SINDH HAZARD AND RISK ATLAS

2022

PROVINCIAL ATLAS

DEVELOPED BY

PDMA SINDH

THROUGH

SUPARCO

WITH THE SUPPORT OF

THE WORLD BANK
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ACKNOWLEDGEMENTS

SUPARCO, the National Space Agency of Pakistan, appreciates the management of PDMA Sindh for envisioning this highly important subject in disaster management and disaster risk reduction. The products of this study are likely to pave the way for disaster risk management in the province on modern lines.

SUPARCO acknowledge and extend special thanks to different departments, which rightly shared the integral data required for this study and made this scientific endeavor possible. In this regard, the efforts of Irrigation Department GoS, Pakistan Bureau of Statistics (PBS), National Disaster Management Authority (NDMA), Board of Revenue GoS, Health Department GoS, Education and Literacy Department GoS and Energy Department GoS are highly valuable.

SUPARCO also extend special thanks to Project Director and Project Coordinator, Sindh Resilience Project (SRP-PDMA) for their valuable inputs and necessary support required during execution of different activities of the project. Moreover the contribution, review and inputs of Dr Sayed Sanaullah Shah (Risk Assessment Expert SRP) are highly significant and commendable.

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- - Disclaimer - -

The Sindh Hazard and Risk Atlas, the product of "Multi-Hazard Vulnerability Risk Assessment (MHVRA) Study" developed for Provincial Disaster Management Authority (PDMA) Sindh under Sindh Resilience Project (PDMA Component) by Pakistan Space and Upper Atmosphere Research Commission (SUPARCO) is based on satellite imagery, data and information obtained from concerned departments and verifiable online sources. Every effort have been made to make this study and database free of errors, however, PDMA Sindh or SUPARCO are not liable for any discrepancy in data obtained from various departments. For hazard and risk assessment, recommended subject specific models have been used and results are based on model outputs. The atlas or any part of it is not to be used for legal or litigation matters and commercial use. However, the information contained in the atlas or any part of the atlas can be used without prior permission of PDMA Sindh with proper citation and acknowledgements.

FOREWORD

Pakistan is ranked among top ten countries which are likely to be affected by climate change (German Watch, 2020). The Sindh province is exposed to a number of adverse natural events and has experienced a wide range of disasters. The indicative natural hazards include floods, cyclones, droughts, earthquakes, heatwaves and tsunami. As the population and asset base of Sindh has increased, so its economic exposure to natural disasters has also increased, therefore damages and losses resulting from natural disasters in Sindh have exceeded multi-million. Different studies suggest that changing climate scenarios are likely to exacerbate existing natural hazards manifesting in raised temperatures, frequent and intensified rains and spells of drought.

The effective management of disaster risks is therefore, increasingly important for development of resilience against natural disasters in the Province. The Government of Sindh is taking timely actions for preparation against disasters to ensure efficient management of risks. The Sindh Resilience Project (SRP) funded by World Bank is an important milestone in disaster management of the Province. SRP aims to strengthen the capacities and resilience of PDMA, DDMAs and communities to proactively manage the disasters. Various vital activities have been initiated by PDMA, Sindh for enhanced coping capacity. The Multi Hazard Vulnerability Risk Assessment (MHVRA) is one of such activities and foundation for disaster risk management and risk reduction. The overall spectrum of disaster management is supposed to be based on results of MHVRA. The results of MHVRA and Informed Disaster Management Plans are planned to be hosted on Disaster Management Information System (DMIS) accessible to planners, decision makers, communities at disaster risk, academia and researchers and general masses at large. The completion of MHVRA and availability of DMIS will embark a new paradigm in disaster management of the Province.

It is pleasure for both PDMA and SUPARCO to publish Sindh Hazard and Risk Atlas for District Badin. The Atlas will be circulated among concerned quarters especially at grass root level, i.e., DDMA. It is anticipated that this Atlas will serve strategic, operational and tactical requirements for disaster management. Both institutions are determined to achieve the desired objectives of this initiative and will continue cooperation and collaboration for research and development in disaster management which will ultimately benefit the province at large.

EXECUTIVE SUMMARY

The disaster resilience is contemporary concept implied and reinforced around the world to mitigate the effects of natural hazards. The disaster is nexus of interaction between natural hazards and human ecosystem. It is believed that natural hazard itself does not cause loss or damage rather it is poor human settings which convert hazards into disasters. The resilience is a modern practice in disaster management which proactively engage all strata of society to consider disaster risk reduction at planning stage of every single human development. In a true sense, to achieve the resilience against natural disasters it is utmost important to know nature and intensity of natural hazards in conjunction with human population and ecosystem. The hazard and risk information base are fundamental for disaster risk reduction in particular and disaster management in general.

PDMA, Sindh with the technical assistance of SUPARCO has developed Multi Hazard Vulnerability and Risk Assessment (MHVRA), Disaster Management Information System (DMIS) and MHVRA Informed Disaster Management Plans to feed wide range of disaster management activities in the province.

The approach implements a general methodology developed to analyze risk for multiple hazards involving; the quantification of the frequency and intensity of possible hazard(s), assessment of the elements that can be destroyed from onset disasters (exposure), degree of the damage each element can sustain when affected by certain disasters of various intensities (vulnerability). Assessment of hazards, exposure, vulnerability and capacity / resilience leads to the risk assessment indicating anticipated damage in case of the future disaster. The information obtained through this study would also provide baseline for Informed Disaster Management Plan enhancing coping capacities of communities as well as cost benefit analysis of provincial disaster management authorities.

Though, the outcomes of MHVRA are planned to be hosted on DMIS which will be publicly available on web, however, in order to facilitate District Disaster Management Authorities (DDMAs) the key findings of MHVRA at Union Council (UC) and subsequently at District and Provincial level have been prepared in an Atlas format for achieving operational requirements. These district atlases for entire province are planned to be prepared and produced for subsequent distribution among the concerned quarters.

The development of MHVRA and atlases is based on diversified information sources including Satellite Remote Sensing (SRS), Digital Elevation Model (DEM) and pertinent information collected from concerned departments. The Atlas depicts landuse / landcover, critical infrastructure and facilities, hazard, exposure, vulnerability and risk maps of cyclone and storm surge, drought, earthquake, flood, heatwave and tsunami along with Disaster Management Plans at UC level.

It is anticipated that, in future all strategic, operational and tactical planning concerning to district level disaster management shall be based on these atlases. The DDMAs are encouraged to align disaster management and disaster risk reduction interventions and initiatives referring to risk profiles of UCs / Districts.

TABLE OF CONTENTS

SINDH PROVINCE
AT A GLANCE

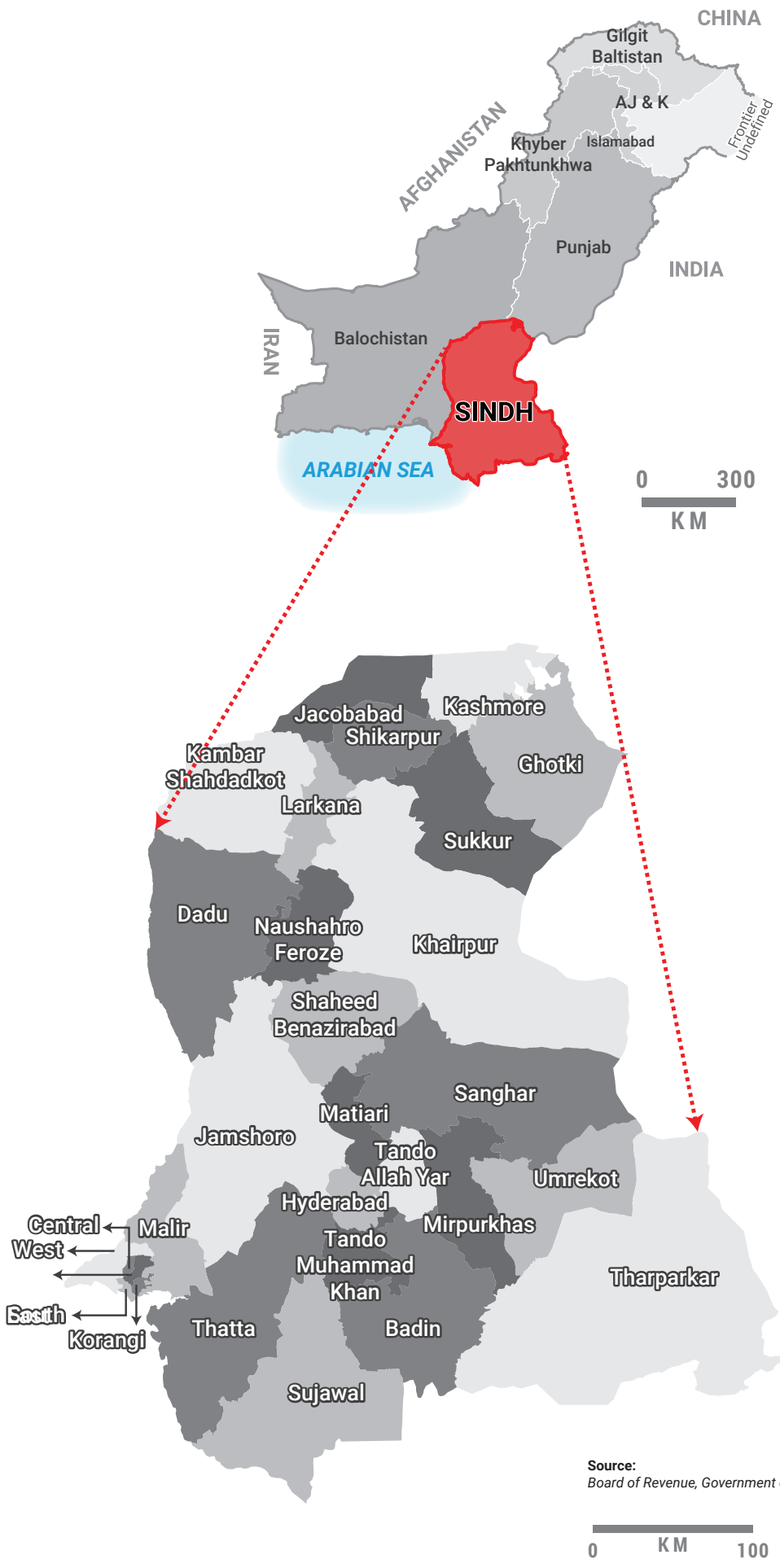
PROFILE

Sindh covers a total land area of 140,914 Sq Km with coordinates extending from 23°36’10” to 28°30’02” North and 66°38’54” to 71°05’30 East. It shares borders with provinces of Balochistan in West and Punjab in North, India in East and Arabian Sea in South. Sindh's landscape consists mostly of alluvial plains flanking the Indus River, the Thar Desert in the eastern portion of the province, Indus delta in the South, Manchar lake in west and the Kirthar Mountains in the western portion of the province.

The climate of Sindh is hot and arid, with varied seasonal temperatures (max mean) of 27.08 °C in winter to 43.32 °C in dry summer and average annual rainfall of 128.80 mm/yr. The population of Sindh province has risen from 30,439,893 in 1998 to 47,854,510 as per 2017 census, showing an average annual growth rate of 2.41%. In keeping with the national demographic profiling, a population of 14,839,448 resides in urban areas and 15,600,445 resides in rural areas as per 1998 census and a population of 24,832,634 resides in urban areas while 23,021,876 resides in rural areas as per 2017 census. The number of households in 2017 are 8,478,047 and ratio of 109 males per 100 females.

Sindh’s economy is much diversified with Sindh being a centre of heavy industry. Major sources of employment are construction, hospitality, commerce and finance. Predominant sectors comprising manufacturing, daily wage labour and mining, with abundance of oil, petrol, coal and natural gas in the region. Agriculture is a significant sector in Sindh and Irrigated agriculture is present along the Indus River. The main produce grown is cotton, rice, wheat, sugarcane, bananas and mangoes.

LOCATION OF
SINDH PROVINCE

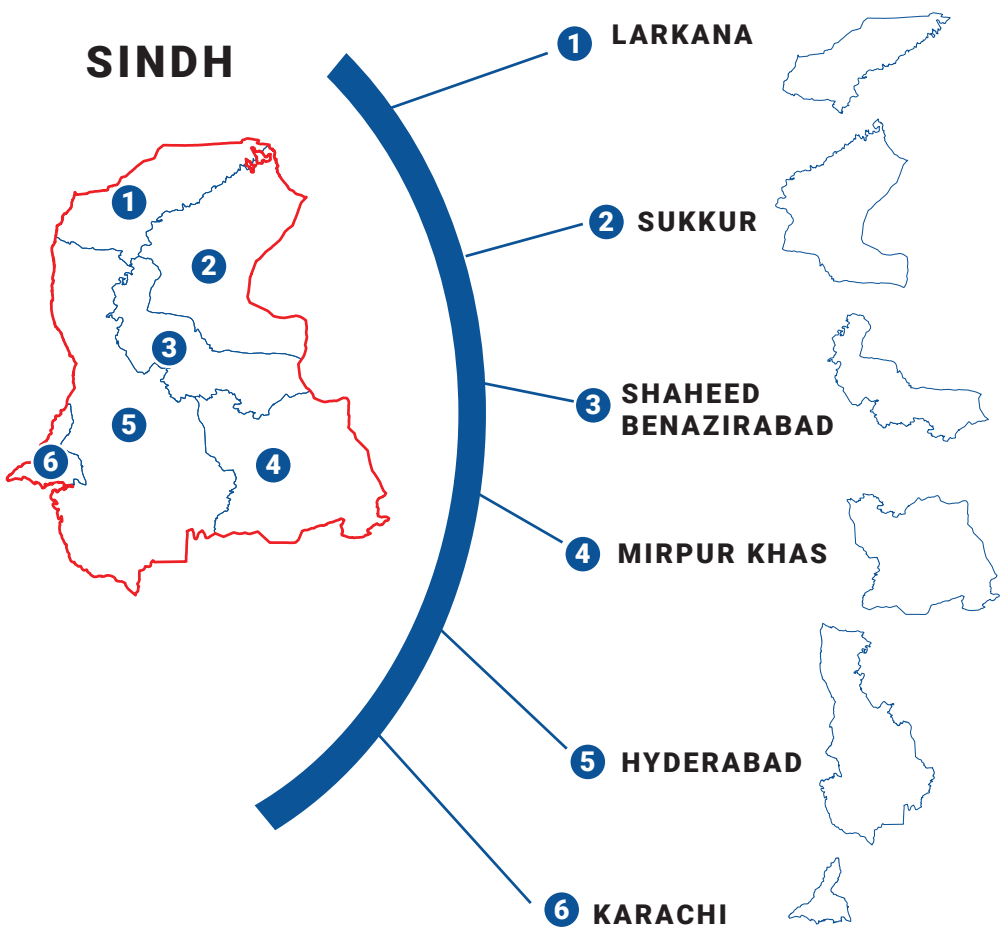


Source:
Board of Revenue, Government of Sindh

ADMINISTRATIVE SYSTEM

PROVINCE

DIVISIONS



DISTRICTS

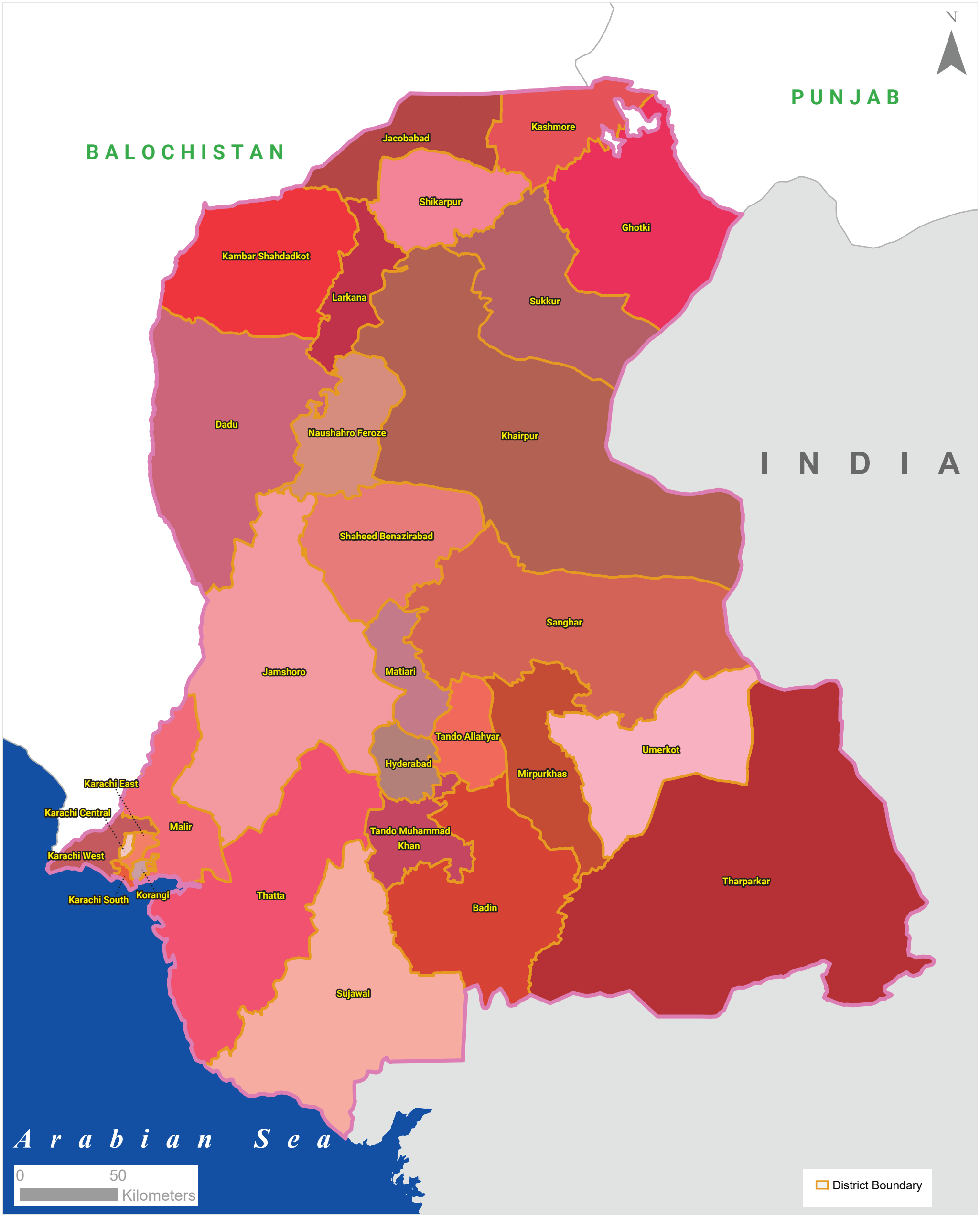
1. Badin
2. Central
3. Dadu
4. East
5. Ghotki
6. Hyderabad
7. Jacobabad
8. Jamshoro
9. Kambar Shahdadkot
10. Kashmore
11. Khairpur
12. Korangi
13. Larkana
14. Malir
15. Matiari
16. Mirpurkhas
17. Naushahro Feroze
18. Sanghar
19. Shaheed Benazirabad
20. Shikarpur
21. South
22. Sujawal
23. Sukkur
24. Tando Allahyar
25. Tando Muhammad Khan
26. Tharparkar
27. Thatta
28. Umerkot
29. West
30. Keamari

