective materials in public spaces and the creation of urban parks and water features to reduce heat.

II. Encourage the construction of heat-resistant infrastructures like cool roofs and walls.

4.2. Response Strategies

a) Rapid Response Teams

i. Form specialized teams equipped to manage heatwaves by setting up temporary cooling centers, distributing water, and providing medical aid to vulnerable populations.

ii. Equip teams with mobile units to monitor heat conditions and provide emergency relief.

b) *Incident Command Systems*

i. Use the Incident Command System (ICS) to coordinate heatwave response efforts across local, provincial, and national authorities.

ii. Ensure that coordination includes healthcare agencies, civil protection, and urban planning teams for an integrated approach.

c) *Community Involvement*

i. Train community volunteers, particularly in heat-vulnerable areas, to assist with heatwave response efforts, such as distributing water or assisting elderly residents.

ii. Establish local heat action networks that can mobilize resources quickly during a heat event.

4.3. Post-Heatwave Recovery Measures

a) *Infrastructure Adaptation*

i. Retrofit public spaces, hospitals, and schools with cooling systems such as air conditioning or ventilation improvements.

ii. Reassess urban planning regulations to ensure that new construction projects are designed with heat resilience in mind.

iii.

b) *Health Monitoring & Rehabilitation*

i. Set up health monitoring systems to track heat-related illnesses focusing on vulnerable populations.

ii. Implement rehabilitation programs for individuals who experienced heatstroke or dehydration, offering long-term medical support and education on how to cope with future heat events.

c) *Environmental Restoration*

i. Restore green spaces that were damaged by heat-related events, and plant more heat-resistant species to improve urban heat management.

ii. Rehabilitate water resources and restore natural cooling systems in cities and rural areas.

4.4. Adapting to Rising Temperatures: Local and Global Academic Insights

- Installation of green roofs provide shade and remove heat from the roof surface and surrounding air.
- Increasing tree plantings around buildings to shade parking lots and in outdoor areas.

- Combine recycled elements with locally sourced materials for aid items, capitalizing on their standardized nature.
- Use evaporative cooling techniques by wetting a surface like cloth or mat, allowing water to evaporate and naturally cool the surrounding air.
- In desert regions, the adoption of sustainable irrigation systems like drip irrigation or recycled water systems can contribute significantly to water conservation efforts.
- Encourage the use of heat resistant paints (containing boric acid and calcium chloride), chemical prophylaxis, and processed foods.
- Maximize shade by building narrow roads and alleys that offer natural relief from sunlight.
- Using materials with higher solar reflectance can help reduce heat absorption and lower surface temperatures, thereby mitigating the heat island effect.
- Instalment of solar powered appliances such as fans and air conditioners to stay cool and comfortable.
- Guide individuals to nearby response centres for assistance by collaborating with social welfare organizations.
- Provide essential health services, nutrition supplements, counselling, preschool activities, and awareness programs for children.
- Capacity building of local communities to better prepare for and respond to heatwaves. This includes training community members in first aid, heat stress management, and disaster preparedness.
- Conduct research to understand the impacts of extreme temperatures on ecosystems, agriculture, infrastructure, and human health.
- Develop innovative solutions to mitigate these impacts, such as heat-tolerant crops, energy-efficient cooling technologies, and urban planning strategies to reduce the urban heat island effect.
- Disseminating accurate information about impending heatwaves, educating the public about the dangers of extreme heat, and providing tips on how to stay safe and cool during heat waves.
- Educating citizens regarding the dangers of extreme heat and the steps they can take to protect themselves when extreme temperatures occur.
- Educate communities about the consequences of heat stress risks, preventive measures, and available resources.
- Use low-tech, high-efficiency methods like a double-roof system and walls constructed with plastic bags filled with compacted earth for effective cooling in refugee camps.
- The use of smart irrigation technologies is another option, which involves sensors and data analysis to adjust watering schedules based on plant requirements and weather patterns.
- Choose homes with limestone and natural materials to naturally control humidity, absorbing moisture in humid conditions and releasing it on sunny days. The sandy

texture reflects solar radiation, providing effective cooling for a comfortable living environment.

- Encourage Construction of thick-walled houses using materials like adobe (soil, water, and organic additives) or stone for insulation against high temperatures.
- Smart building design considerations:
    - ✓ Minimize solar heating in hot seasons.
    - ✓ Maximize indoor cooling rate in summer.
    - ✓ Optimize orientation and window size for efficiency.
- Ambulances should initiate early cooling treatment upon picking up the patient.
- Regular monitoring of weather patterns and issuing early warnings about potential heatwaves, allowing authorities and communities to take proactive measures to mitigate their impact.
- Harness natural energy for passive summer cooling.
- Locating and rescuing individuals who may be at risk due to the heat, such as hikers, elderly individuals, or those experiencing heat-related illnesses.
- Companies must assess and reduce their carbon footprint, compensating for any remaining emissions.





4.5. Case Studies on Heatwave Management Around the Globe

4.5.1. Singapore – Urban Cooling Initiative

Overview

Singapore has adopted a unique approach by integrating "urban cooling" as part of its long-term climate action plans.

Best Practices

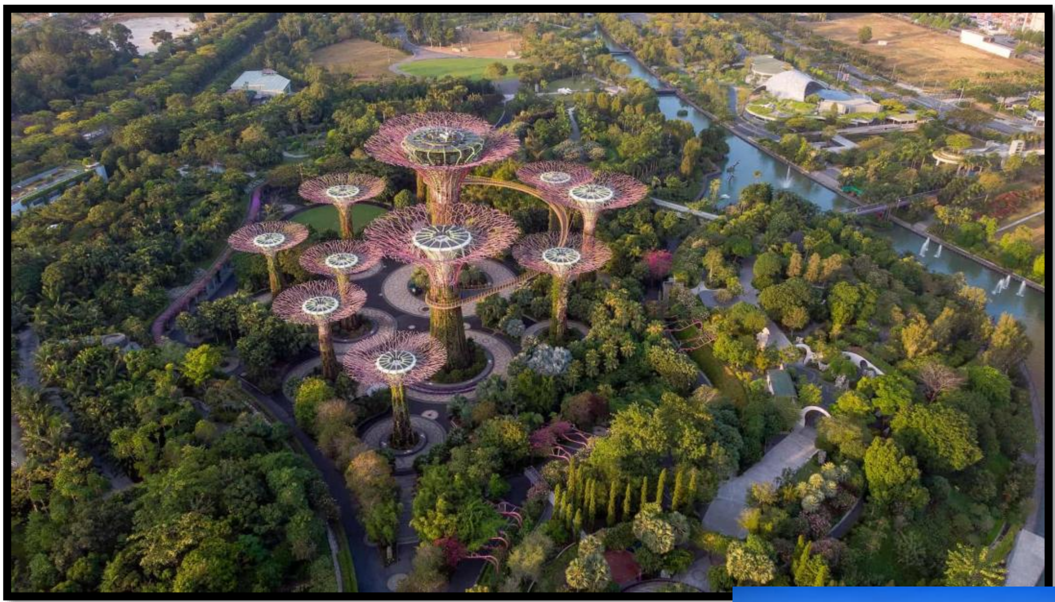
I. The city has implemented green roofs, vertical gardens, and rooftop parks to absorb heat and provide shade, helping to reduce ambient temperatures.