DISASTER PROFILE[1]

District	Hazard	Frequency	Severity	Years
Karachi Central	Urban Floods	Monsoon	Medium	1966, 1977
	Heat Wave	Frequently	High	Almost Every Year
	Earthquake	Rare	Low	2013
Karachi East	Floods	Monsoon	Medium	2017
	Heat Wave	Frequently	High	Almost Every Year
	Earthquake	Rare	Low	2013
Karachi South	Urban Floods	Monsoon	Medium	1966, 1977, 2017
	Heat Wave	Frequently	High	2015
	Earthquake	Rare	Low	2013
Karachi West	Urban Floods	Monsoon	Medium	1966, 1977
	Heat Wave		High	Almost Every Year
	Earthquake	Rare	Low	2013
Korangi	Urban Floods	Monsoon	Medium	1966, 1977, 2017
	Heat Wave	Frequently	High	2015 - 2017
	Earthquake	Rare	Low	2013
Malir	Floods	Monsoon	Medium	2013, 2014
	Heat Wave	Frequently	High	Almost Every Year
	Earthquake	Rare	Low	2013
Hyderabad	Floods /Rain	Monsoon	Medium	2010,2011, 2012,2014
	Droughts	Rare	Medium	1998-2012
	Earthquake	Rare	Low	2011, 2013
	Heatwave	Rare	High	2015
Badin	Floods /Rain	Monsoon	High	1970,1975, 1979,1994, 2003,2006, 2011,2012
	Droughts	Rare	Medium	1998 to 2012, 2014-15, 2018-19
	Earthquake	Rare	Low	20112013
	Cyclone	Rare	High	1964, 1999, 2007
Dadu	Floods /Rain	Monsoon	High	2010
	Flood /Rain	Monsoon	High	2011, 2012, 2019
	Droughts	Rare	Low	1997-2002, 2018-19
Jamshoro	Riverine Floods	Monsoon	High	2010, 2011, 2019
	Heavy Rainfall	Monsoon	Low	Heavy Rainfall Monsoon Low 2011, 2012, 2013, 2014
	Droughts	Rare	High	1999-2002, 2018
	Earthquake	Rare	Low	2013
Matiari	Riverine Floods	Monsoon	Medium	2010, 2011
	Heavy Rains	Monsoon	High	2011, 2012
	Earthquake	Rare	Low	2013
Sujawal	Floods/Rain	Monsoon	Medium	2012
	Droughts	Rare	Medium	1998 to 2012
	Earthquake	Rare	Low	20112013
Tando Allahyar	Flood	Monsoon	Medium	2010, 2011, 2012
	Earthquake	Rare	Low	2013
	Heavy Rains	Monsoon	Medium	2010, 2011, 2012
Tando Muhammad Khan	Flood	Monsoon	High	2010
	Rain/Flood	Monsoon	Medium	2011
Thatta	Flood	Monsoon	High	1840,1856, 1874,1942,1946,1948, 1956,1973, 1974, 1976, 1978, 1978, 1988, 1989, 1992, 1994, 1995,1996, 1999, 2003, 2006, 2007, 2010, and 2011
	Cyclones	Seasonal	High	1964,1993, 1999,2003, 2021
	Monsoon rains	Seasonal	Medium	Every year
	Tsunami	Rare	High	1945, 2005
	Earthquake	Rare	Low	2001, 2013
Mirpur Khas	Rain/ Flood	Monsoon	Medium	2006-2012
	Earthquake	Rare	Low	2013
Larkana	Riverine Floods	Monsoon	Medium	2010, 2011, 2012
	Flash Floods	Seasonal	Low	
	Earthquake	Rare	Low	1997
Jacobabad	Floods	Monsoon	Medium	1942, 2010
	Drought	Rare	Low	1999
	Earthquake	Rare	Low	1997
Kambar Shahdad Kot	Flash Flood	Monsoon	Medium	2007, 2010, 2011
	Drought	Infrequent	Low	1999-2002, 2018
	Earthquake	Infrequent	Low	1935, 1997
Kashmore	Floods	Monsoon	High	2003, 2005, 2010
	Drought	Rare	Low	2002
	Earthquake	Rare	Low	2001, 2013
Shikarpur	Floods	Monsoon	High	2003,2005, 2010-2012
	Earthquake		Low	2001
Shaheed Benazirabad	Riverine Flood	Monsoon	Medium	1973,1976, 1992,2010
	Drought	Frequent	High	1999 - 2002
	Earthquake	Rare	Very Low	2013
Naushahro Feroze	Riverine Flood	Monsoon	High	1973
	Earthquake	Rare	Low	
Sanghar	Riverine Flood	Monsoon	High	2006,2007, 2011,2012
	Drought	Common	Low	1997-2000, 2013-2014, 2018
	Earthquake	Rare	Low	2013
Sukkur	Riverine Flood	Monsoon	High	1973,1976, 2010, 2010
	Drought	Rare	Low	1999, 2002
	Earthquake	Rare	Low	1997
Ghotki	Riverine Flood	Monsoon	High	2010,2011, 2012
	Drought	Rare	Low	2002
	Earthquake	Rare	Low	1997
Khairpur	Riverine Flood	Monsoon	High	2010,2011, 2012, 2014
	Drought	Infrequent	Low	1999-2002, 2013-14
	Earthquake	Infrequent	Low	
Tharparkar	Drought	Frequently	High	1987-88, 1991-92, 1999,2000,2002-03,2005, 2013-2015, 2018
	Earthquake	Rare	Low	1982,2001, 2005,2009
Umerkot	Floods	Monsoon	low	2011, 2012
	Drought	Rare	Low	1999- 2002, 2013-2015, 2018

[1] *Source: Organizational Capacity Assesment and Development of Capacity Enhancement Plan, 2017-18*

ADMINISTRATIVE SETUP

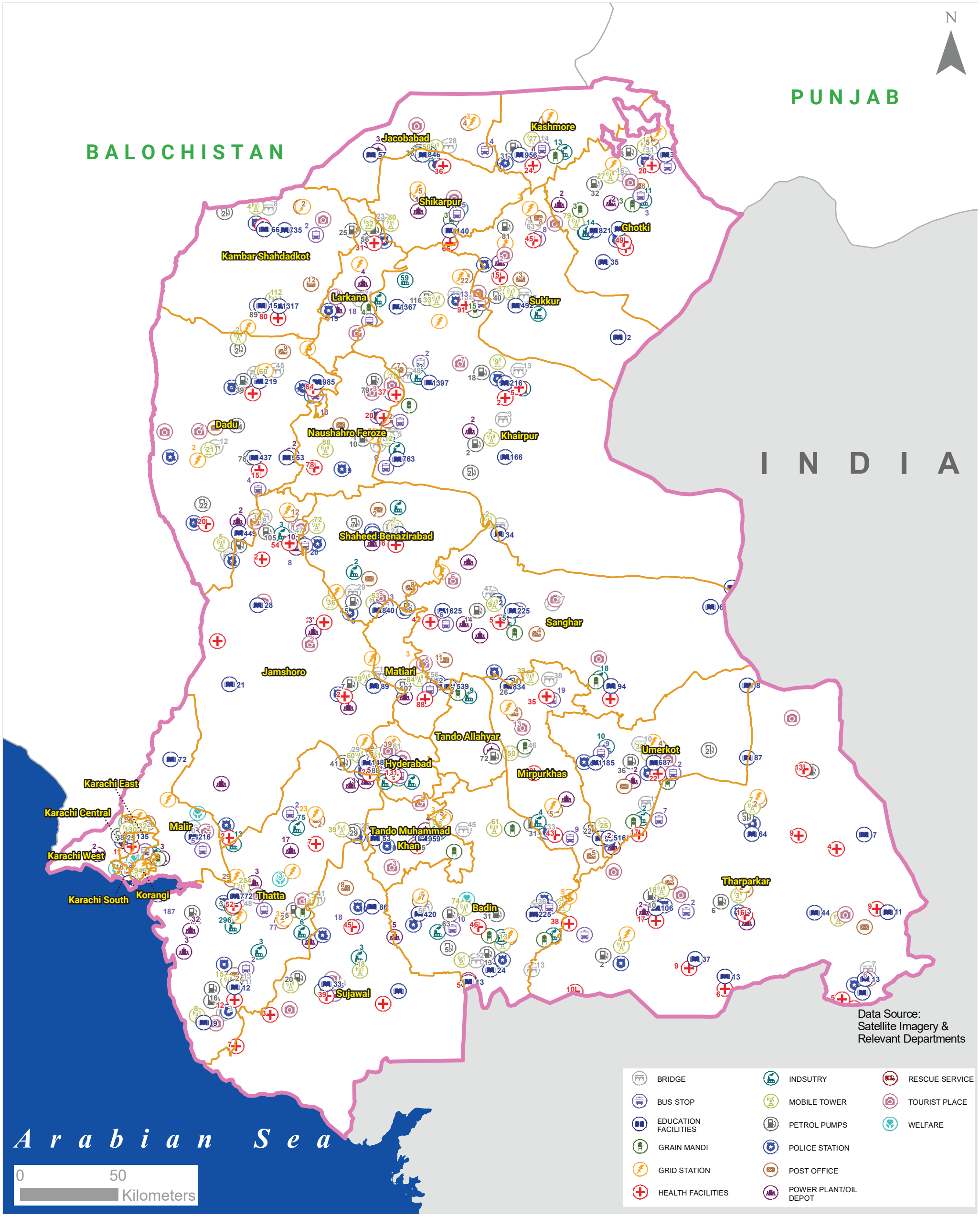


SATELLITE IMAGERY

DIGITAL ELEVATION MODEL

LAND USE / LAND COVER

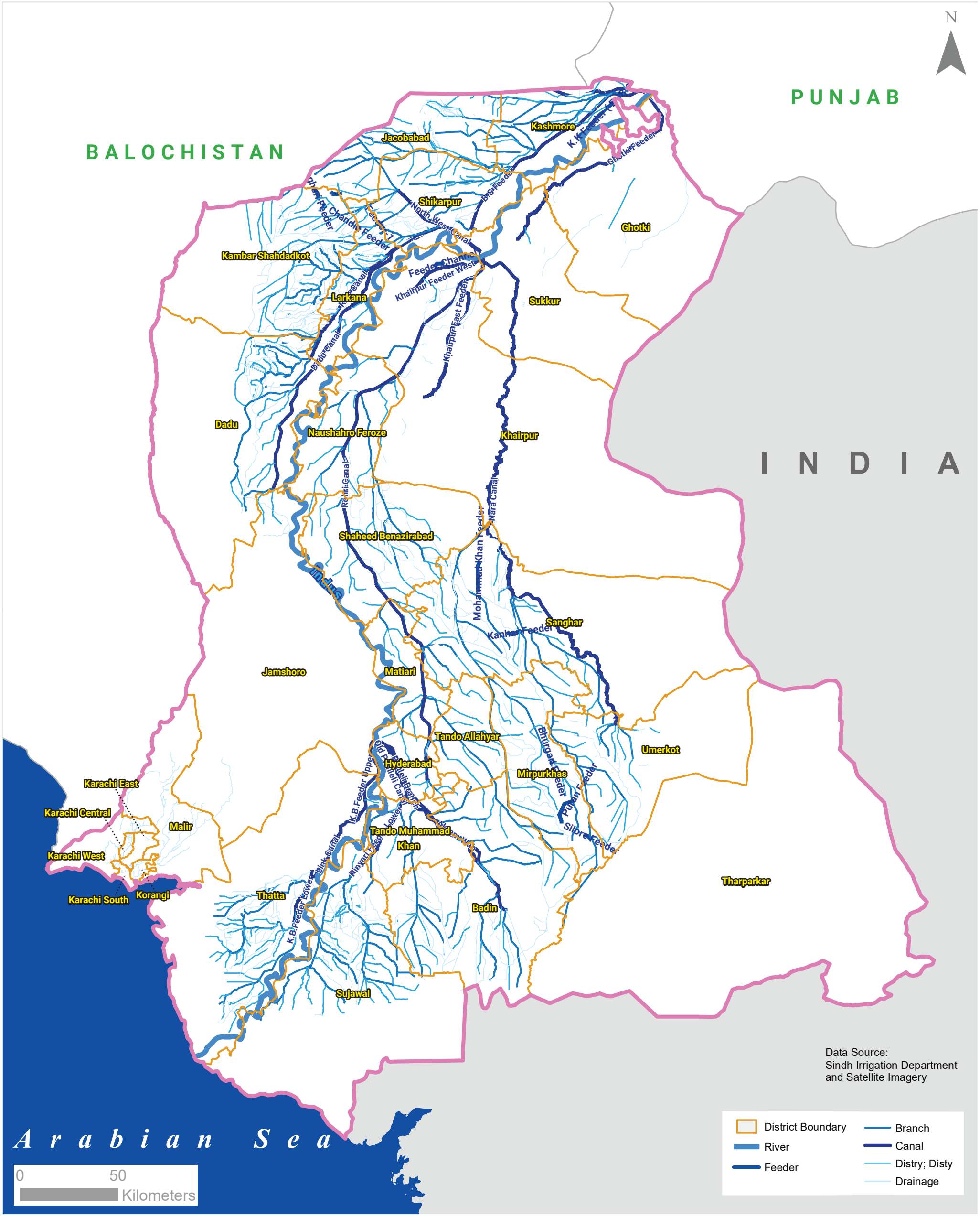
CRITICAL INFRASTRUCTURE



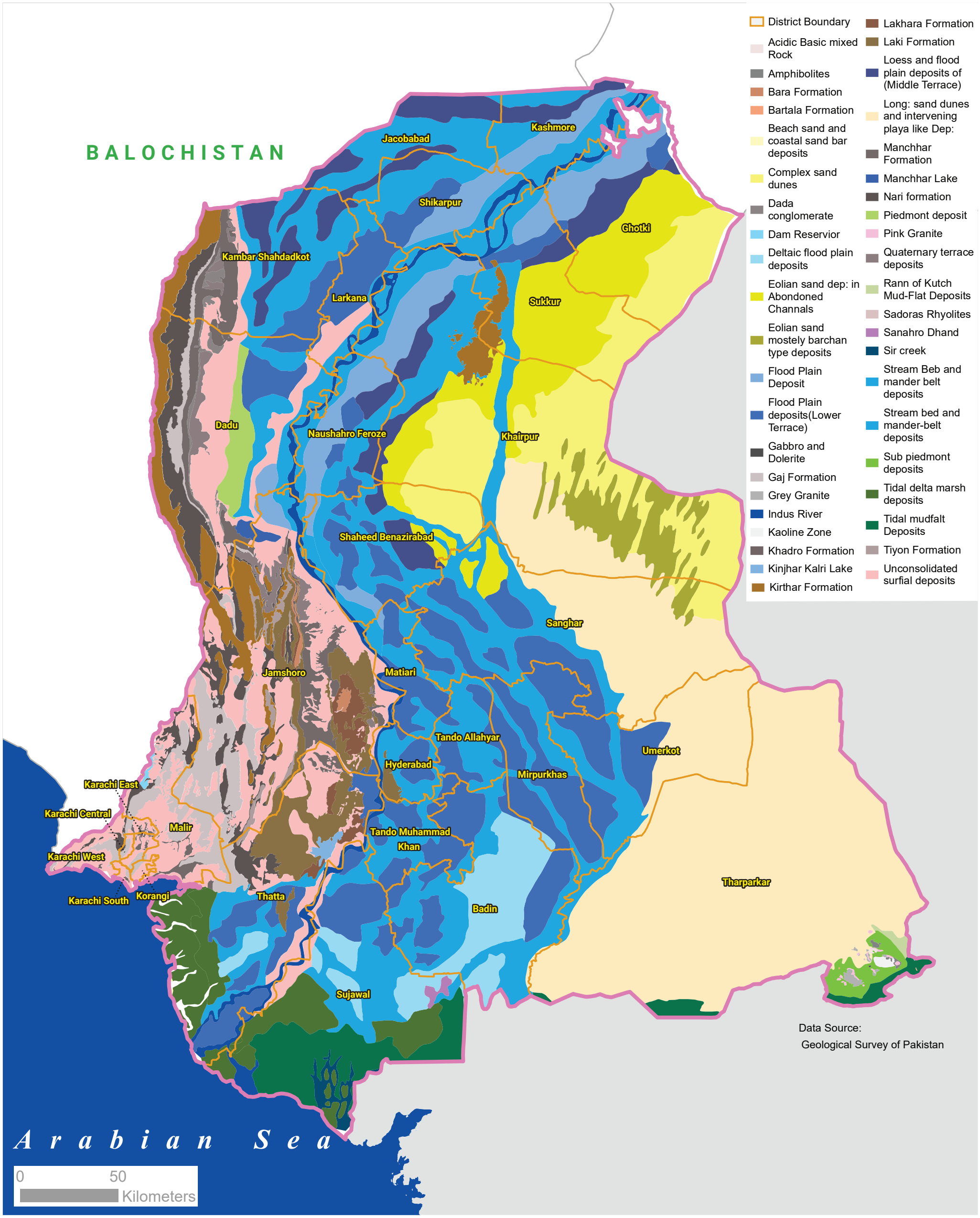
Note: No. of features in cluster is shown beside icon