II. Streets and walkways are designed with shade structures and cooling plants, creating pathways of relief from the heat.

III. The use of water features like fountains and misting systems in public spaces helps lower temperatures and improve air quality.

Outcome

Singapore's efforts have created more comfortable living spaces and significantly reduced the urban heat island effect.



4.5.2. United Kingdom – Heatwave Action Plan (HAP)

Overview

The UK has developed a proactive Heatwave Action Plan that includes specific measures tailored to the country's cooler climate and the vulnerability of the elderly population.

Best Practices

I. The UK sends personalized heat warnings to vulnerable individuals, such as elderly people and those with pre-existing medical conditions, through health services.
II. Public buildings like libraries and community centers are designated as cooling centers and are open during extreme heat events.
III. Initiatives like green roofs, tree planting, and shaded walkways are encouraged to reduce urban heat exposure.

Outcome
This proactive approach has minimized heat-related health risks and prevented fatalities, especially among at-risk groups.

4.5.3 United States – Phoenix, Arizona: Cool Pavement Program
Overview
Phoenix, one of the hottest cities in the U.S., has implemented the Cool Pavement Program as part of its strategy to mitigate the effects of heatwaves.
Best Practices
I. The city has used reflective materials and coatings on roads and pavements to lower surface temperatures.
II. Streetlights and other city infrastructure have been modified to use less heat-absorbing materials, and buildings are retrofitted to improve cooling efficiency.
III. Phoenix has aggressively expanded its urban tree canopy to provide natural shade and cool urban spaces.

Outcome
The Cool Pavement Program has reduced temperatures by several degrees, offering relief to residents during peak heat events.

4.5.4. Spain – Valencia Heatwave Action and Early Warning System

Overview

Spain, which faces frequent and intense heatwaves, has developed a sophisticated Heatwave Early Warning System (HEWS) to reduce the impacts of extreme temperatures.

Best Practices

I. The HEWS provides early alerts, allowing local authorities to prepare and deploy resources, such as ambulances and cooling centers.
II. The government runs campaigns to raise awareness about heat risks, hydration, and prevention measures for vulnerable populations.
III. New buildings are required to have heat-resistant features such as reflective roofs, green walls, and better insulation.

Outcome

The HEWS has significantly improved response times during heatwaves and reduced the number of heat-related fatalities.

4.5.5. Mexico – Mexico City's Heat-Resilient Housing Program

Overview

Mexico City has faced severe heatwaves due to its geographical location and urban density. The city has initiated a unique heat-resilient housing program to address these challenges.

Best Practices

I. The city has partnered with local organizations to install reflective materials on residential rooftops to reduce indoor temperatures.
II. Mexico City has also implemented vertical gardens and green roofs to combat the urban heat island effect in densely populated neighborhoods.
III. The city has introduced solar-powered fans and air conditioning units in low-income areas to provide cooling without adding strain to the power grid.

Outcome

These measures have helped mitigate indoor heat and have made the city's most vulnerable populations more resilient to heatwaves.

4.5.6. Japan – Heatstroke Prevention in Tokyo

Overview

Japan, particularly Tokyo, faces intense summer heatwaves. The city has developed unique measures to protect citizens from heatstroke.

Best Practices

I. Tokyo has a real-time heatstroke risk alert system that sends notifications to residents on their mobile phones, advising them to stay cool or hydrate.
II. The city has established cooling centers that are equipped with fans, ice packs, and water for residents, particularly targeting the elderly and children.
III. Tokyo has installed sensors on public infrastructure, such as bus stops and train stations, to monitor heat levels and activate cooling measures like misters when temperatures rise.

Outcome

The heatstroke prevention measures have been successful in reducing hospital admissions and fatalities related to heat stress.

4.5.7. South Korea – Busan Heatwave Management and Cooling Trees

Overview

Busan, South Korea's second-largest city, implemented a unique strategy involving “cool trees” to combat heatwaves.

Best Practices

I. The city planted specific tree species known for their ability to reduce temperatures by providing dense shade and moisture through transpiration.

II. The city integrates green spaces, parks, and urban forests into new developments to cool the urban environment.
III. Special “cool parks” are established with water features, shaded rest areas, and other heat mitigation technologies to provide residents with cool spaces during heat events.

Outcome

This strategy has improved public health outcomes during heatwaves and helped make the urban environment more resilient to future heat impacts.

4.5.8. India – Ahmedabad Heat Action Plan (HAP)

Overview

In 2013, the city of Ahmedabad in India launched the Ahmedabad Heat Action Plan (HAP), one of the first of its kind in India. The plan was developed with the support of the Indian Institute of Public Health and the World Bank.

Best practice

I. The plan uses meteorological data to predict and issue heat warnings, which is communicated to the public via media outlets and mobile messages.
II. Cooling centers in public spaces like malls and schools are established for vulnerable populations during extreme heat.
III. Mass campaigns educate the public about heat-related risks and preventive measures.
IV. Hospitals and clinics are equipped and prepared for an increase in heat-related illnesses.

Outcome

The plan has been successful in reducing the number of heat-related deaths and improving public awareness and preparedness. Other cities in India, including New Delhi and Mumbai, have adopted similar plans based on Ahmedabad’s success.

4.5.9. Australia – Melbourne's Cool Roofs Program

Overview

In Melbourne, the increasing urban heat island effect led the city to launch an initiative to reduce indoor temperatures during heatwaves through the use of "cool roofs" and other green infrastructure.

Best practice

I. The city incentivized businesses and homeowners to install reflective roofs that can significantly reduce building temperatures.
II. Parks, green roofs, and urban forests have been expanded to reduce the ambient temperature.
III. Public campaigns encourage people to minimize heat exposure by staying in cool environments and using reflective materials.

Outcome

The program has led to a reduction in indoor temperatures during extreme heat, providing relief for vulnerable populations.

4.5.10. Europe – The European Heat-Health Action Plans (HHAP)

Overview

The European Union has implemented Heat-Health Action Plans (HHAP) across several member states to address the increasing frequency of heatwaves due to climate change.

Best practice

I. These plans involve forecasting and issuing early warnings about heatwaves, targeting vulnerable populations, and setting up public information systems.
II. Hospitals are equipped to manage heat-related illnesses, with extra staff and cooling systems during heat events.
III. Cities like Paris, Rome, and Madrid have adopted heat-resilient urban planning strategies, such as creating more green spaces, using reflective pavement, and planting trees.

Outcome

These initiatives have reduced the mortality rate during heatwaves across the EU, particularly in countries like Spain, France, and Italy, where heatwaves are more frequent.

4.6. Survival guide

Extreme heat can be fatal for people of all ages, including those with chronic illnesses, pregnant women, and the elderly. However, there are numerous actions we can do to shield our loved ones and ourselves from the heat.

1. Adopt cool roof technologies, such as reflective coatings and green roofs, to lower building temperatures.
2. Avoid outdoor activities during peak heat hours.
3. Stay hydrated by drinking plenty of water and natural juices (e.g., sattu, mint).
4. Wear natural materials like cotton to stay cool.
5. Take baths with neem water to reduce body heat.
6. Wear light-coloured to stay cool.
7. Close curtains or blinds during the hottest part of the day to block out the sun's heat.
8. Use high-SPF sunscreen/sunblock to prevent sunburn on your skin.
9. Understand about the signs and symptoms of heat exhaustion and heatstroke, such as headache, nausea, fast heartbeat, and disorientation.
10. Encourage the use of energy-efficient appliances and lighting to reduce heat generation and lower energy costs.
11. Implement water-saving techniques and collaborate with local authorities for sustainable water management.
12. Employ evaporative cooling techniques, such as wetting a cloth or mat, to naturally cool down spaces.