TRANSPORTATION NETWORK

IRRIGATION AND DRAINAGE

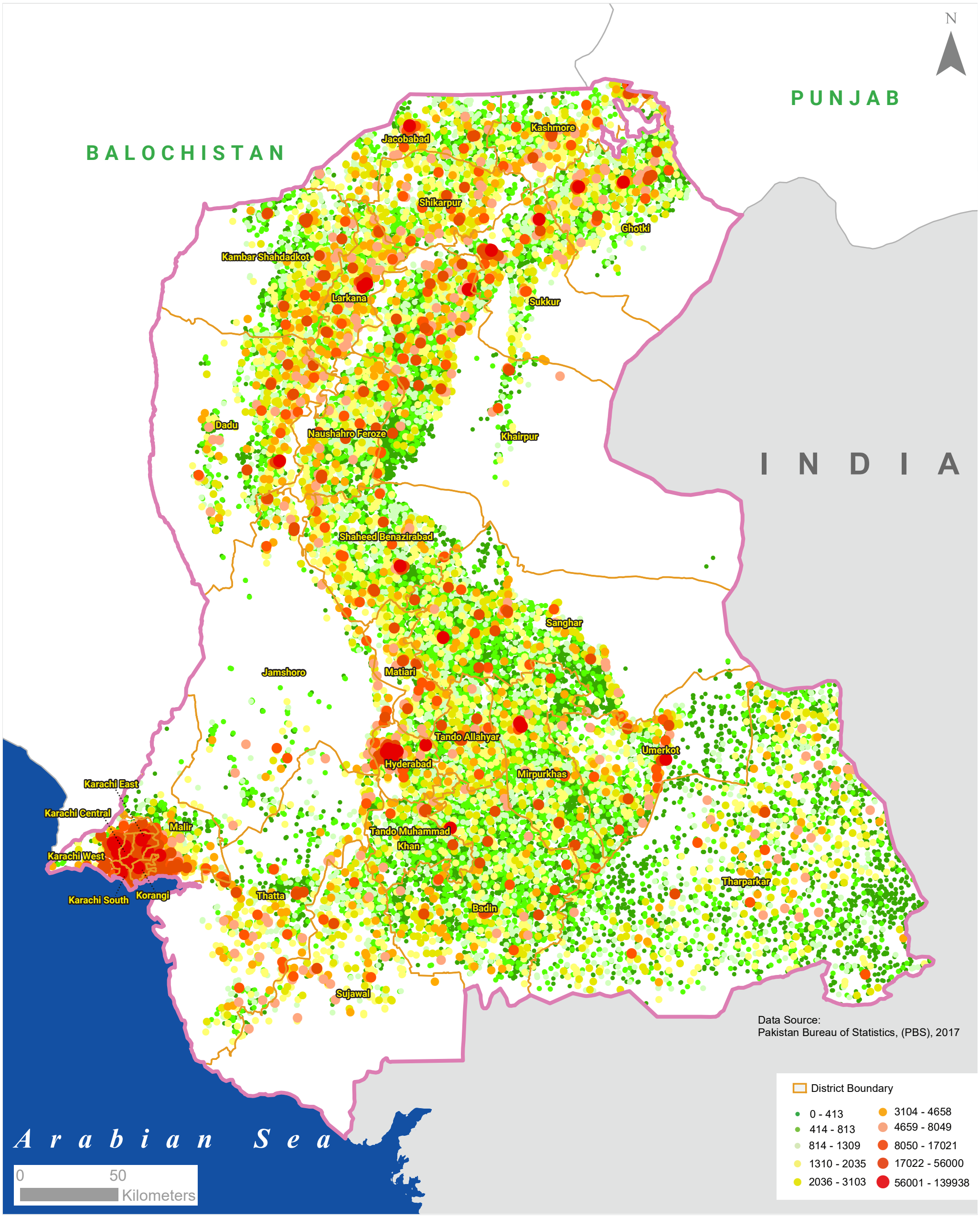


GEOLOGICAL MAP

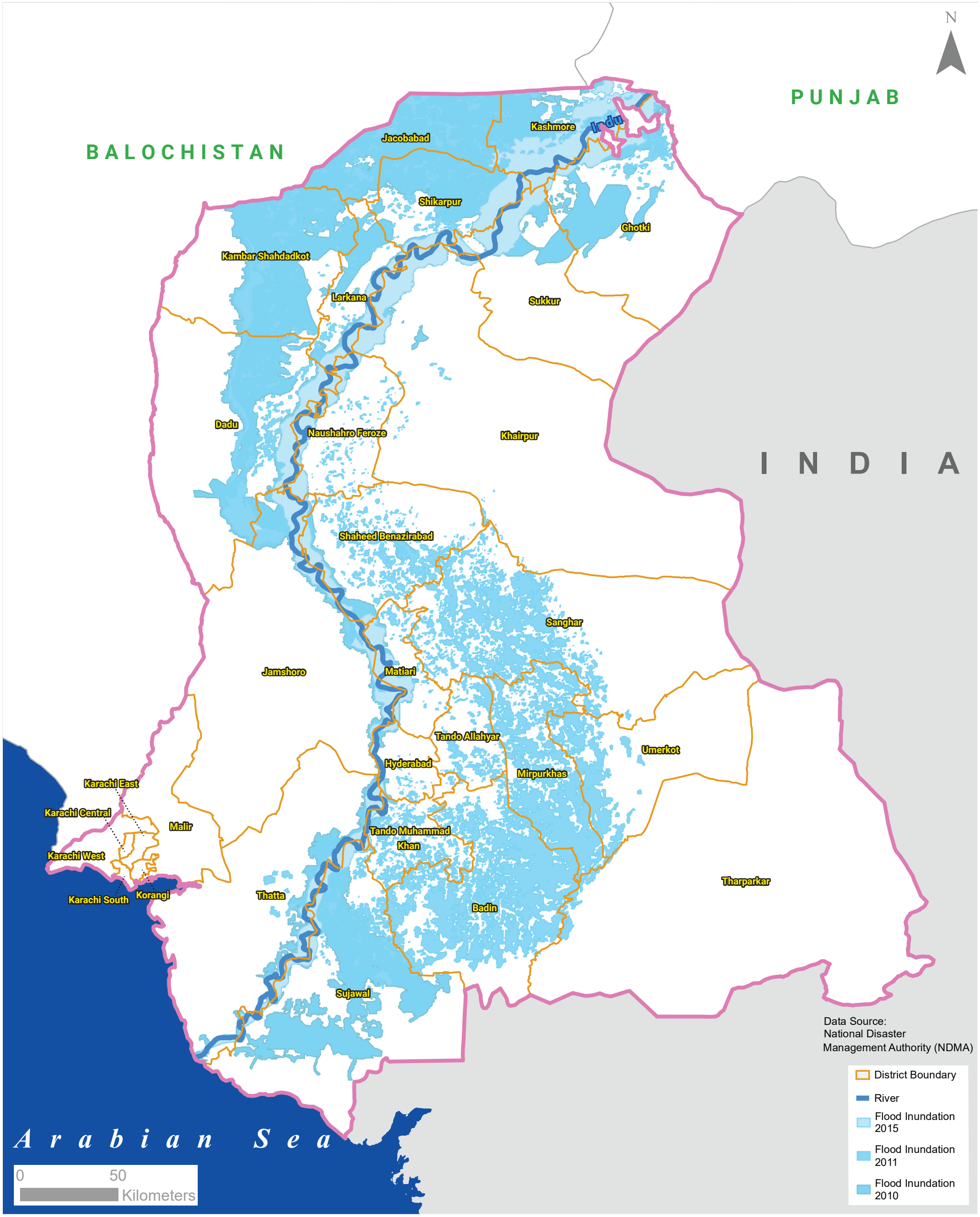


Data Source:
Geological Survey of Pakistan

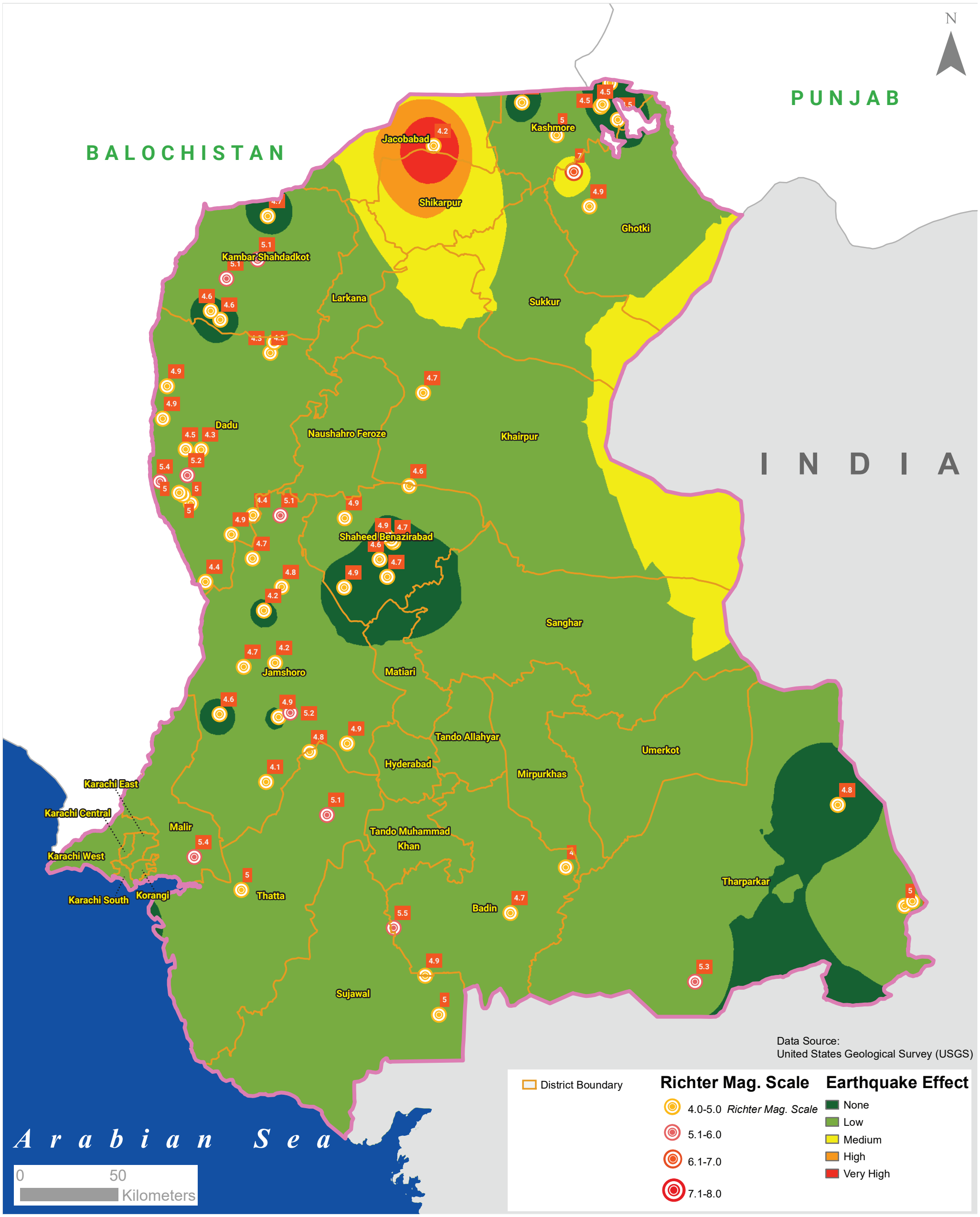
POPULATION DENSITY



PAST FLOOD EXTENTS



PAST EARTHQUAKE EVENTS



PAST CYCLONE TRACKS

HAZARD AND RISK ASSESSMENT

FLOOD

HAZARD 05 YEARS

HAZARD

Low | Medium | High | Very High

FLOOD

HAZARD 25 YEARS

HAZARD

Low | Medium | High | Very High

FLOOD

HAZARD 50 YEARS

HAZARD

Low Medium High Very High

FLOOD

HAZARD 100 YEARS

HAZARD

Low | Medium | High | Very High

FLOOD

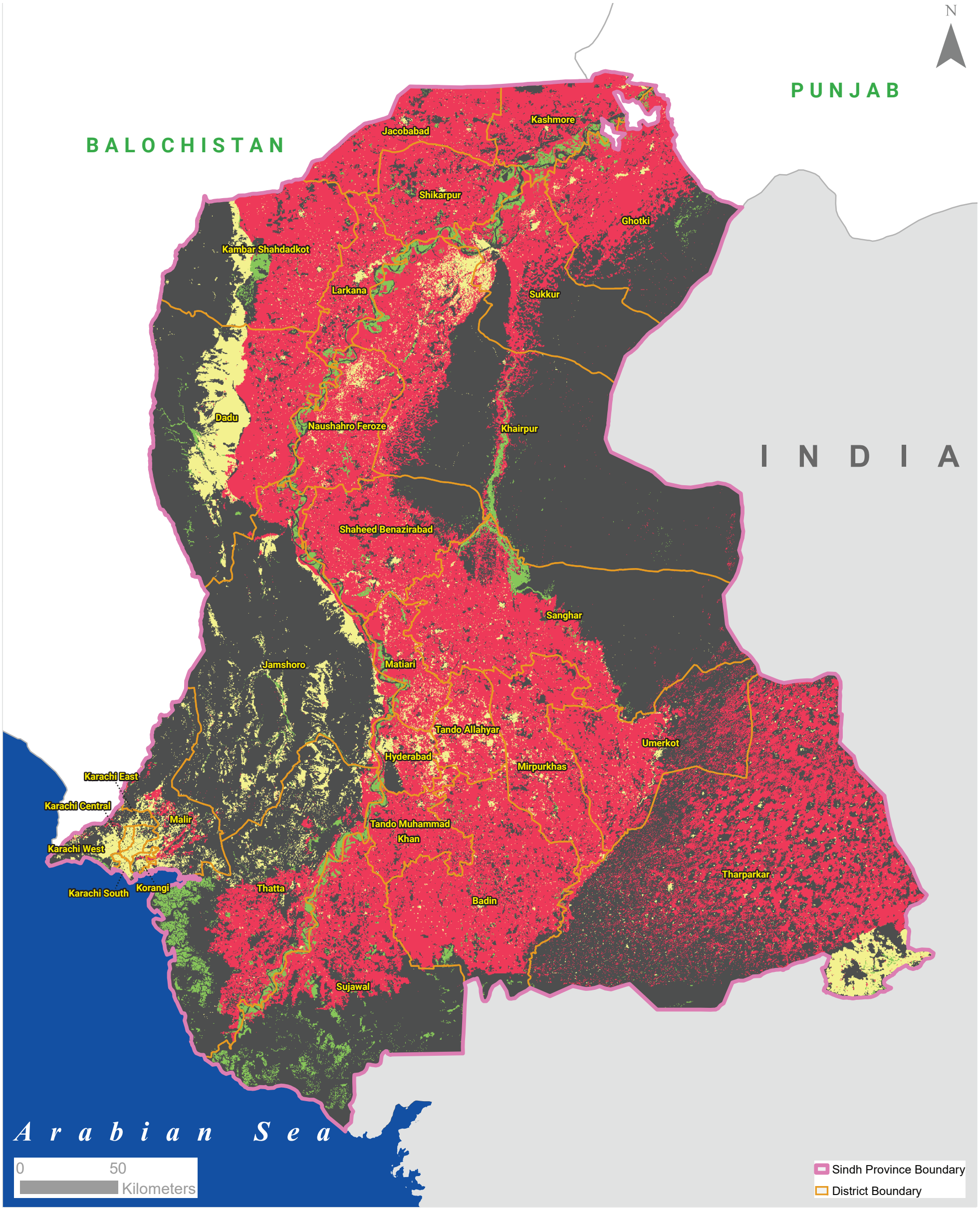
HAZARD 250 YEARS

HAZARD

Low | Medium | High | Very High

FLOOD

VULNERABILITY



VULNERABILITY

None	Low	Medium	High
0 - 25	*26 - 50*	*51 - 75*	*76 - 100*

FLOOD

RISK 05 YEARS

RISK

Very Low	Low	Medium	High	Extreme
0 - 49	*50 - 99*	*100 - 199*	*200 - 249*	*250 - 300*