4.7. Gap Analysis for Heatwaves in Pakistan

I. Most risk assessments are generalized and fail to account for Pakistan's diverse geography and climate. Specific regions such as Sindh's urban centers (Karachi, Hyderabad) and rural areas (Tharparkar, Umerkot) experience vastly different heatwave impacts, requiring tailored strategies.

II. Indigenous knowledge of coping with extreme heat, such as traditional housing designs (mud huts, ventilated structures) and cultural practices (use of lightweight clothing), is underutilized in urban planning and community-based interventions.

III. Coordination between provincial and municipal authorities is weak, resulting in delayed responses and inefficient resource allocation during heatwaves. For instance, the lack of synchronization between Karachi Metropolitan Corporation (KMC) and Sindh’s provincial disaster management authorities was evident in past heatwave crises.

IV. While early warning systems exist for rural flood-prone areas, urban heatwaves lack robust alert mechanisms. For example, Karachi, with its history of deadly heatwaves, does not have a dedicated city-wide alert system tailored to the urban population's needs.

V. Urban areas often rely on concrete-heavy designs that exacerbate the urban heat island (UHI) effect. Unlike international cities employing cool pavements and shaded corridors, Pakistani cities largely neglect such measures. Rural areas face challenges with non-heat-resistant housing that traps heat during extreme temperatures.

VI. Pakistan's labor force, particularly outdoor workers (e.g., construction workers, farmers, and street vendors), is among the most vulnerable to heatwaves. Workplace safety regulations and heat-adaptive work practices (e.g., flexible work hours, cooling stations) are either absent or inadequately enforced.

VII. Women in rural areas often face additional burdens during heatwaves, such as increased water collection efforts and caregiving roles. Policies and interventions seldom address these gendered impacts, leaving women more exposed to heat-related risks.

VIII. Cooling technologies, such as affordable fans or air conditioners, remain inaccessible to a significant portion of the population, particularly in low-income households. Public cooling centers are sparse, and their coverage is limited.

IX. Major urban centers lack basic hydration facilities like water fountains or kiosks in public spaces, which are vital for preventing heat-related illnesses during peak heat hours.

X. Heatwave awareness campaigns are sporadic and fail to drive behavioral changes, such as the adoption of protective clothing, staying hydrated, and identifying early symptoms of heatstroke.

4.8. Recommendations

1. Develop region-specific heatwave vulnerability maps using GIS and satellite data to tailor interventions.
2. Integrate traditional cooling practices with modern design in rural and urban housing projects.
3. Establish heatwave-specific task forces at municipal levels to coordinate early warnings, public awareness, and emergency responses.
4. Invest in cool pavements, green roofs, and shaded pedestrian pathways to mitigate the UHI effect.
5. Introduce policies mandating heat-adaptive work hours, breaks, and shaded rest areas for outdoor workers.
6. Ensure heatwave interventions address the unique needs of women, such as access to water and childcare facilities.
7. Provide subsidies for affordable cooling technologies and establish public cooling centers in densely populated areas.
8. Install water kiosks in urban and rural areas, particularly along high-traffic roads and in markets.
9. Implement year-round campaigns targeting heatwave preparedness and early response, leveraging schools, mosques, and local media for outreach.

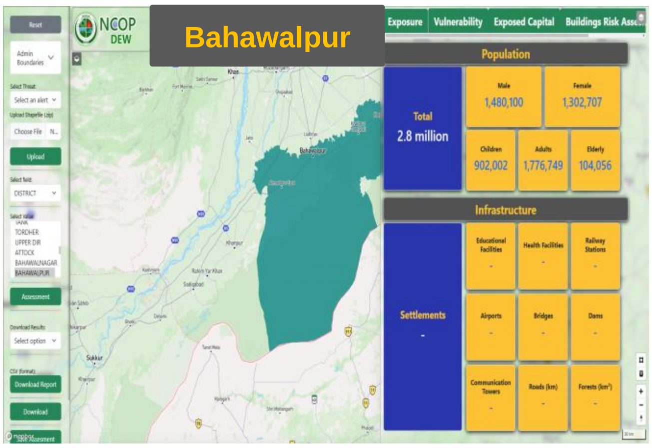
5. Guidelines: Roles and Responsibilities. (Anticipatory Actions DRR)

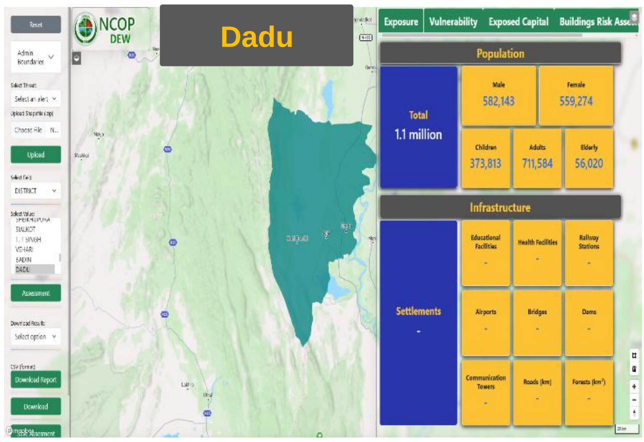
Heatwaves	**Federal Government**	• Ensure adequate medical facilities and resources for heatstroke and respiratory issues. • Develop public health advisories for extreme weather conditions. • Coordinate national response mechanisms for heatwaves.
	National Disaster Management Authority (NDMA)	• Issue timely warnings in collaboration with meteorological agencies. • Develop heatwave response plans and guidelines. • Ensure availability of emergency cooling shelters in high-risk areas.
	Provincial Disaster Management Authority (PDMA)	• Implement localized early warning systems. • Coordinate with municipalities to establish cooling centers. • Conduct public awareness campaigns on hydration and safety measures.
	Healthcare & Emergency Services	• Equip hospitals with necessary resources for treating heat-related illnesses. • Deploy mobile health units in vulnerable areas. • Train medical personnel in heatwave emergency response.
	Local Governments & Municipal Authorities	• Ensure access to clean drinking water and shade in public spaces. • Implement regulations to reduce outdoor labor during peak heat hours. • Promote energy-efficient cooling solutions in residential areas.
	Households & Individuals	• Stay hydrated and avoid outdoor activities during peak heat hours. • Use cooling methods such as fans and air-conditioning. • Look out for vulnerable family members, including children and the elderly.

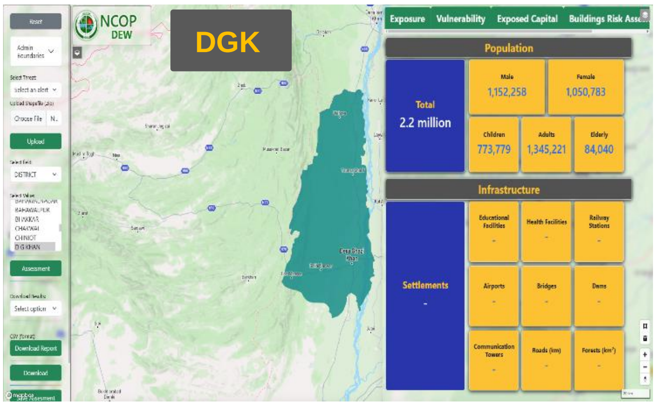
6. Impact After Interventions.

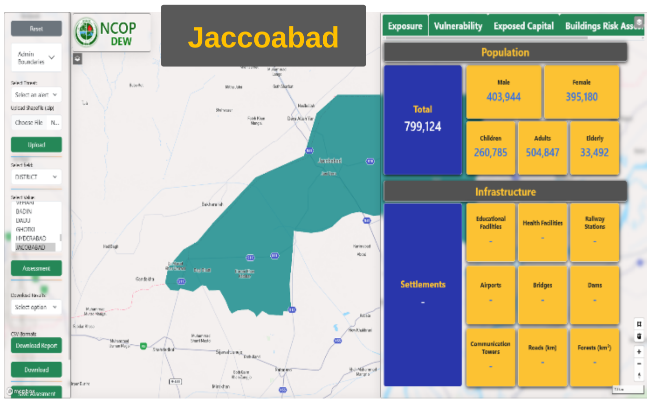
NDMA has developed a list of anticipatory actions that are to be taken to prepare for the anticipated **Heatwave** events. The roles and responsibilities of all relevant line departments have also been assigned already. These interventions will result in reducing the impact of possible Heatwave events. Below are the impact maps of the most vulnerable GLOF site after these interventions.

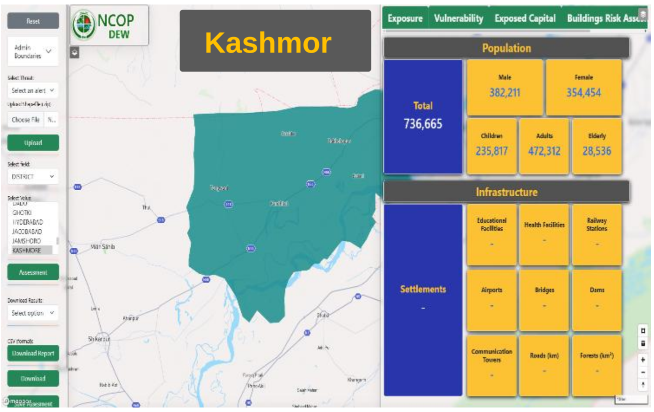
6.1. Post Intervention Impact on Population