FLOOD

RISK 25 YEARS

RISK

Very Low	Low	Medium	High	Extreme
0 - 49	*50 - 99*	*100 - 199*	*200 - 249*	*250 - 300*

FLOOD

RISK 50 YEARS

RISK

Very Low	Low	Medium	High	Extreme
0 - 49	*50 - 99*	*100 - 199*	*200 - 249*	*250 - 300*

FLOOD

RISK 100 YEARS

RISK

Very Low	Low	Medium	High	Extreme
0 - 49	*50 - 99*	*100 - 199*	*200 - 249*	*250 - 300*

FLOOD

RISK 250 YEARS

RISK

Very Low	Low	Medium	High	Extreme
0 - 49	*50 - 99*	*100 - 199*	*200 - 249*	*250 - 300*

METEOROLOGICAL DROUGHT

HAZARD 05 YEARS

HAZARD

No Hazard | Mild | Moderate | Severe | Extreme

METEOROLOGICAL DROUGHT

HAZARD 10 YEARS

HAZARD

No Hazard | Mild | Moderate
Severe | Extreme

METEOROLOGICAL DROUGHT

HAZARD 25 YEARS

HAZARD

No Hazard | Mild | Moderate

Severe | Extreme

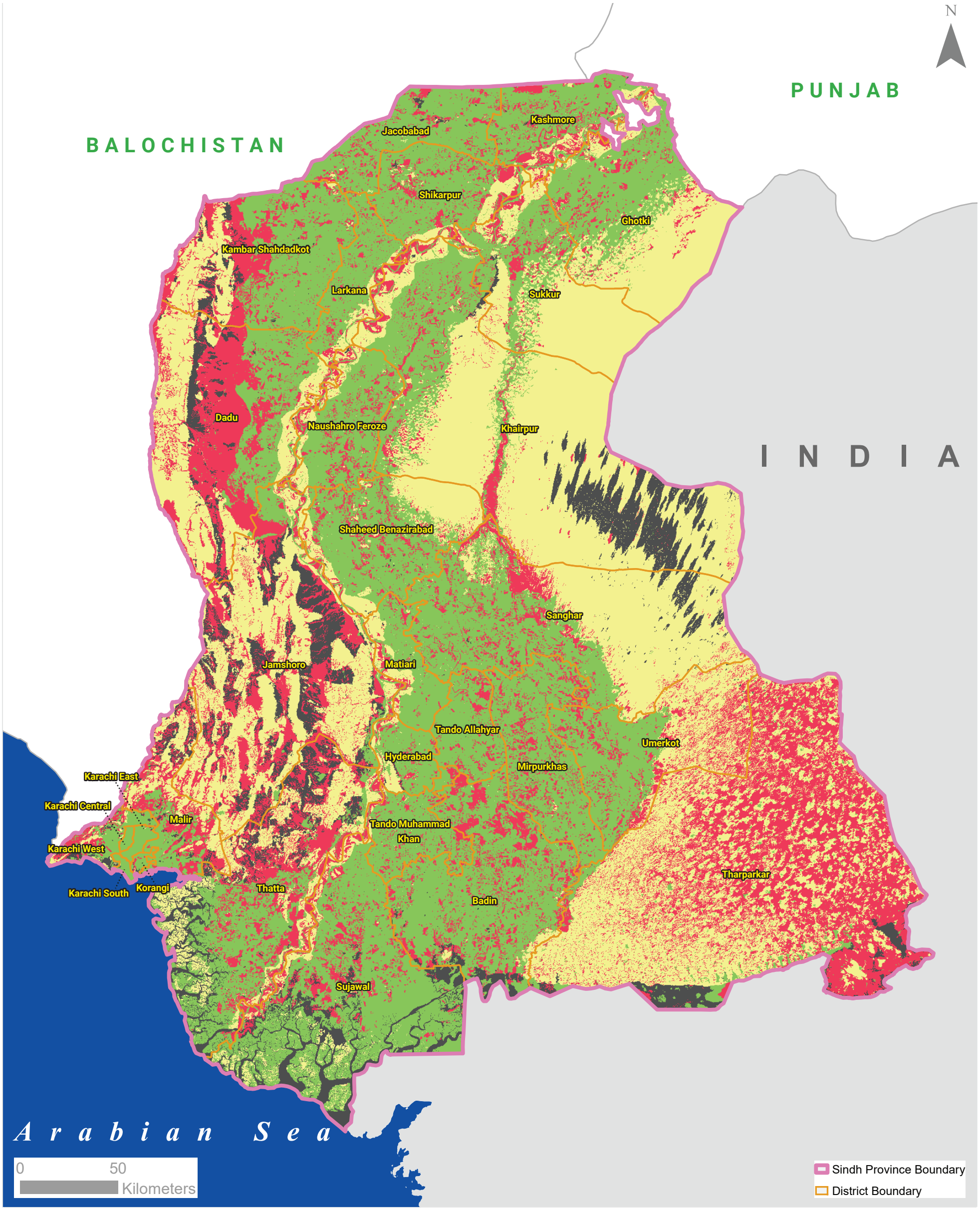
METEOROLOGICAL DROUGHT

HAZARD 50 YEARS

HAZARD

No Hazard | Mild | Moderate | Severe | Extreme

METEOROLOGICAL DROUGHT VULNERABILITY



VULNERABILITY

None	Low	Medium	High
0 - 25	*26 - 50*	*51 - 75*	*76 - 100*

METEOROLOGICAL DROUGHT

RISK 05 YEARS

RISK

Very Low	Low	Medium	High	Extreme
0 - 49	*50 - 99*	*100 - 199*	*200 - 249*	*250 - 300*

METEOROLOGICAL DROUGHT

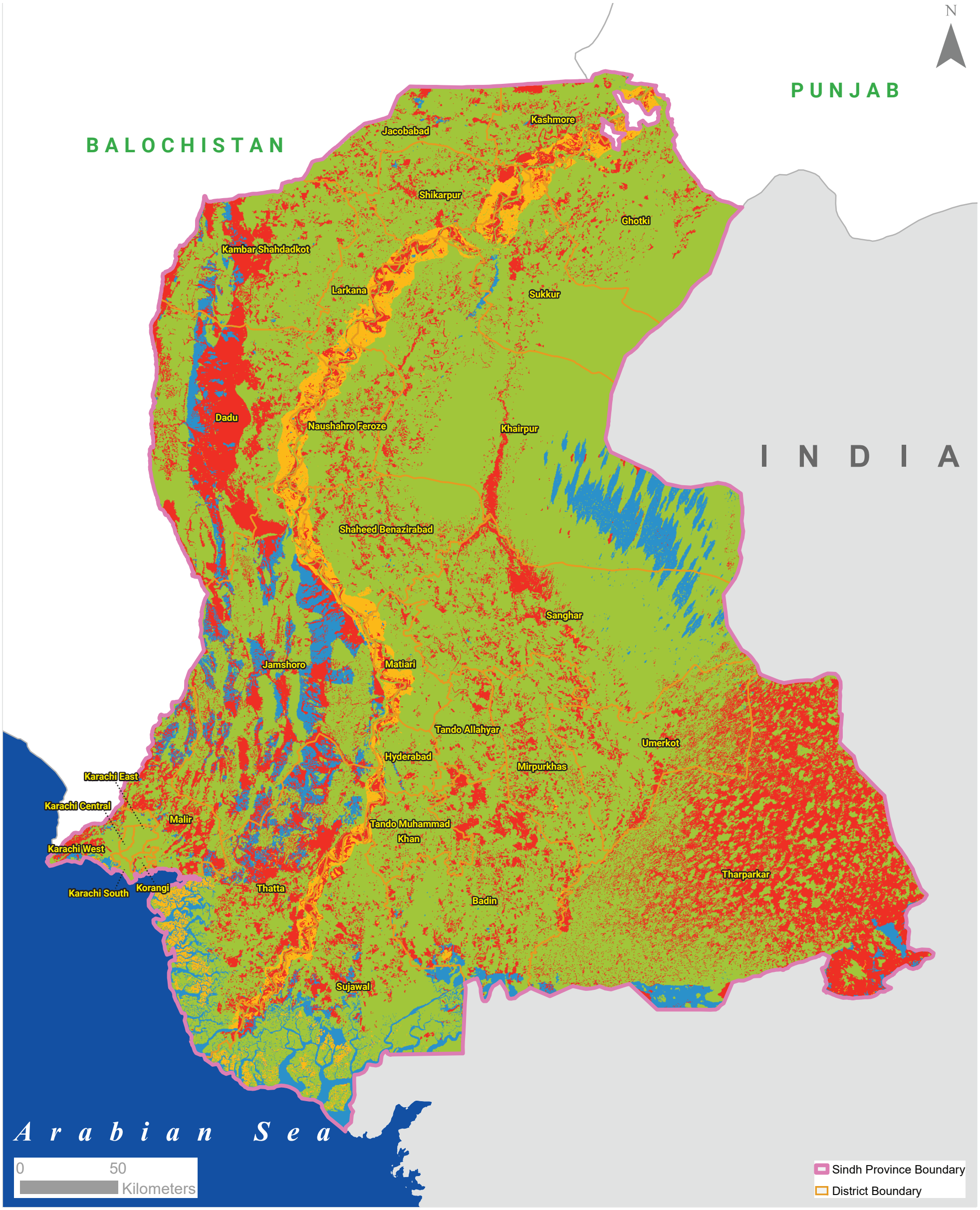
RISK 10 YEARS

RISK

Very Low	Low	Medium	High	Extreme
0 - 49	*50 - 99*	*100 - 199*	*200 - 249*	*250 - 300*

METEOROLOGICAL DROUGHT

RISK 25 YEARS

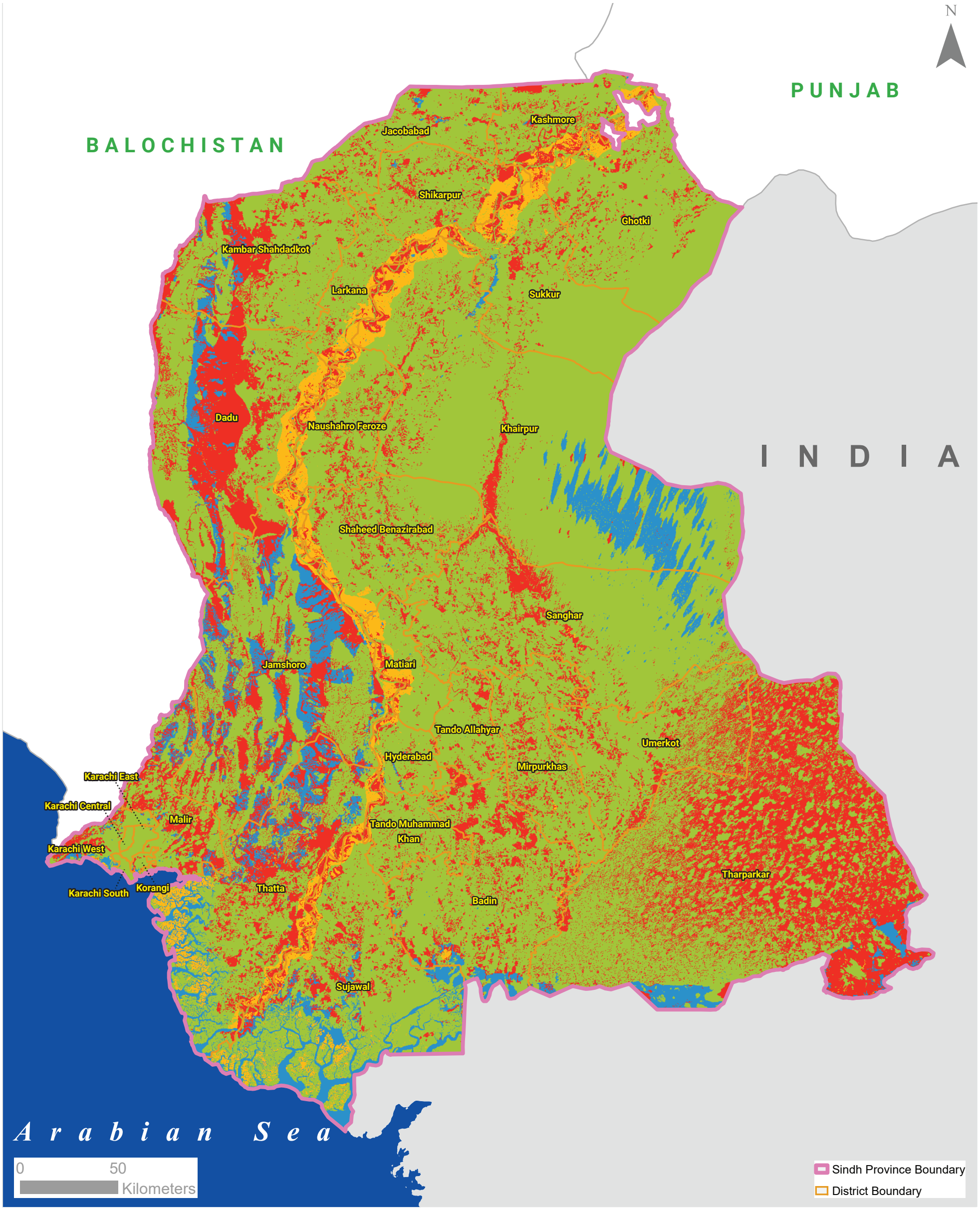


RISK

Very Low	Low	Medium	High	Extreme
0 - 49	*50 - 99*	*100 - 199*	*200 - 249*	*250 - 300*

METEOROLOGICAL DROUGHT

RISK 50 YEARS

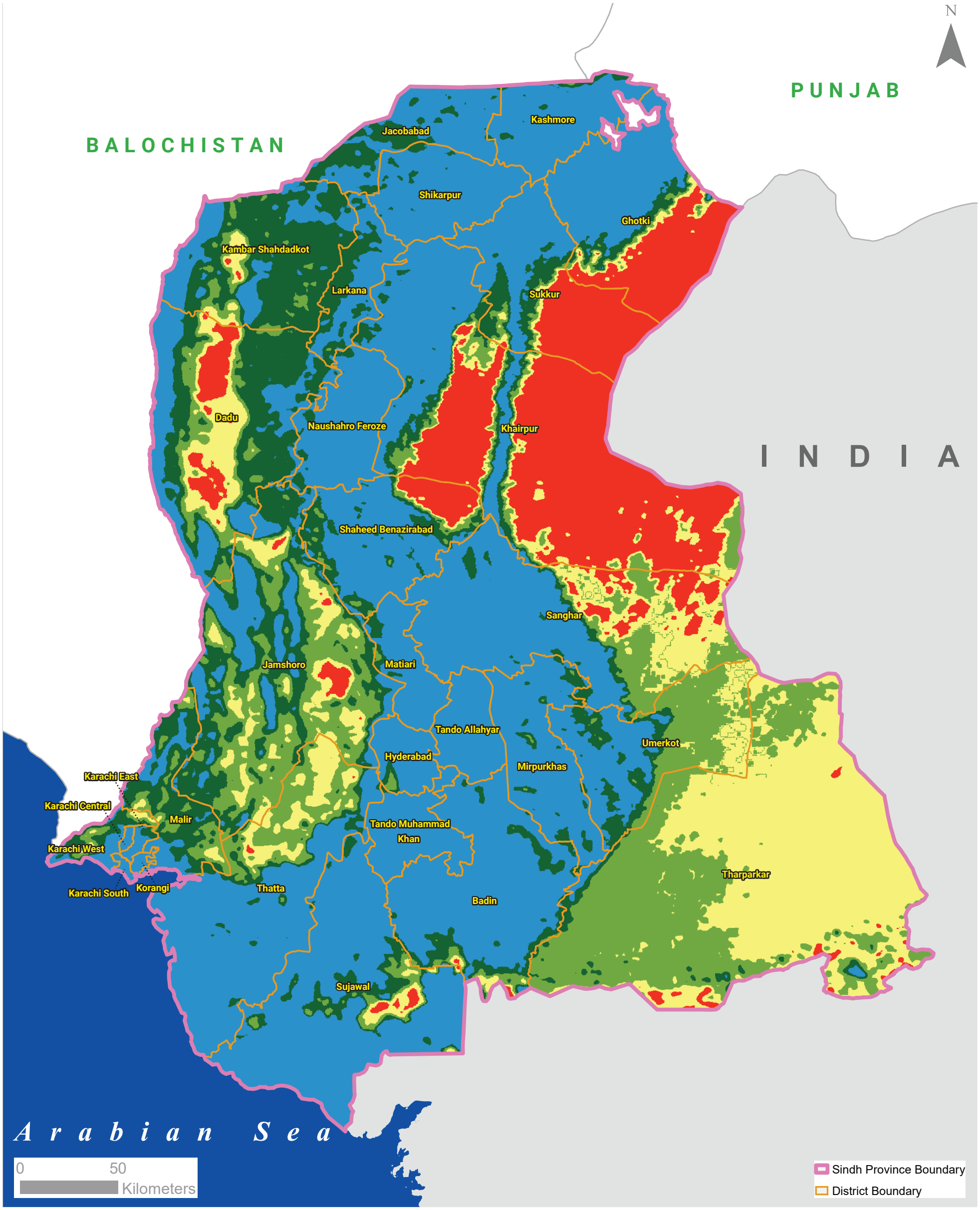


RISK

Very Low	Low	Medium	High	Extreme
0 - 49	*50 - 99*	*100 - 199*	*200 - 249*	*250 - 300*

AGRICUTURAL DROUGHT

HAZARD 05 YEARS

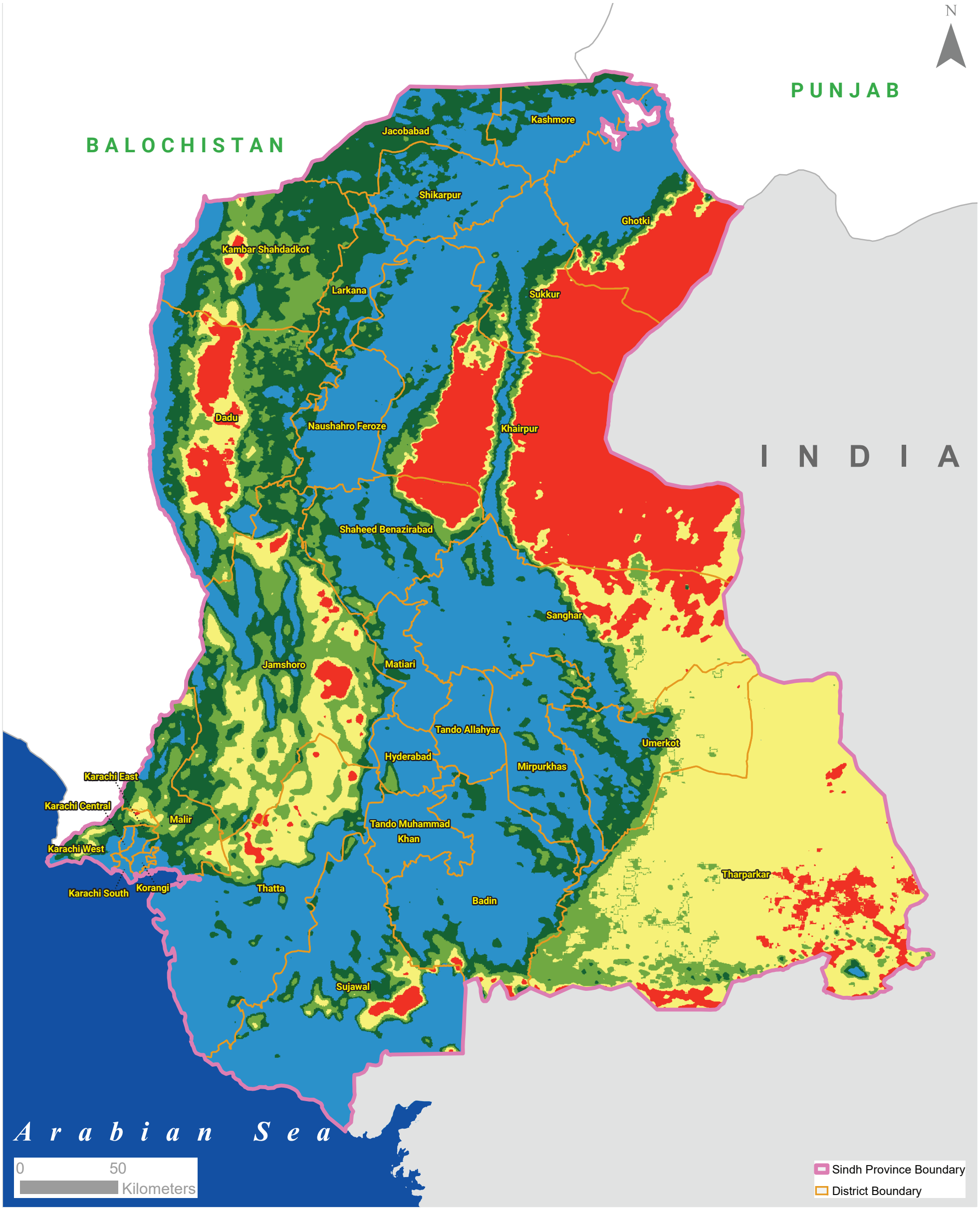


HAZARD

No Hazard | Mild | Moderate | Severe | Extreme

AGRICUTURAL DROUGHT

HAZARD 10 YEARS

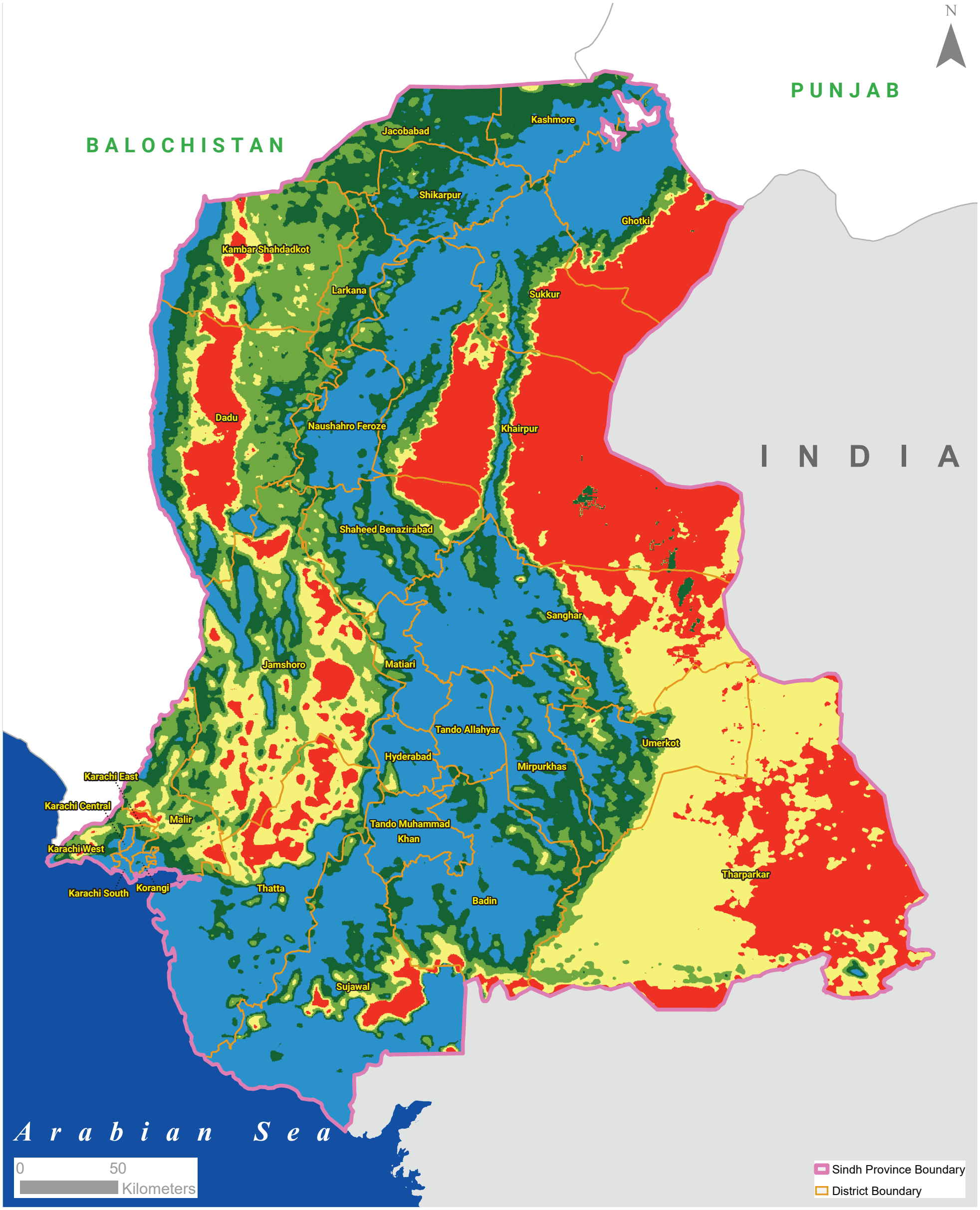


HAZARD

No Hazard | Mild | Moderate | Severe | Extreme

AGRICUTURAL DROUGHT

HAZARD 25 YEARS

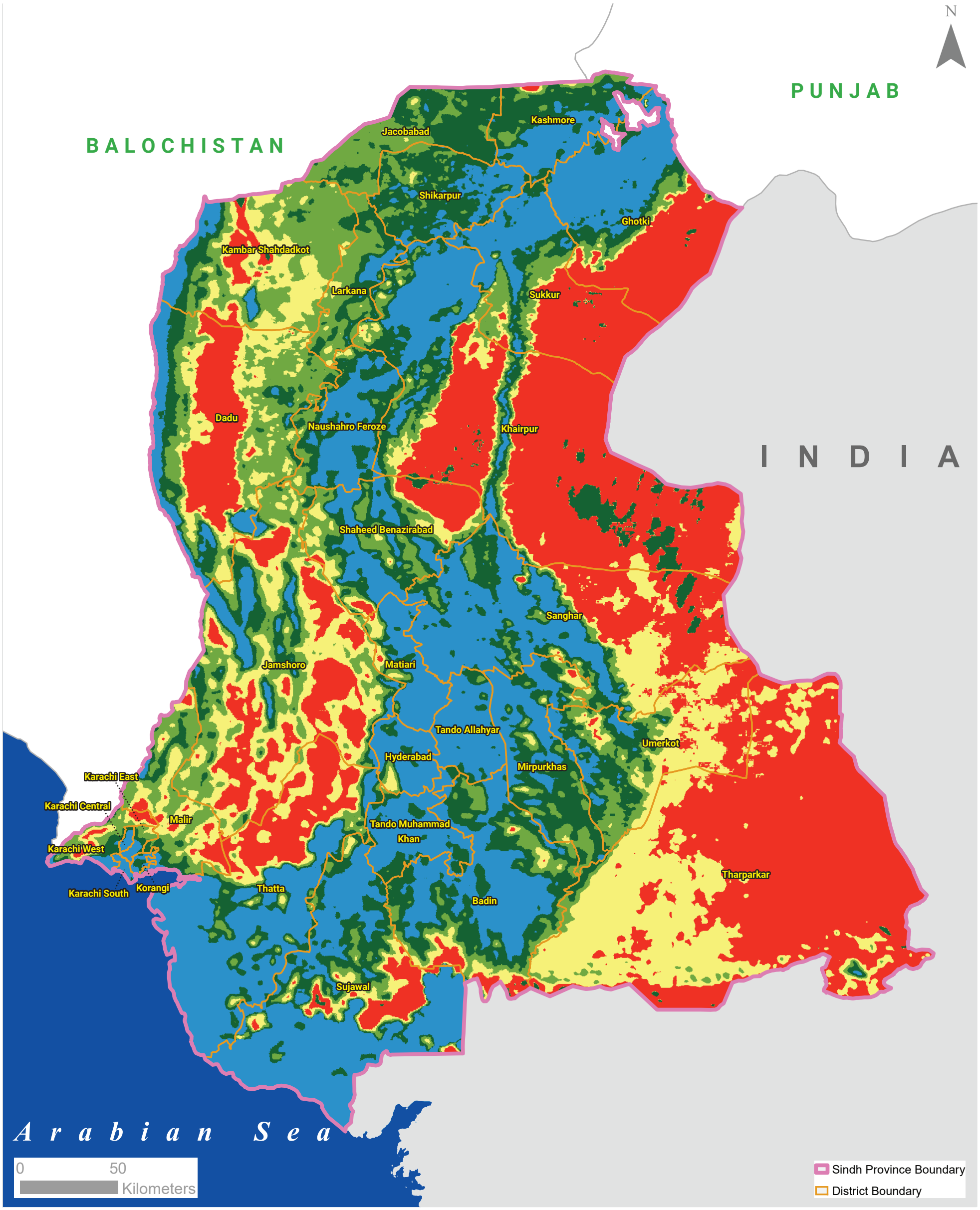


HAZARD

- No Hazard
- Mild
- Moderate
- Severe
- Extreme

AGRICUTURAL DROUGHT

HAZARD 50 YEARS

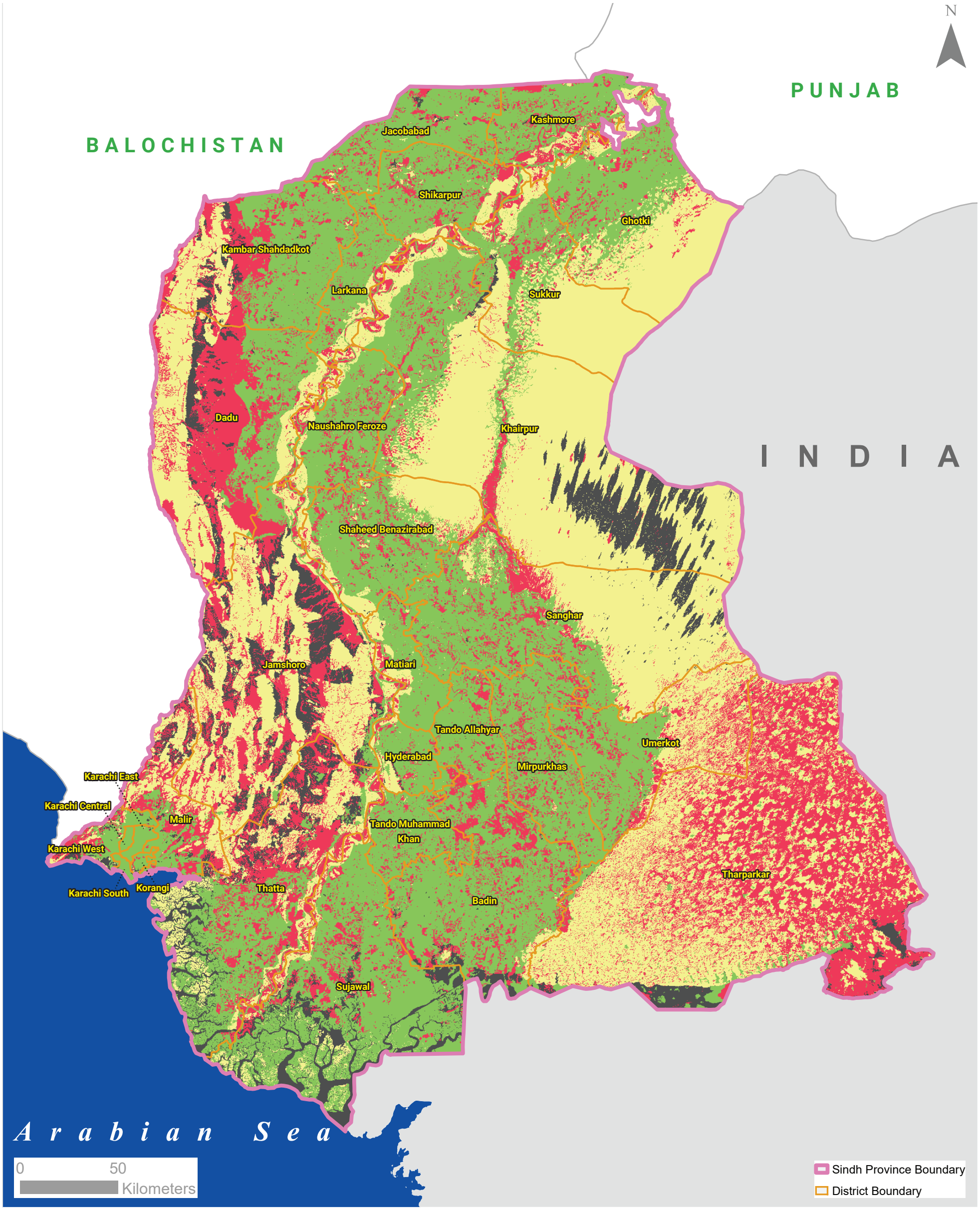


HAZARD

- No Hazard
- Mild
- Moderate
- Severe
- Extreme

AGRICUTURAL DROUGHT

VULNERABILITY

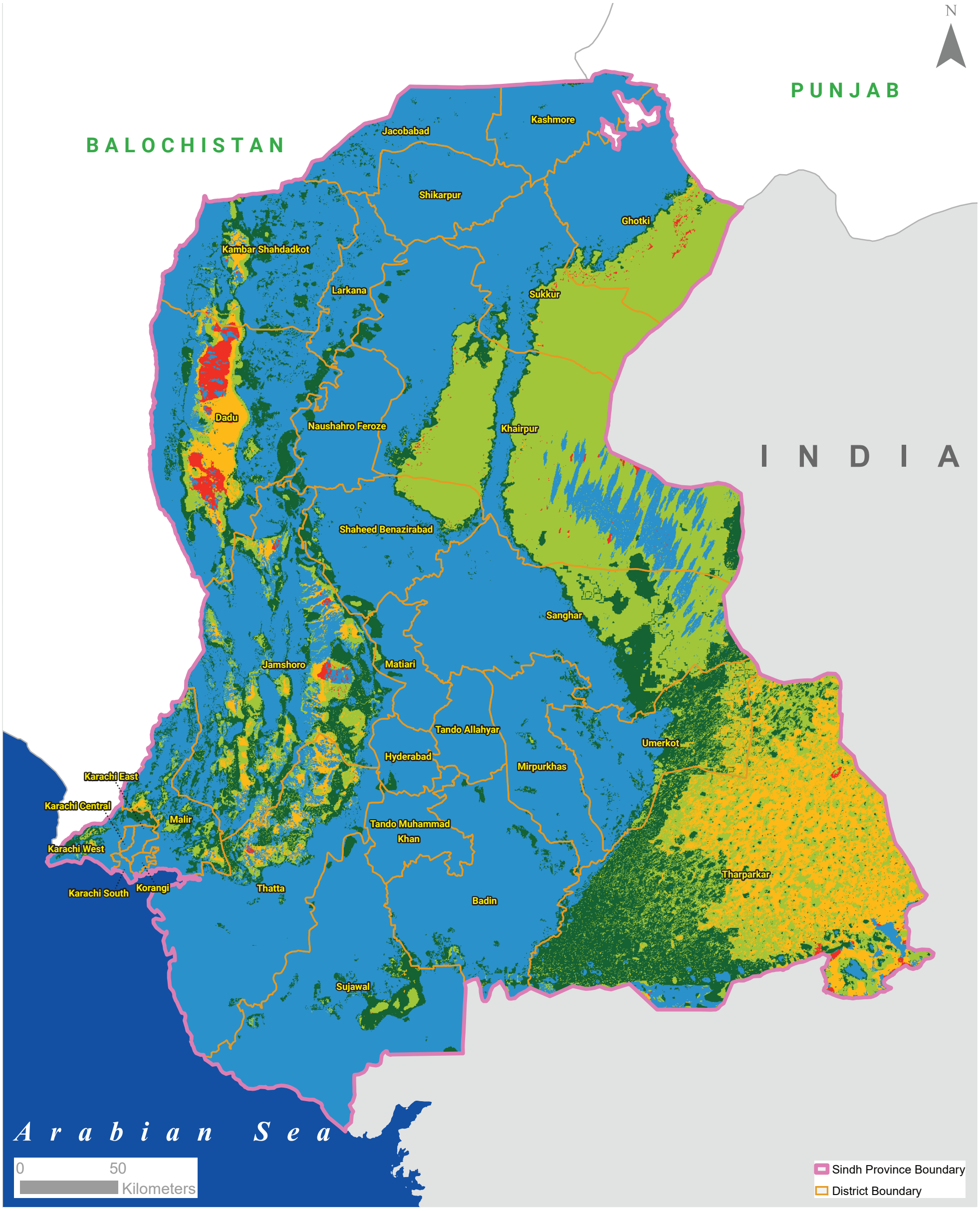


VULNERABILITY

None	Low	Medium	High
0 - 25	*26 - 50*	*51 - 75*	*76 - 100*

AGRICUTURAL DROUGHT

RISK 05 YEARS

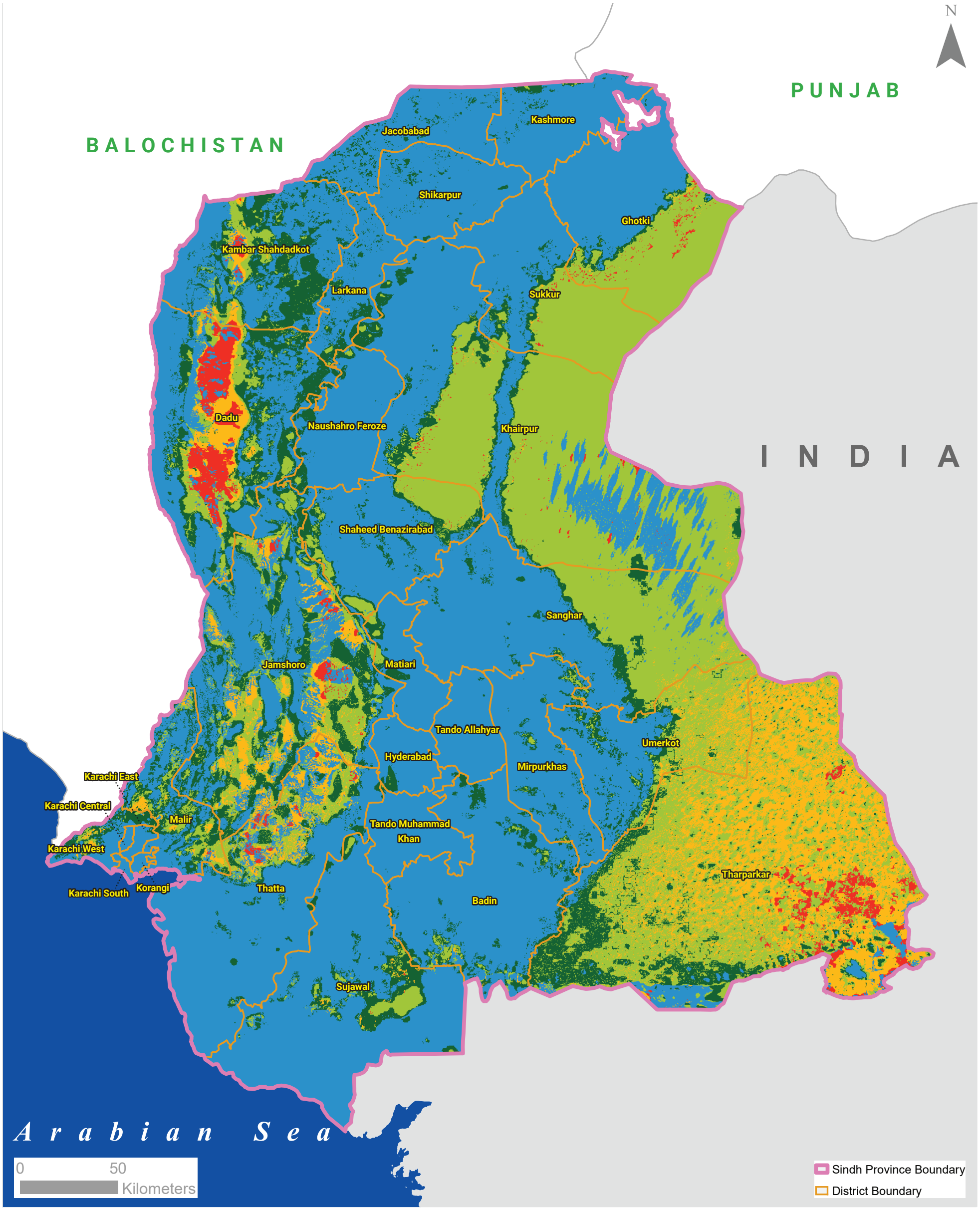


RISK

Very Low	Low	Medium	High	Extreme
0 - 49	*50 - 99*	*100 - 199*	*200 - 249*	*250 - 300*

AGRICUTURAL DROUGHT

RISK 10 YEARS

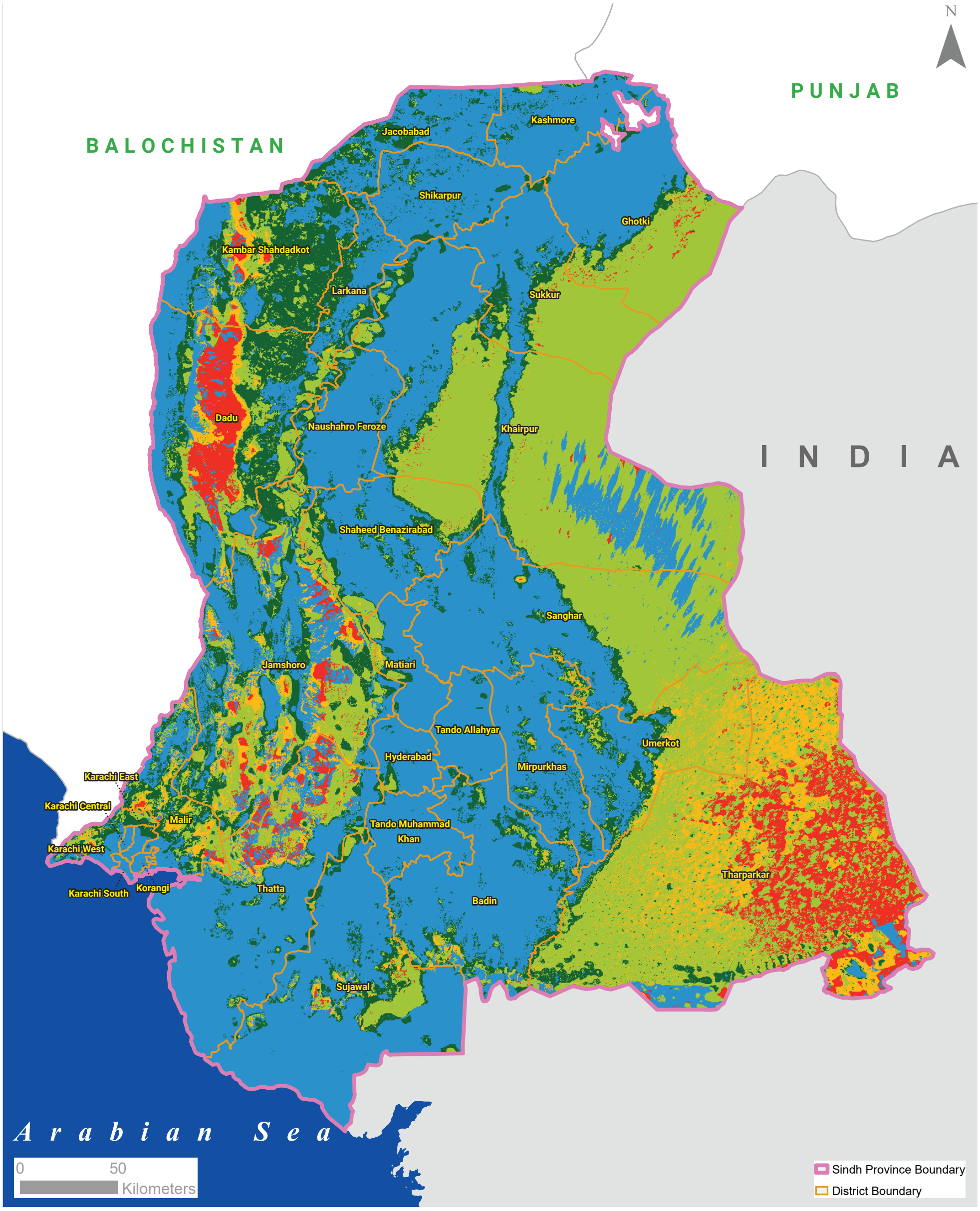


RISK

Very Low	Low	Medium	High	Extreme
0 - 49	*50 - 99*	*100 - 199*	*200 - 249*	*250 - 300*

AGRICUTURAL DROUGHT

RISK 25 YEARS

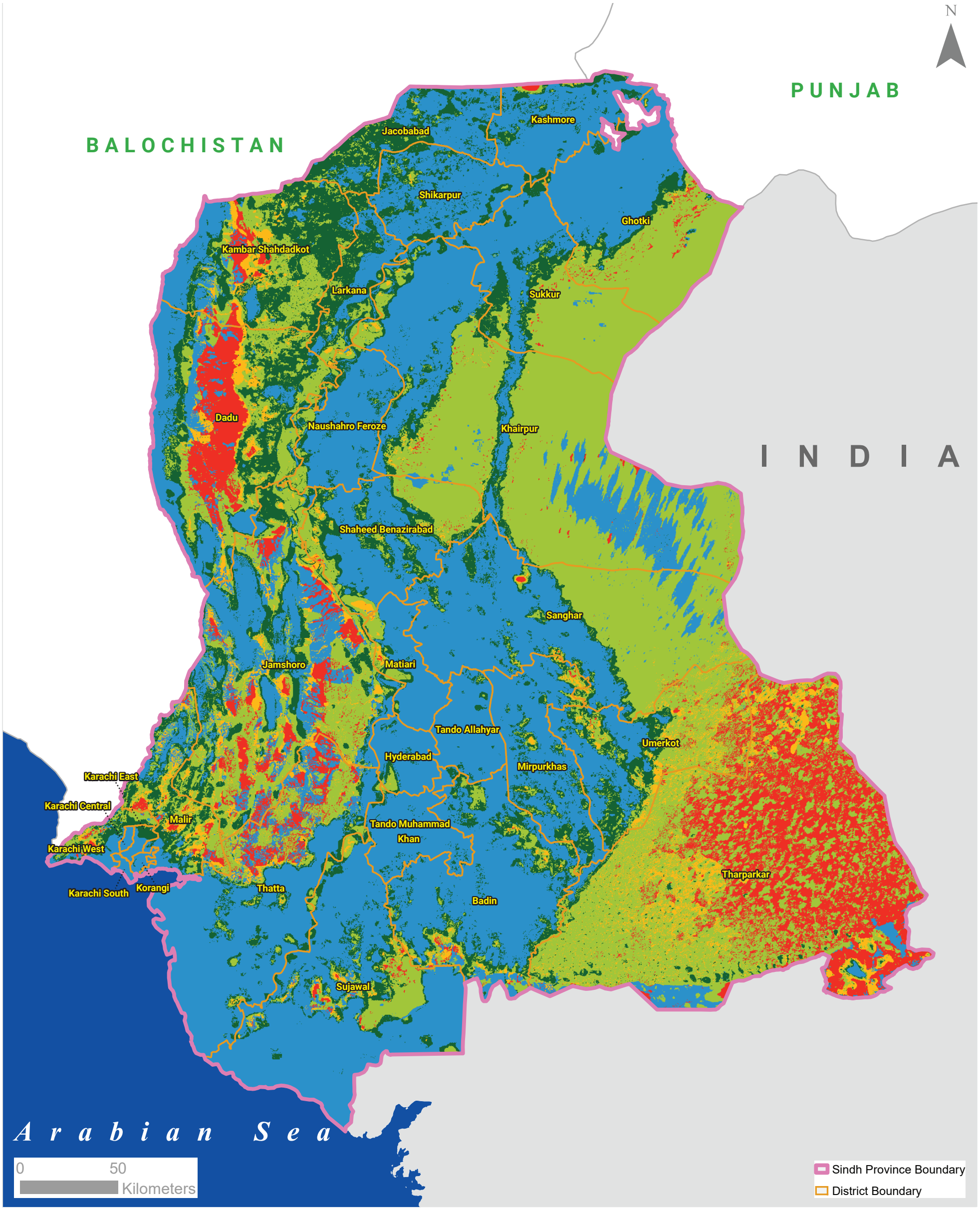


RISK

Very Low	Low	Medium	High	Extreme
0 - 49	*50 - 99*	*100 - 199*	*200 - 249*	*250 - 300*

AGRICUTURAL DROUGHT

RISK 50 YEARS



RISK

Very Low	Low	Medium	High	Extreme
0 - 49	*50 - 99*	*100 - 199*	*200 - 249*	*250 - 300*