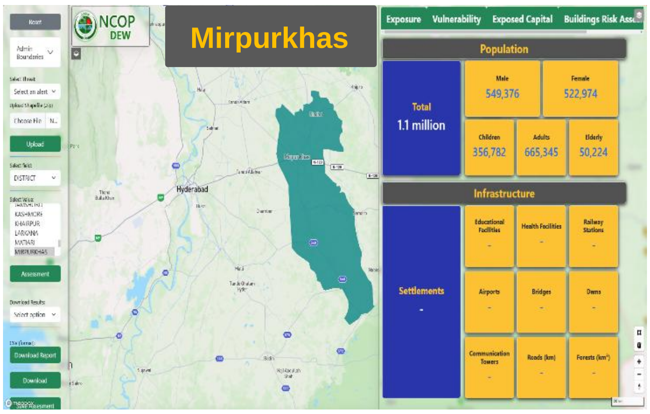


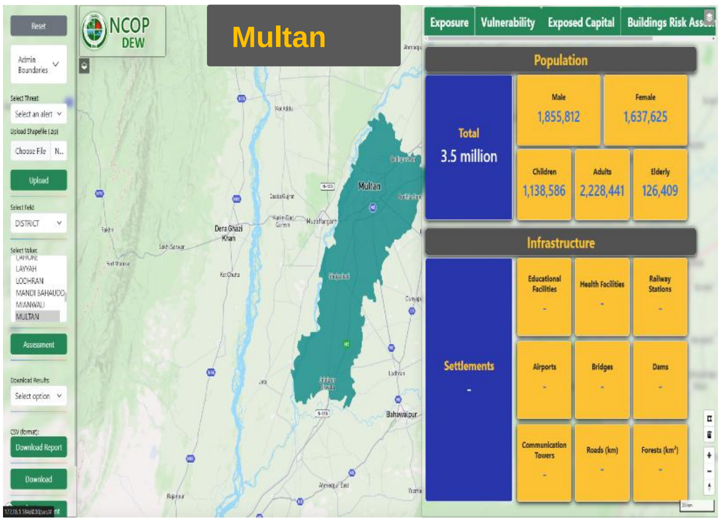








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Adults
2,228,441
Elderly
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Infrastructure
Settlements
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Health Facilities
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Bridges
Dams
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Roads (km)
Forests (km²)
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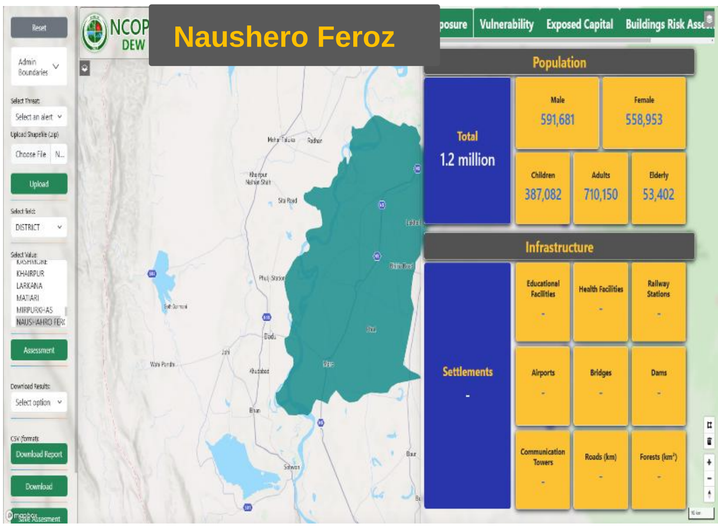
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1.2 million
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591,681
Female
558,953
Children
387,082
Adults
710,150
Elderly
53,402
Infrastructure
Settlements
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Educational Facilities
Health Facilities
Railway Stations
Airports
Bridges
Dams
Communication Towers
Roads (km)
Forests (km²)
Assessment
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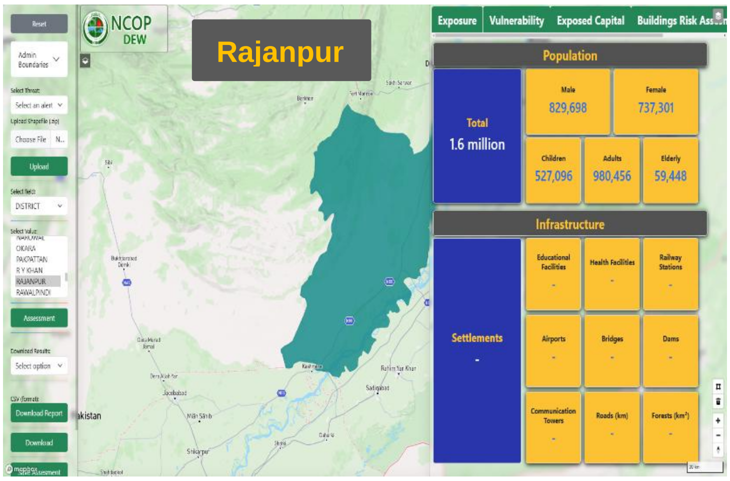
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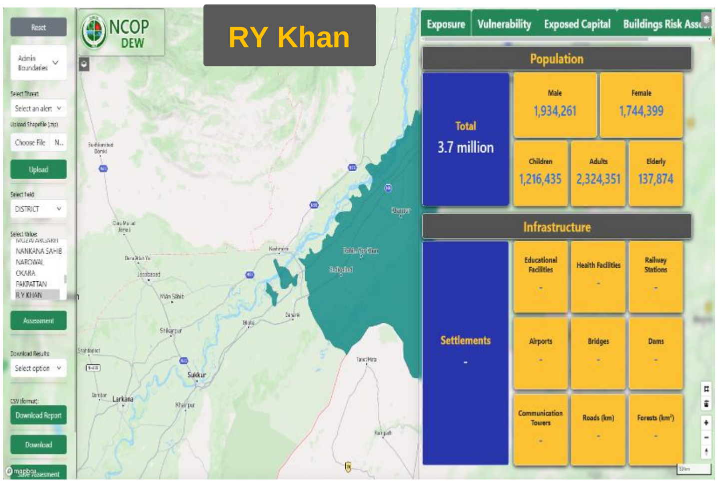
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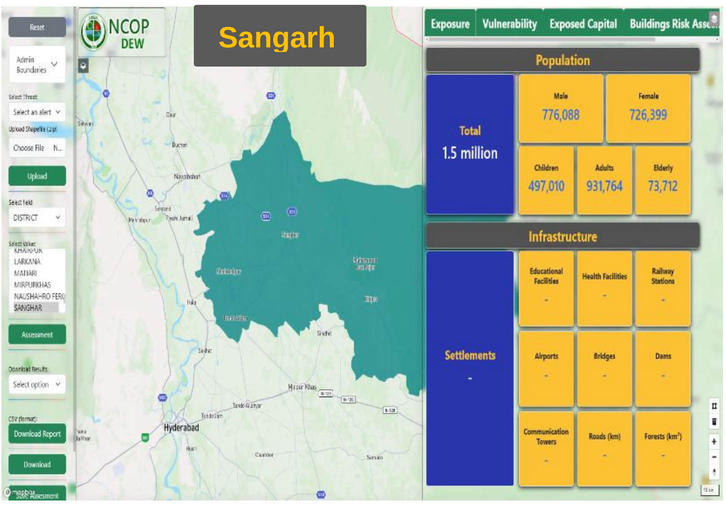
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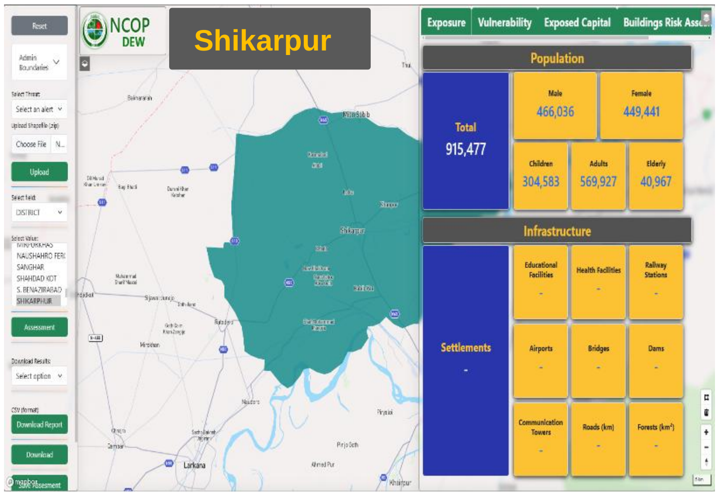
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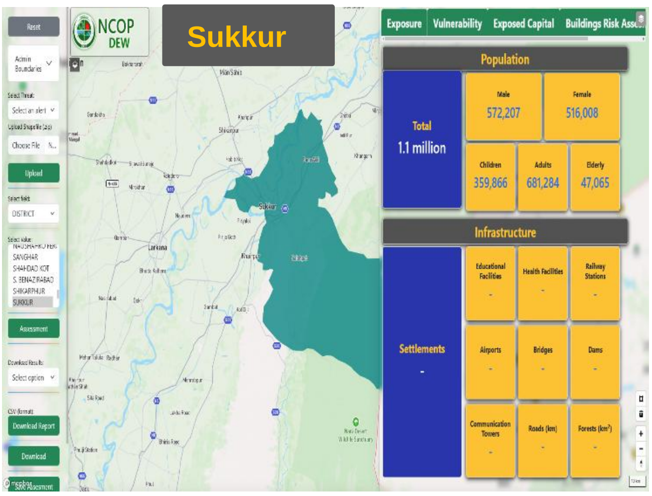
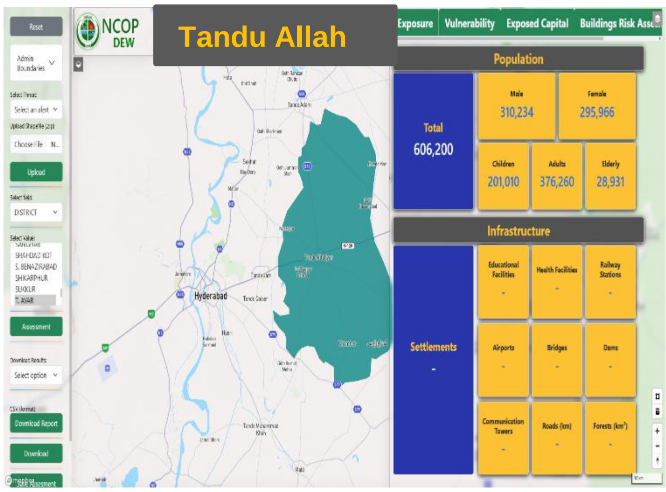
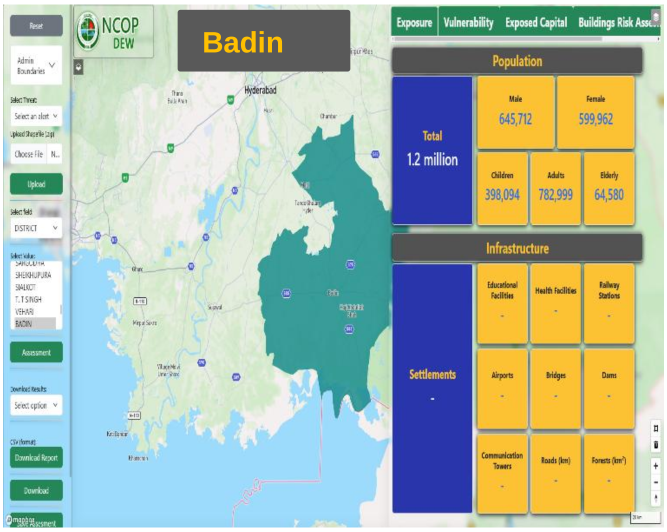
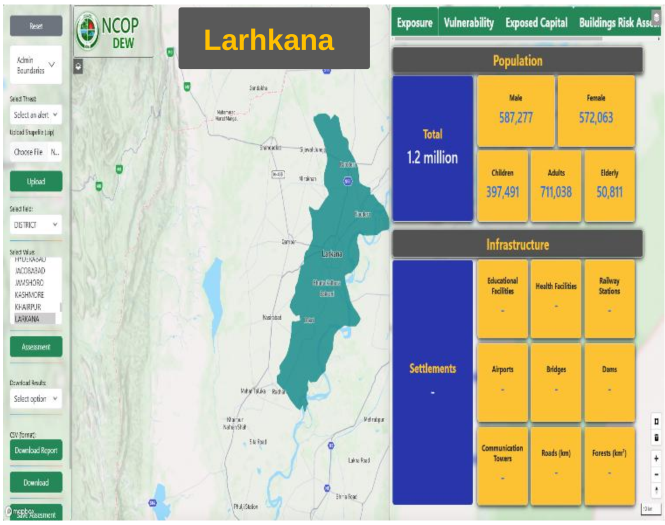
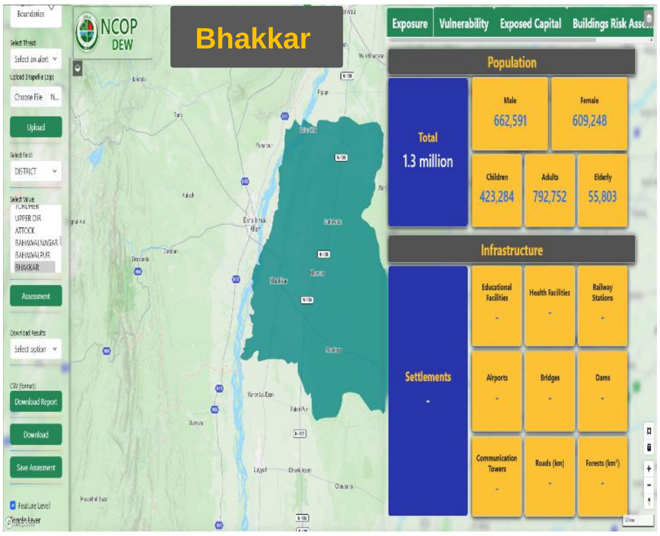
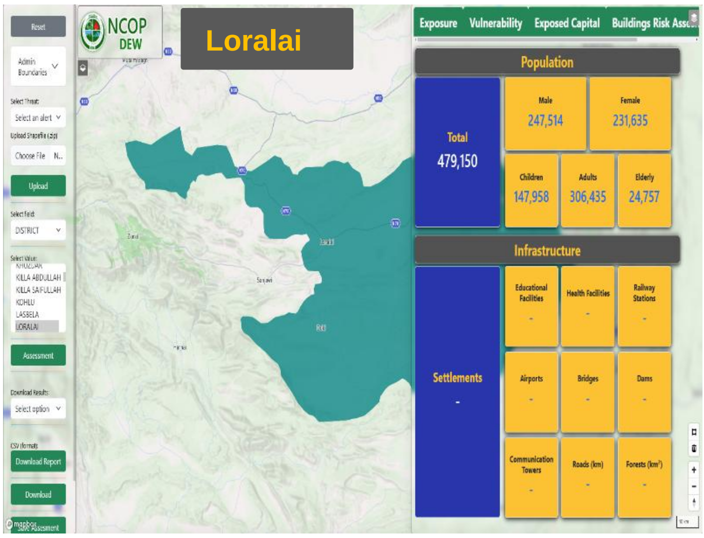