HEATWAVE

HAZARD 05 YEARS

HAZARD

Normal | Moderate | High
Severe | Extreme

HEATWAVE

HAZARD 10 YEARS

HAZARD

Normal | Moderate | High
Severe | Extreme

HEATWAVE

HAZARD 25 YEARS

HAZARD

Normal | Moderate | High
Severe | Extreme

HEATWAVE

HAZARD 50 YEARS

HAZARD

Normal
Moderate
High
Severe
Extreme

HEATWAVE

HAZARD 100 YEARS

HAZARD

Normal | Moderate | High
Severe | Extreme

HEATWAVE

VULNERABILITY

VULNERABILITY

None	Low	Medium	High
0 - 25	*26 - 50*	*51 - 75*	*76 - 100*

HEATWAVE

RISK 05 YEARS

RISK

Very Low	Low	Medium	High	Extreme
0 - 49	*50 - 99*	*100 - 199*	*200 - 249*	*250 - 300*

HEATWAVE

RISK 10 YEARS

RISK

Very Low	Low	Medium	High	Extreme
0 - 49	*50 - 99*	*100 - 199*	*200 - 249*	*250 - 300*

HEATWAVE

RISK 25 YEARS

RISK

Very Low	Low	Medium	High	Extreme
0 - 49	*50 - 99*	*100 - 199*	*200 - 249*	*250 - 300*

HEATWAVE

RISK 50 YEARS

RISK

Very Low	Low	Medium	High	Extreme
0 - 49	*50 - 99*	*100 - 199*	*200 - 249*	*250 - 300*

HEATWAVE

RISK 100 YEARS

RISK

Very Low	Low	Medium	High	Extreme
0 - 49	*50 - 99*	*100 - 199*	*200 - 249*	*250 - 300*

CYCLONE

HAZARD 25 YEARS

HAZARD

Calm Wind | Tropical Depression | Tropical Storm

Cat-1 TC | Cat-2 TC | Cat-3 TC | Cat-4 TC | Cat-5 TC

CYCLONE

HAZARD 100 YEARS

HAZARD

Calm Wind | Tropical Depression | Tropical Storm | Cat-1 TC | Cat-2 TC | Cat-3 TC | Cat-4 TC | Cat-5 TC

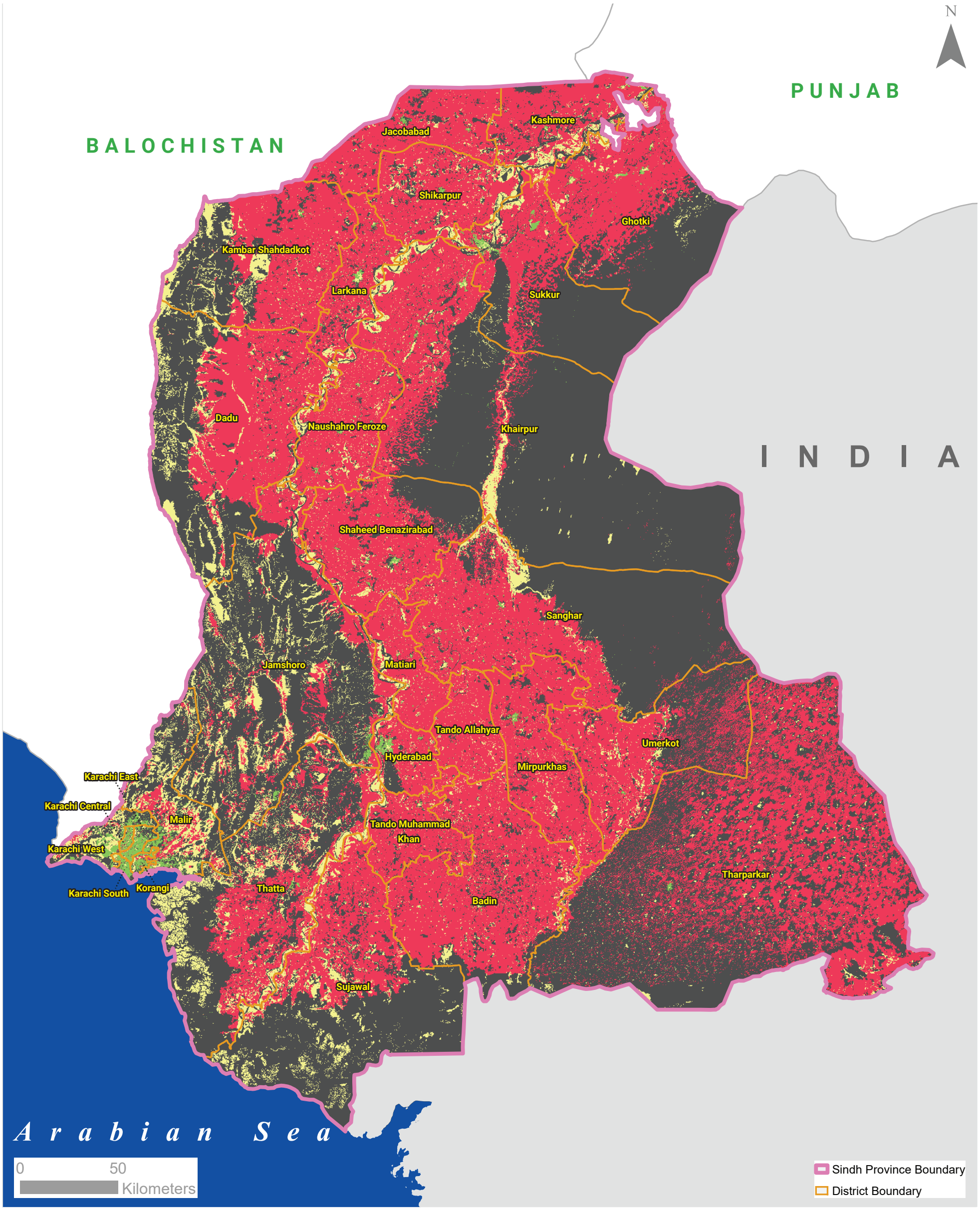
CYCLONE

HAZARD 500 YEARS

HAZARD

Calm Wind | Tropical Depression | Tropical Storm | Cat-1 TC | Cat-2 TC | Cat-3 TC | Cat-4 TC | Cat-5 TC

CYCLONE VULNERABILITY



VULNERABILITY

None	Low	Medium	High
0 - 25	*26 - 50*	*51 - 75*	*76 - 100*

CYCLONE

RISK 25 YEARS

RISK

Very Low	Low	Medium	High	Extreme
0 - 49	*50 - 99*	*100 - 199*	*200 - 249*	*250 - 300*

CYCLONE

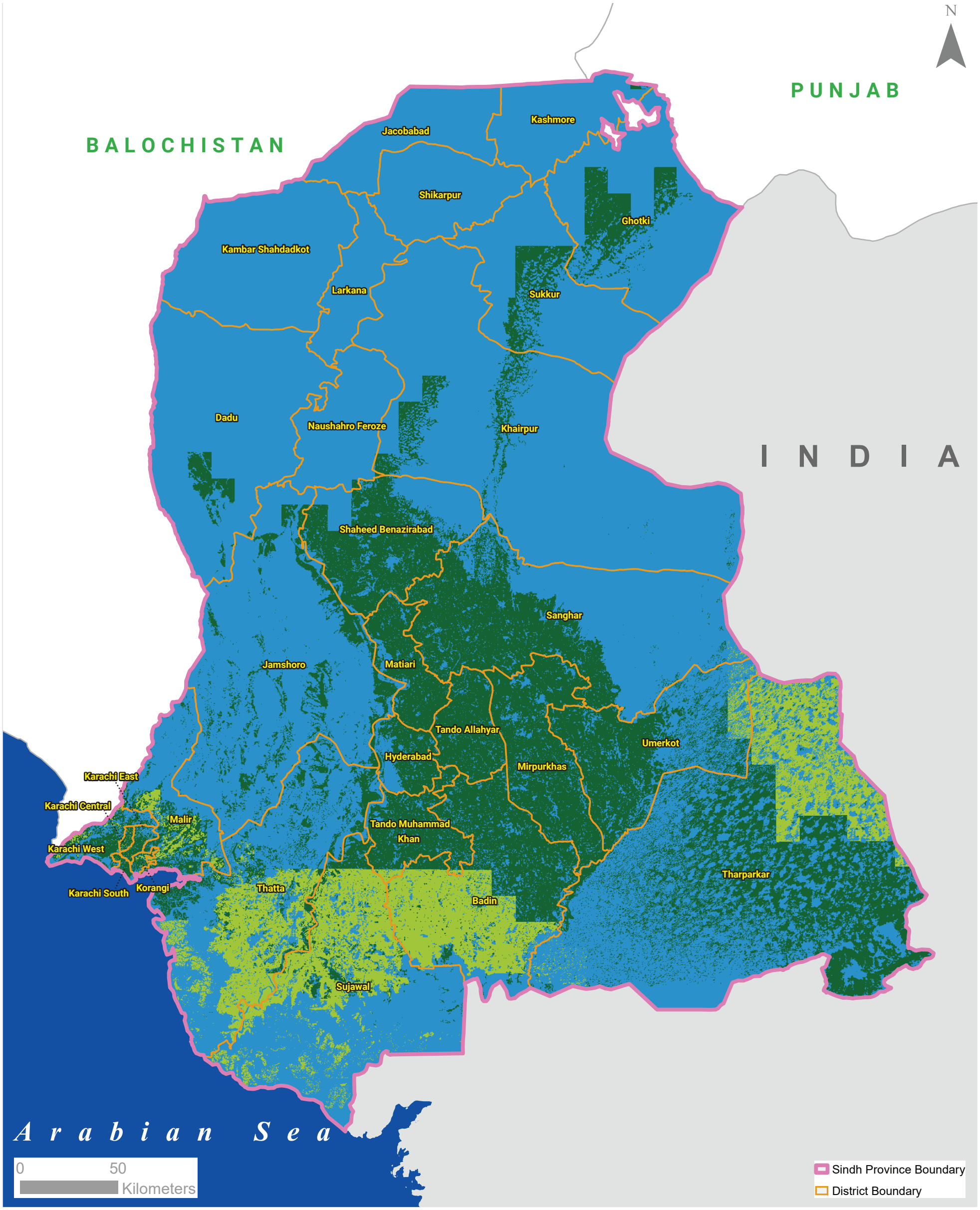
RISK 100 YEARS

RISK

Very Low	Low	Medium	High	Extreme
0 - 49	*50 - 99*	*100 - 199*	*200 - 249*	*250 - 300*

CYCLONE

RISK 500 YEARS



RISK

Very Low	Low	Medium	High	Extreme
0 - 49	*50 - 99*	*100 - 199*	*200 - 249*	*250 - 300*

STORM SURGE

HAZARD 25 YEARS

HAZARD

- No Hazard
- Low
- Medium
- High
- Very High

STORM SURGE

HAZARD 100 YEARS

HAZARD

- No Hazard
- Low
- Medium
- High
- Very High

STORM SURGE

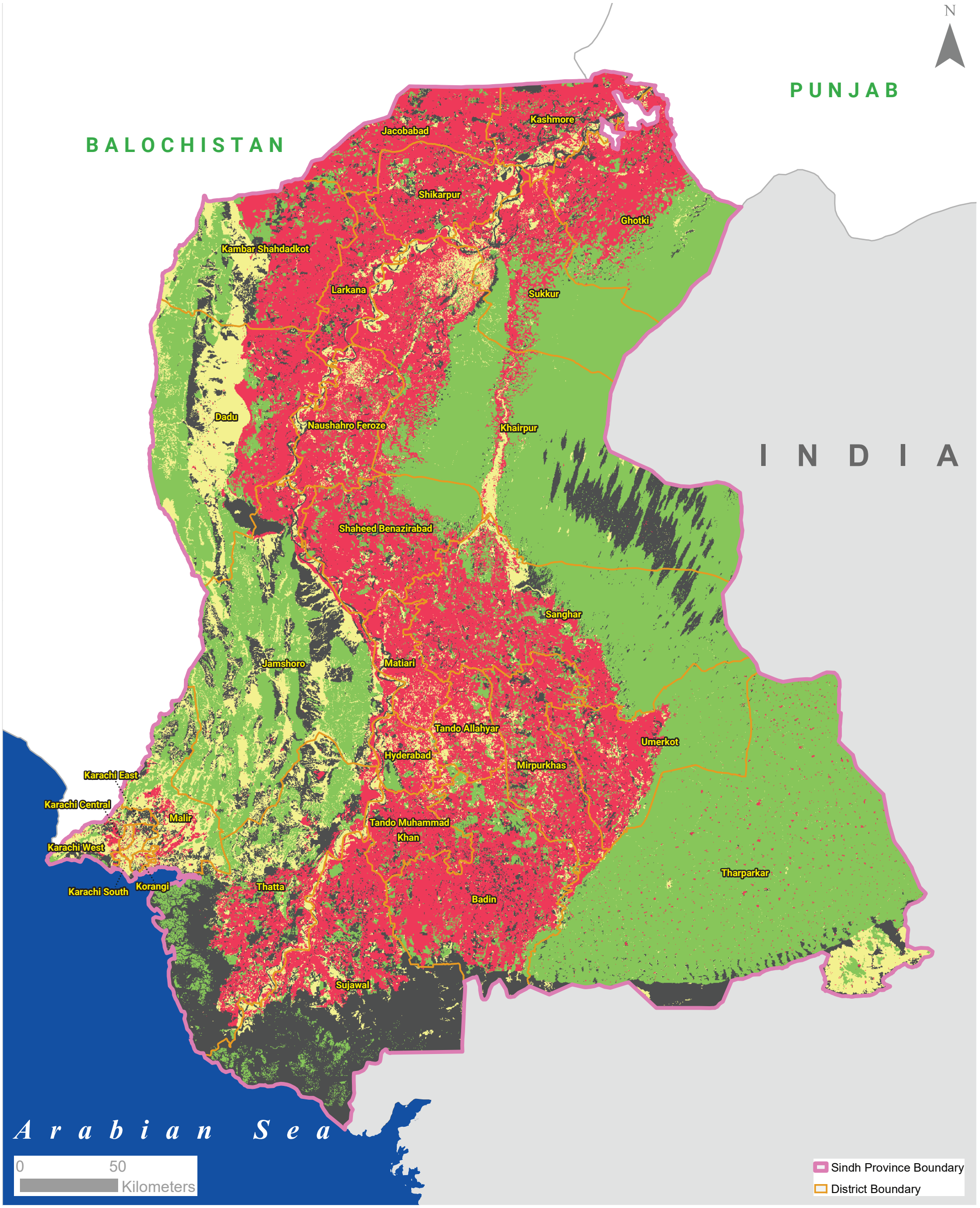
HAZARD 500 YEARS

HAZARD

- No Hazard
- Low
- Medium
- High
- Very High

STORM SURGE

VULNERABILITY



VULNERABILITY

None	Low	Medium	High
0 - 25	*26 - 50*	*51 - 75*	*76 - 100*

STORM SURGE

RISK 25 YEARS

RISK

Very Low	Low	Medium	High	Extreme
0 - 49	*50 - 99*	*100 - 199*	*200 - 249*	*250 - 300*

STORM SURGE

RISK 100 YEARS

RISK

Very Low	Low	Medium	High	Extreme
0 - 49	*50 - 99*	*100 - 199*	*200 - 249*	*250 - 300*

STORM SURGE

RISK 500 YEARS

RISK

Very Low	Low	Medium	High	Extreme
0 - 49	*50 - 99*	*100 - 199*	*200 - 249*	*250 - 300*

EARTHQUAKE

HAZARD 95 YEARS

HAZARD ZONE	ZONE 1	ZONE 2A	ZONE 2B	ZONE 3	ZONE 4	ZONE 5	ZONE 6
PGA VALUE (ACCELERATION)	0.05 - 0.08	0.08 - 0.16	0.16 - 0.24	0.24 - 0.32	>0.32 - 0.45	0.45 - 0.50	0.50 - 0.54
POTENTIAL DAMAGE	Very Light	Very Light-Light	Moderate	Moderate	Moderate-Heavy	Moderate-Heavy	Moderate-Heavy

EARTHQUAKE

HAZARD 475 YEARS

HAZARD ZONE	ZONE 1	ZONE 2A	ZONE 2B	ZONE 3	ZONE 4	ZONE 5	ZONE 6
PGA VALUE (ACCELERATION)	0.05 - 0.08	0.08 - 0.16	0.16 - 0.24	0.24 - 0.32	>0.32 - 0.45	0.45 - 0.50	0.50 - 0.54
POTENTIAL DAMAGE	Very Light	Very Light-Light	Moderate	Moderate	Moderate-Heavy	Moderate-Heavy	Moderate-Heavy

EARTHQUAKE

HAZARD 975 YEARS

HAZARD ZONE	ZONE 1	ZONE 2A	ZONE 2B	ZONE 3	ZONE 4	ZONE 5	ZONE 6
PGA VALUE (ACCELERATION)	0.05 - 0.08	0.08 - 0.16	0.16 - 0.24	0.24 - 0.32	>0.32 - 0.45	0.45 - 0.50	0.50 - 0.54
POTENTIAL DAMAGE	Very Light	Very Light-Light	Moderate	Moderate	Moderate-Heavy	Moderate-Heavy	Moderate-Heavy

EARTHQUAKE

HAZARD 2475 YEARS

HAZARD ZONE	ZONE 1	ZONE 2A	ZONE 2B	ZONE 3	ZONE 4	ZONE 5	ZONE 6
PGA VALUE (ACCELERATION)	0.05 - 0.08	0.08 - 0.16	0.16 - 0.24	0.24 - 0.32	>0.32 - 0.45	0.45 - 0.50	0.50 - 0.54
POTENTIAL DAMAGE	Very Light	Very Light-Light	Moderate	Moderate	Moderate-Heavy	Moderate-Heavy	Moderate-Heavy

EARTHQUAKE

VULNERABILITY

VULNERABILITY

None	Low	Medium	High
0 - 25	*26 - 50*	*51 - 75*	*76 - 100*

EARTHQUAKE

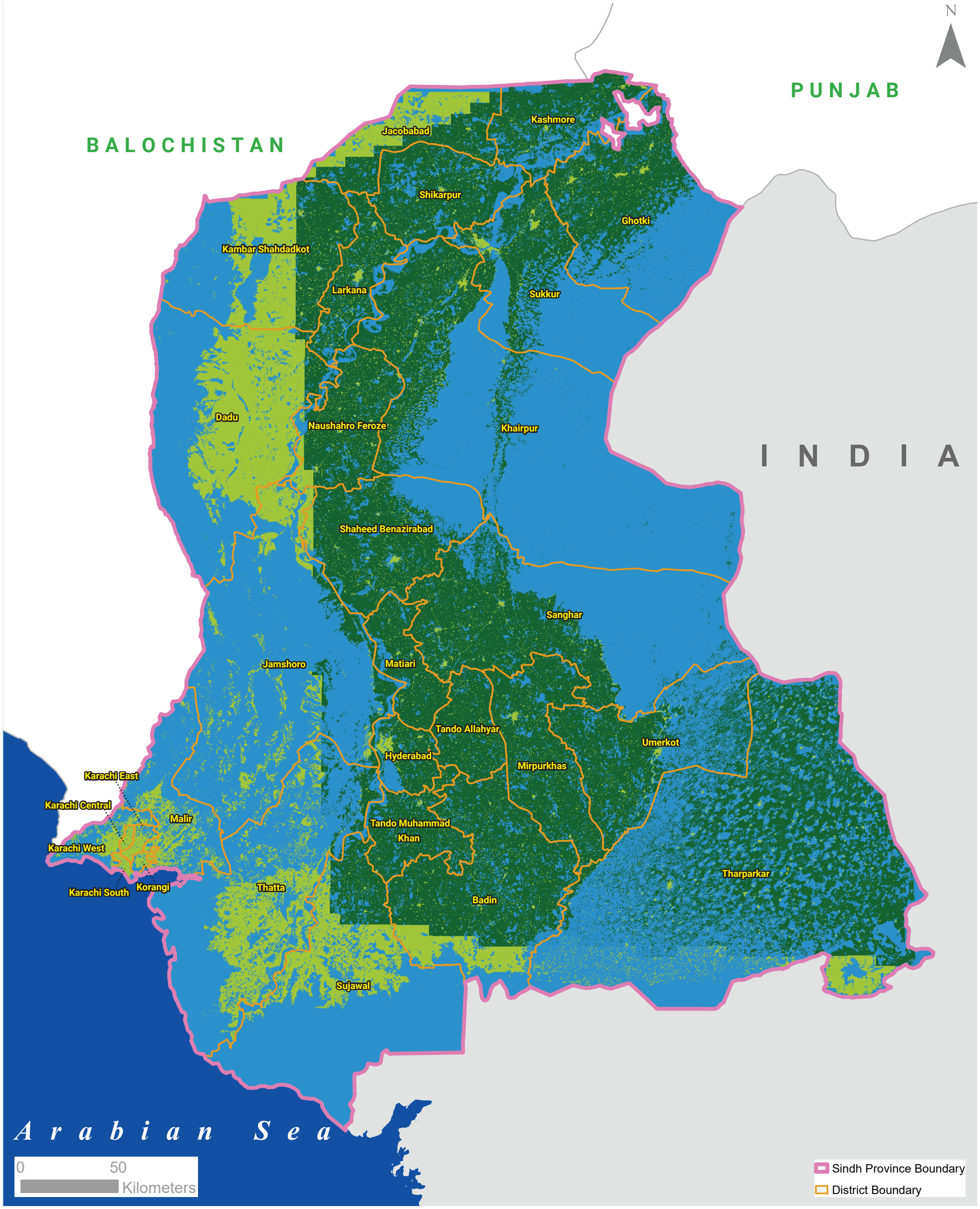
RISK 95 YEARS

RISK

Very Low	Low	Medium	High	Extreme
0 - 49	*50 - 99*	*100 - 199*	*200 - 249*	*250 - 300*