Sukkur
NCOP DEW
Exposure
Vulnerability
Exposed Capital
Buildings Risk Asse
Population
Total 1.1 million
Male 572,207
Female 516,008
Children 359,866
Adults 681,284
Elderly 47,065
Infrastructure
Educational Facilities
Health Facilities
Railway Stations
Settlements
Airports
Bridges
Dams
Communication Towers
Roads (km)
Forests (km²)

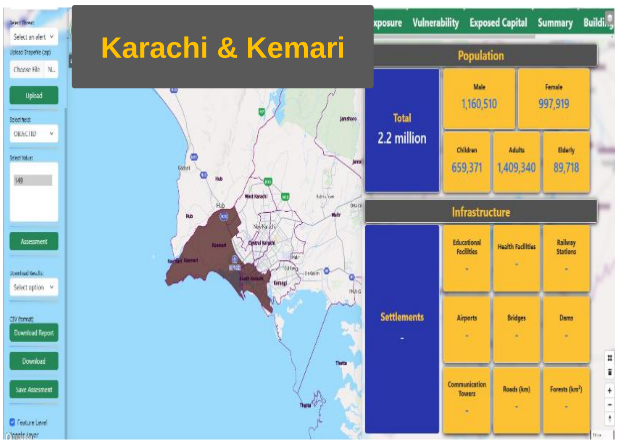

Tandu Allah
NCOP DEW
Exposure
Vulnerability
Exposed Capital
Buildings Risk Asse
Population
Total 606,200
Male 310,234
Female 295,966
Children 201,010
Adults 376,260
Elderly 28,931
Infrastructure
Educational Facilities
Health Facilities
Railway Stations
Settlements
Airports
Bridges
Dams
Communication Towers
Roads (km)
Forests (km²)


Badin
NCOP DEW
Exposure
Vulnerability
Exposed Capital
Buildings Risk Asse
Population
Total 1.2 million
Male 645,712
Female 599,962
Children 398,094
Adults 782,999
Elderly 64,580
Infrastructure
Educational Facilities
Health Facilities
Railway Stations
Settlements
Airports
Bridges
Dams
Communication Towers
Roads (km)
Forests (km²)

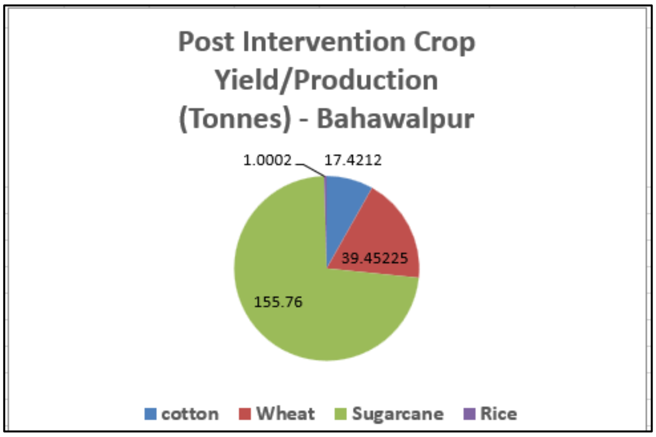

Larhkana
NCOP DEW
Exposure
Vulnerability
Exposed Capital
Buildings Risk Asse
Population
Total 1.2 million
Male 587,277
Female 572,063
Children 397,491
Adults 711,038
Elderly 50,811
Infrastructure
Educational Facilities
Health Facilities
Railway Stations
Settlements
Airports
Bridges
Dams
Communication Towers
Roads (km)
Forests (km²)