EARTHQUAKE

RISK 475 YEARS



RISK

Very Low	Low	Medium	High	Extreme
0 - 49	*50 - 99*	*100 - 199*	*200 - 249*	*250 - 300*

EARTHQUAKE

RISK 975 YEARS

RISK

Very Low	Low	Medium	High	Extreme
0 - 49	*50 - 99*	*100 - 199*	*200 - 249*	*250 - 300*

EARTHQUAKE

RISK 2475 YEARS

RISK

Very Low	Low	Medium	High	Extreme
0 - 49	*50 - 99*	*100 - 199*	*200 - 249*	*250 - 300*

TSUNAMI

HAZARD 8.0 EQ. MAG

HAZARD

No Hazard | Low | Medium | High | Very High

Note: Tsunami hazard and other products are based on simulated/synthetic events of earthquake with mentioned magnitudes. Possibility of tsunami is limited with Makran subdivision zone

TSUNAMI

HAZARD 8.5 EQ. MAG

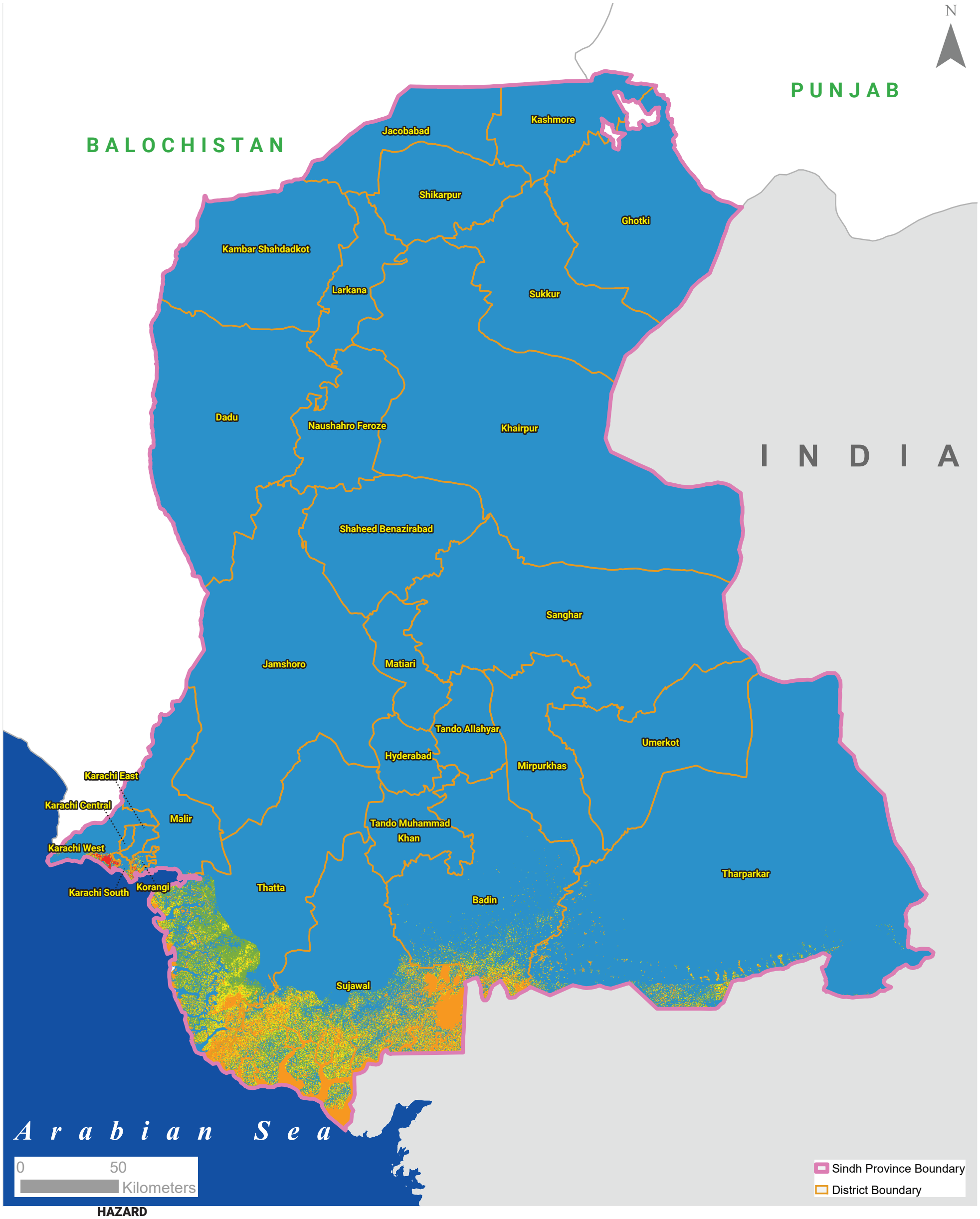
HAZARD

No Hazard | Low | Medium | High | Very High

Note: Tsunami hazard and other products are based on simulated/synthetic events of earthquake with mentioned magnitudes. Possibility of tsunami is limited with Makran subdivision zone

TSUNAMI

HAZARD 9.0 EQ. MAG



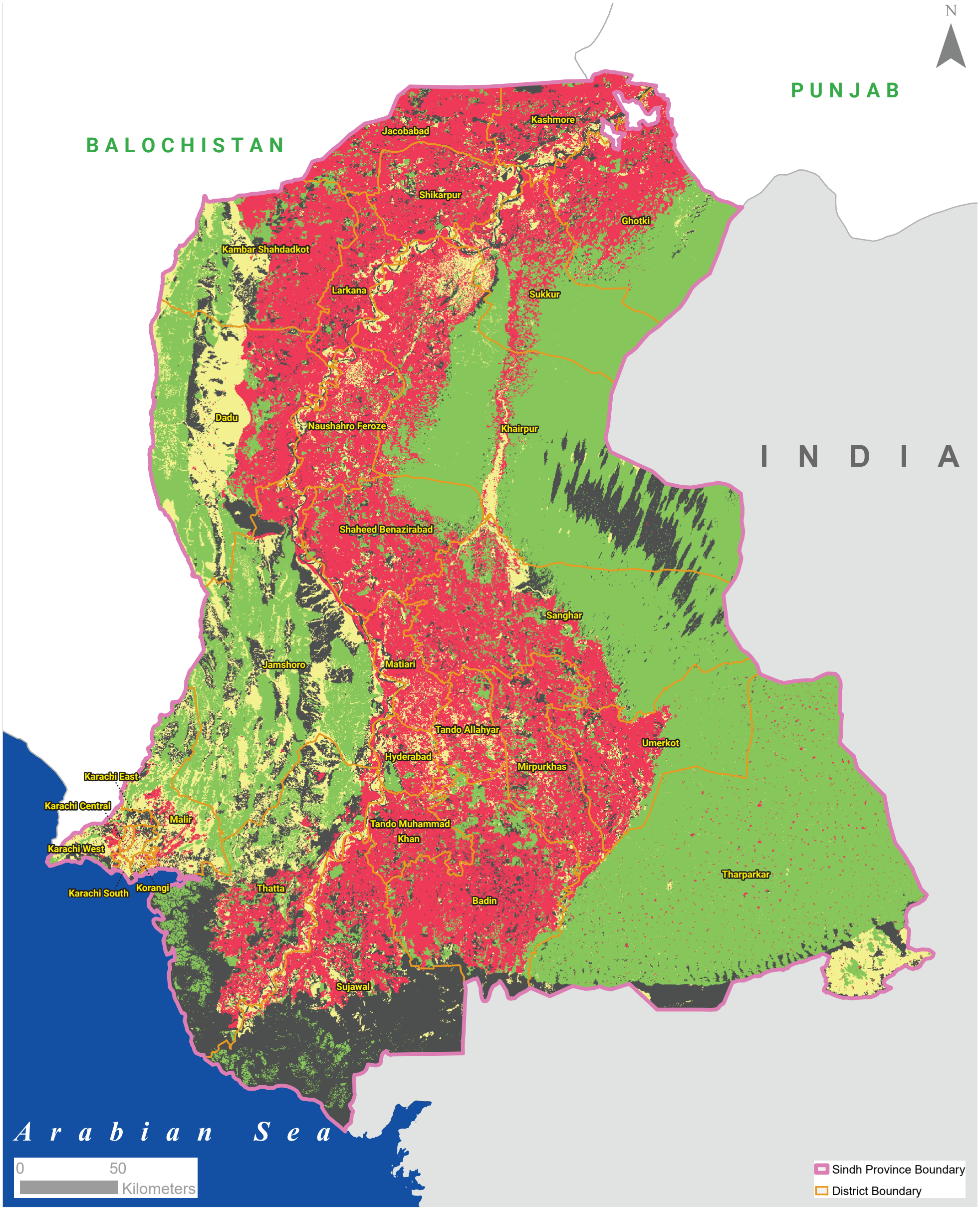
HAZARD

No Hazard | Low | Medium | High | Very High

Note: Tsunami hazard and other products are based on simulated/synthetic events of earthquake with mentioned magnitudes. Possibility of tsunami is limited with Makran subdivision zone

TSUNAMI

VULNERABILITY



VULNERABILITY

None	Low	Medium	High
0 - 25	*26 - 50*	*51 - 75*	*76 - 100*

Note: Tsunami hazard and other products are based on simulated/synthetic events of earthquake with mentioned magnitudes. Possibility of tsunami is limited with Makran subdivision zone

TSUNAMI

RISK 8.0 EQ. MAG

RISK

Very Low	Low	Medium	High	Extreme
0 - 49	*50 - 99*	*100 - 199*	*200 - 249*	*250 - 300*

Note: Tsunami hazard and other products are based on simulated/synthetic events of earthquake with mentioned magnitudes. Possibility of tsunami is limited with Makran subdivision zone

TSUNAMI

RISK 8.5 EQ. MAG

RISK

Very Low	Low	Medium	High	Extreme
0 - 49	*50 - 99*	*100 - 199*	*200 - 249*	*250 - 300*

Note: Tsunami hazard and other products are based on simulated/synthetic events of earthquake with mentioned magnitudes. Possibility of tsunami is limited with Makran subdivision zone

TSUNAMI

RISK 9.0 EQ. MAG

RISK

Very Low	Low	Medium	High	Extreme
0 - 49	*50 - 99*	*100 - 199*	*200 - 249*	*250 - 300*

Note: Tsunami hazard and other products are based on simulated/synthetic events of earthquake with mentioned magnitudes. Possibility of tsunami is limited with Makran subdivision zone

RISK MATRIX

HAZARD

	RETURN PERIODS: 5 YEARS	10 YEARS	25 YEARS	50 YEARS	100 YEARS	250 YEARS	500 YEARS
FLOOD	Low, Medium, High, Extreme	●	Low, Medium, High, Extreme	Low, Medium, High, Extreme	Low, Medium, High, Extreme	Low, Medium, High, Extreme	●
METEOROLOGICAL DROUGHT	Low, Medium	Low, Medium, High, Extreme	Medium, High, Extreme	Medium, High, Extreme	●	●	●
AGRICULTURAL DROUGHT	Low, Medium, High, Extreme	Low, Medium, High, Extreme	Low, Medium, High, Extreme	Low, Medium, High, Extreme	●	●	●
HEATWAVE	Low, Medium	Low, Medium, High	Low, Medium, High, Extreme	Low, Medium, High, Extreme	Low, Medium, High, Extreme	●	●
CYCLONE	●	●	Low	●	Low	●	Low, Medium
STORM SURGE	●	●	Low, Medium, High	●	Low, Medium, High, Extreme	●	Low, Medium, High, Extreme

	RETURN PERIODS: 95 YEARS	475 YEARS	975 YEARS	2475 YEARS
EARTHQUAKE	Low	Low, Medium	Medium, High	Medium, High, Extreme

	EARTHQUAKE MAGNITUDES: 8.0 MAG.	8.5 MAG.	9.0 MAG.
TSUNAMI	Low	Low, Medium	Low, Medium, High, Extreme

Low *50-99*
Medium *100-199*
High *200-249*
Extreme *250-300*

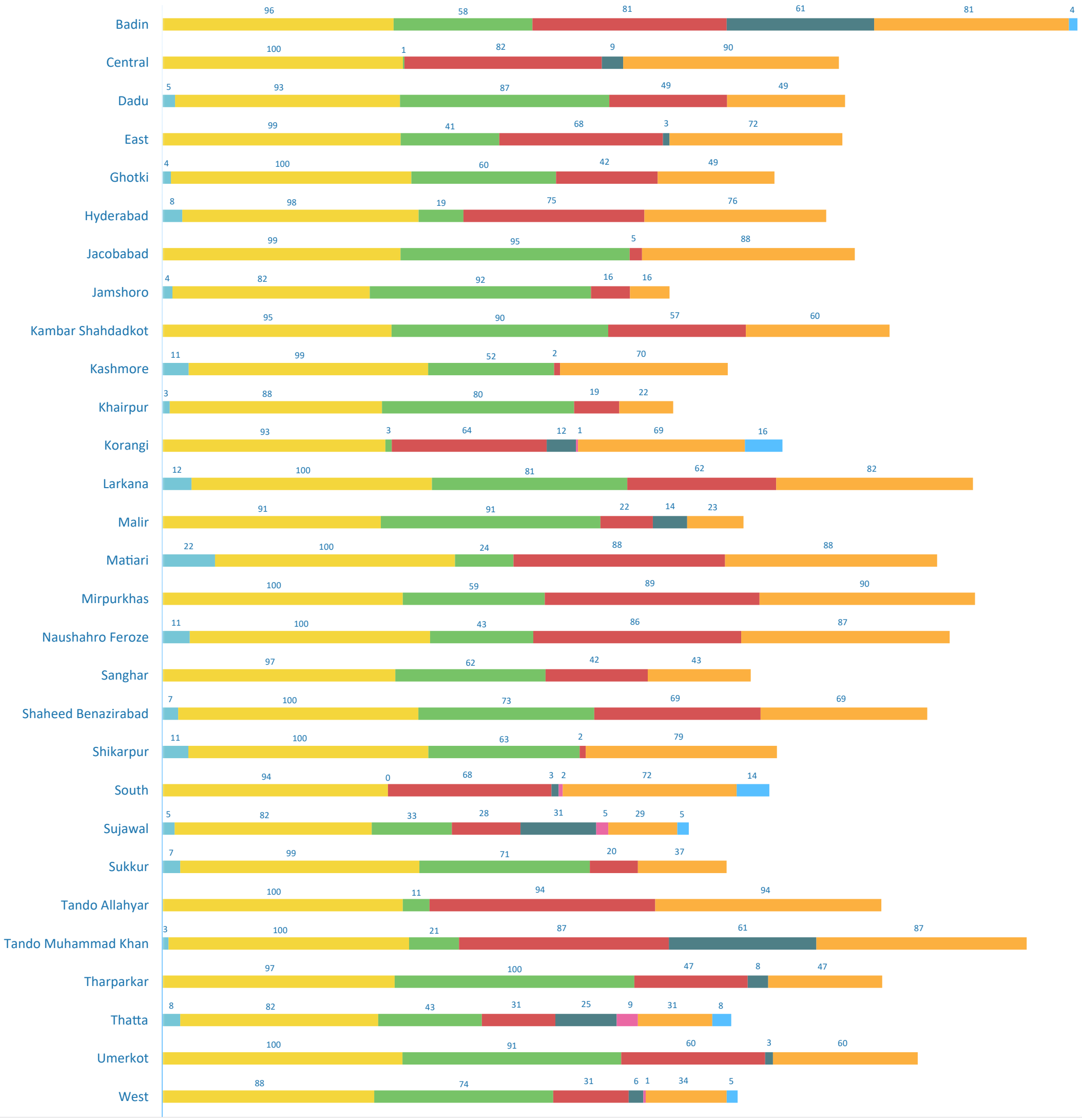
MULTI-HAZARD RISK - SINDH PROVINCE

AT DISTRICT LEVEL

LEGEND

PERCENTAGE OF AREA AT RISK

FLOOD · METEOROLOGICAL DROUGHT · AGRICULTURE DROUGHT · HEATWAVE · CYCLONE · STORM SURGE · EARTHQUAKE · TSUNAMI



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