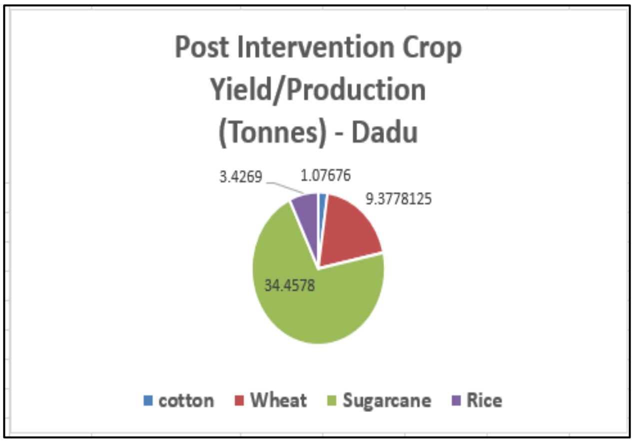

Bhakkar
NCOP DEW
Exposure
Vulnerability
Exposed Capital
Buildings Risk Asse
Population
Total 1.3 million
Male 662,591
Female 609,248
Children 423,284
Adults 792,752
Elderly 55,803
Infrastructure
Educational Facilities
Health Facilities
Railway Stations
Settlements
Airports
Bridges
Dams
Communication Towers
Roads (km)
Forests (km²)

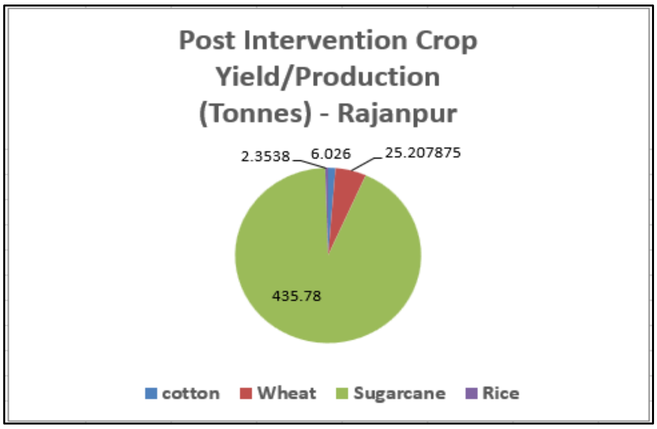

Loralai
NCOP DEW
Exposure
Vulnerability
Exposed Capital
Buildings Risk Asse
Population
Total 479,150
Male 247,514
Female 231,635
Children 147,958
Adults 306,435
Elderly 24,757
Infrastructure
Educational Facilities
Health Facilities
Railway Stations
Settlements
Airports
Bridges
Dams
Communication Towers
Roads (km)
Forests (km²)

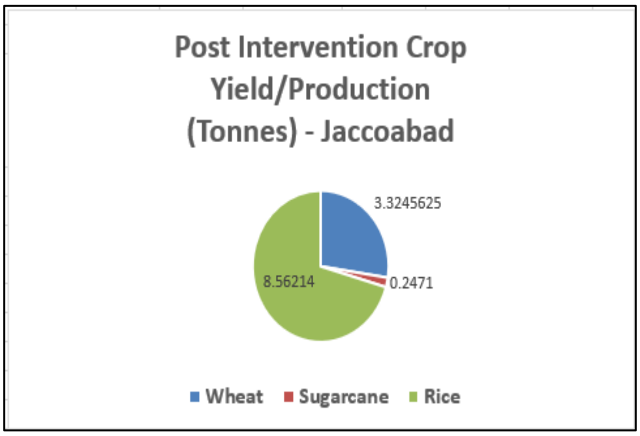

Karachi & Kemari
Exposure
Vulnerability
Exposed Capital
Summary
Population
Total 2.2 million
Male 1,160,510
Female 997,919
Children 659,371
Adults 1,409,340
Elderly 89,718
Infrastructure
Educational Facilities
Health Facilities
Railway Stations
Settlements
Airports
Bridges
Dams
Communication Towers
Roads (km)
Forests (km²)

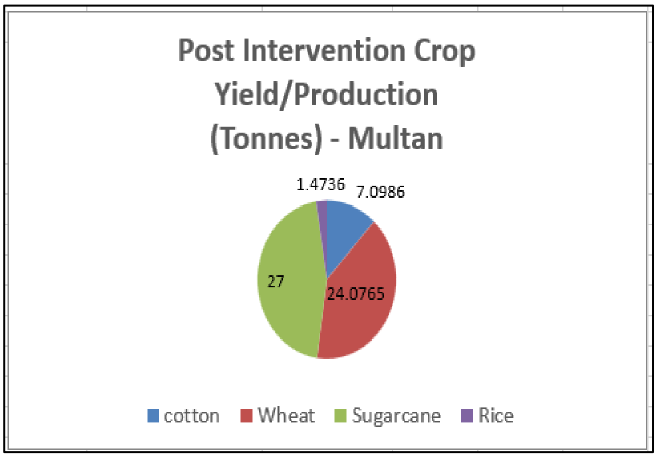
6.2. Post Intervention Impact on Agriculture

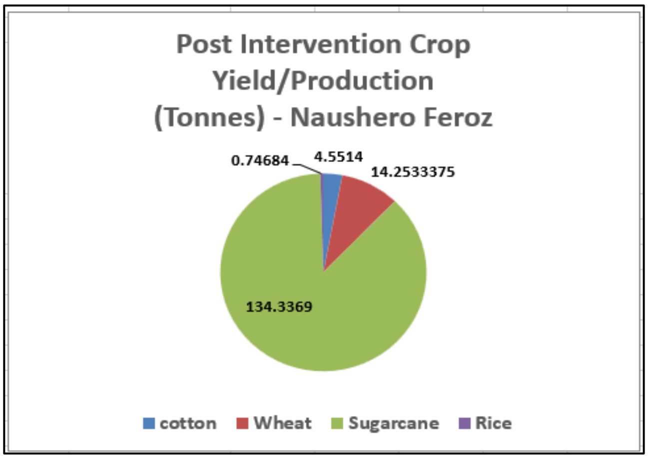


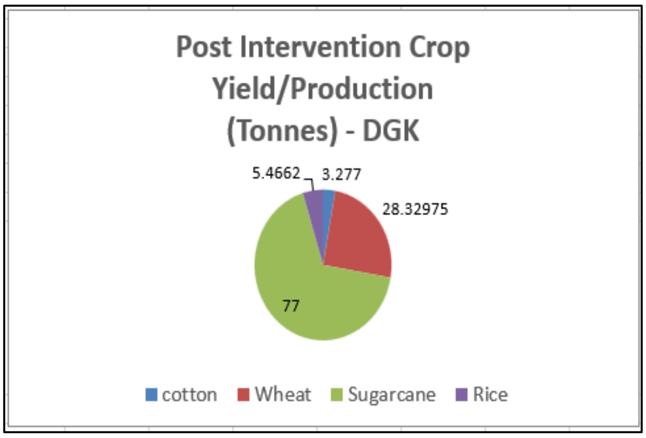




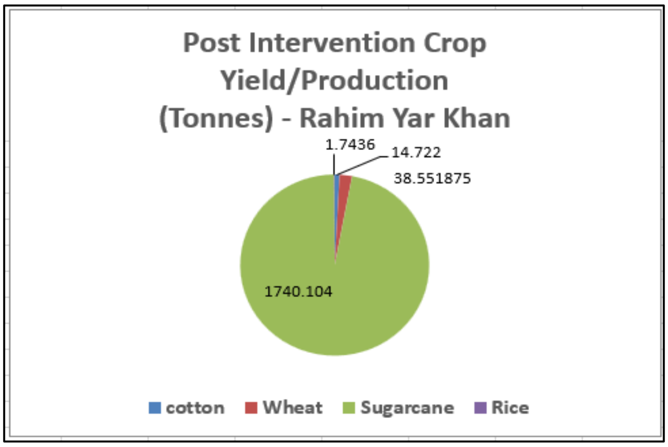




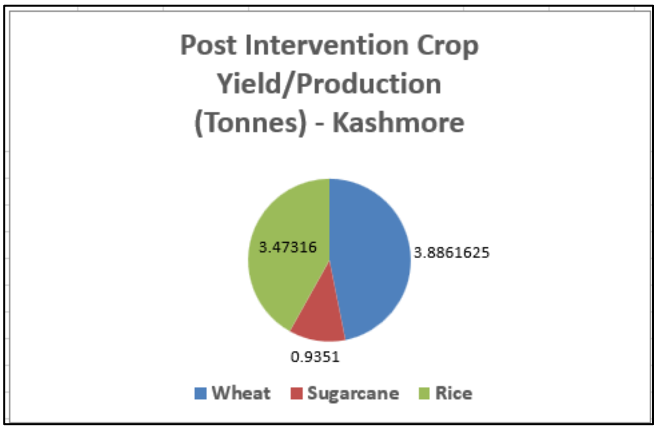




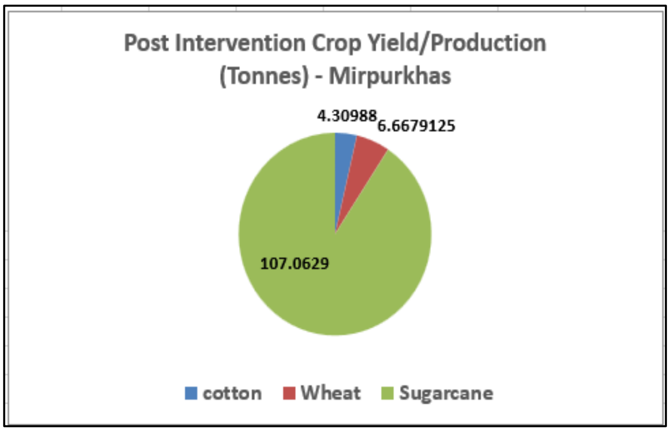
Post Intervention Crop Yield/Production (Tonnes) - DGK
5.4662
3.277
28.32975
77
cotton
Wheat
Sugarcane
Rice



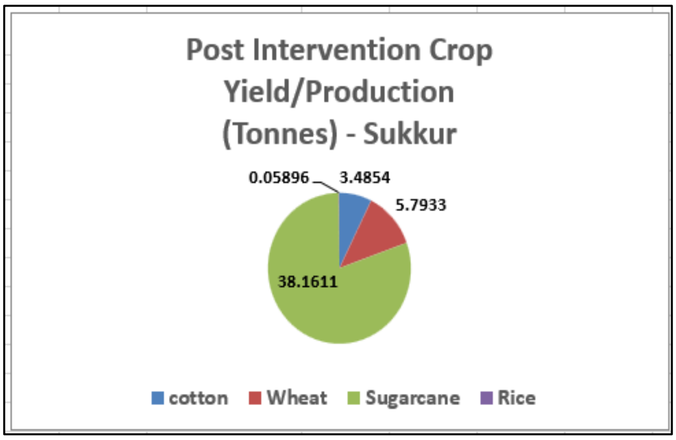
Post Intervention Crop Yield/Production (Tonnes) - Rahim Yar Khan
1.7436
14.722
38.551875
1740.104
cotton
Wheat
Sugarcane
Rice



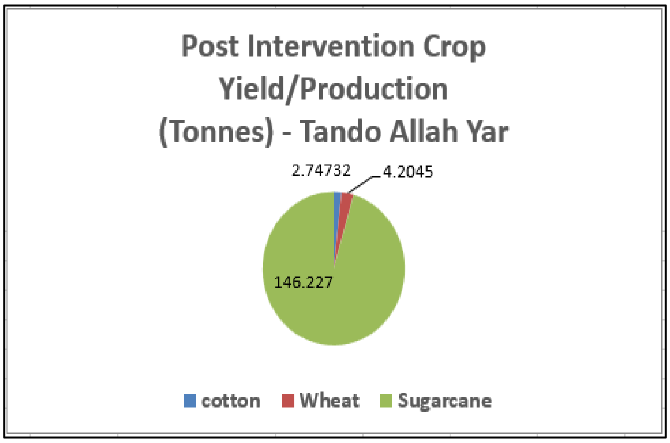
Post Intervention Crop Yield/Production (Tonnes) - Kashmore
3.47316
3.8861625
0.9351
Wheat
Sugarcane
Rice



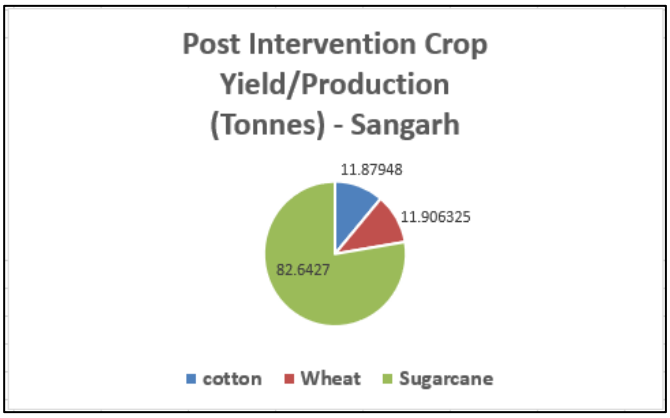
Post Intervention Crop Yield/Production (Tonnes) - Mirpurkhas
4.30988
6.6679125
107.0629
cotton
Wheat
Sugarcane



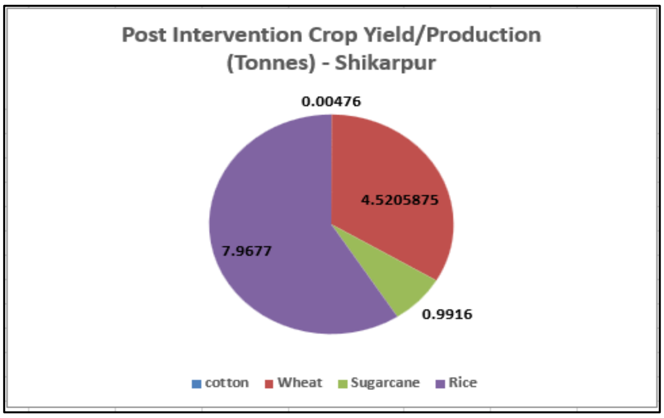
Post Intervention Crop Yield/Production (Tonnes) - Sukkur
0.05896
3.4854
5.7933
38.1611
cotton
Wheat
Sugarcane
Rice



Post Intervention Crop Yield/Production (Tonnes) - Tando Allah Yar
2.74732
4.2045
146.227
cotton
Wheat
Sugarcane



Post Intervention Crop Yield/Production (Tonnes) - Sangarh
11.87948
11.906325
82.6427
cotton
Wheat
Sugarcane



Post Intervention Crop Yield/Production (Tonnes) - Shikarpur
0.00476
4.5205875
7.9677
0.9916
cotton
Wheat
Sugarcane
Rice