#UNited4Land
OUR LEGACY.
OUR FUTURE.
DESERTIFICATION AND DROUGHT DAY · 17 JUNE 2024

DesertNet International

United Nations
Convention to Combat Desertification

"DRYLAND dynamics: Exploring Desertification Status in the Drylands of South Punjab, Pakistan"

Presented By:

Dr. Nausheen Mazhar
Chairperson & Associate Professor
Geography Department
Head International Resource Centre (IRC) DFDI,
Lahore College for Women University, Lahore


United Nations
Convention to Combat
Desertification
#UNited4Land
OUR LEGACY.
OUR FUTURE.
DESERTIFICATION AND
DROUGHT DAY · 17 JUNE 2024
NACHHALTIGKEIT.
SUSTAINABILITY.
DURABILITÉ.
BONN.
Federal Ministry
for Economic Cooperation
and Development

Agenda:

- ❑Introduction
- ❑Statement of the Problem
- ❑Study area
- ❑Objectives of the study
- ❑Methodology
- ❑Results
- ❑Recommendations
- ❑Conclusion

United Nations
Convention to Combat
Desertification

Supervisors

Prof. Dr. Safdar Ali Shirazi

Former Director Institute of Geography

University of the Punjab, Lahore Pakistan

Prof. Dr. Lindsay C. Stringer

Environment and Development

Department of Environment and Geography,

Wentworth Way, University of York, UK

Dr. Martin Dallimer

Sustainability Research Institute,

School of Earth and Environment,

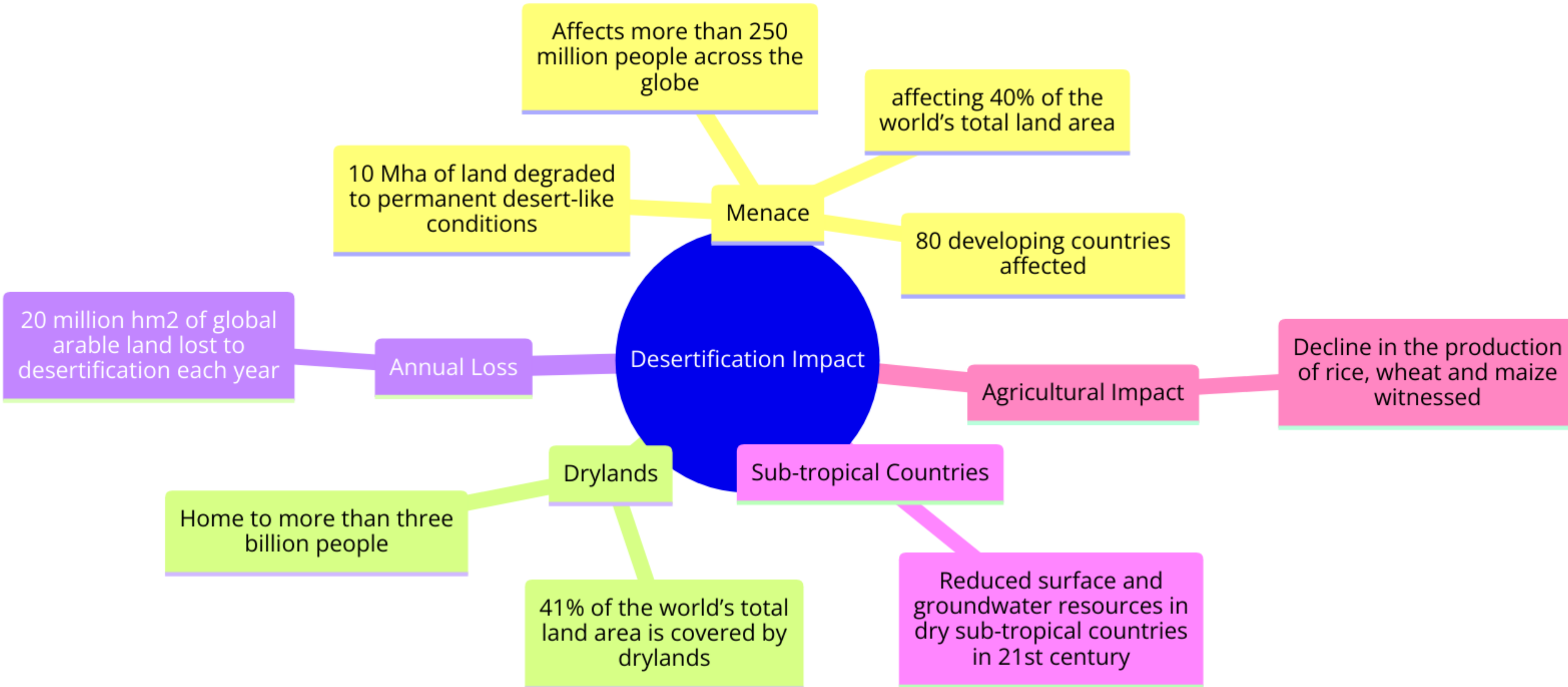
University of Leeds, UK

Introduction

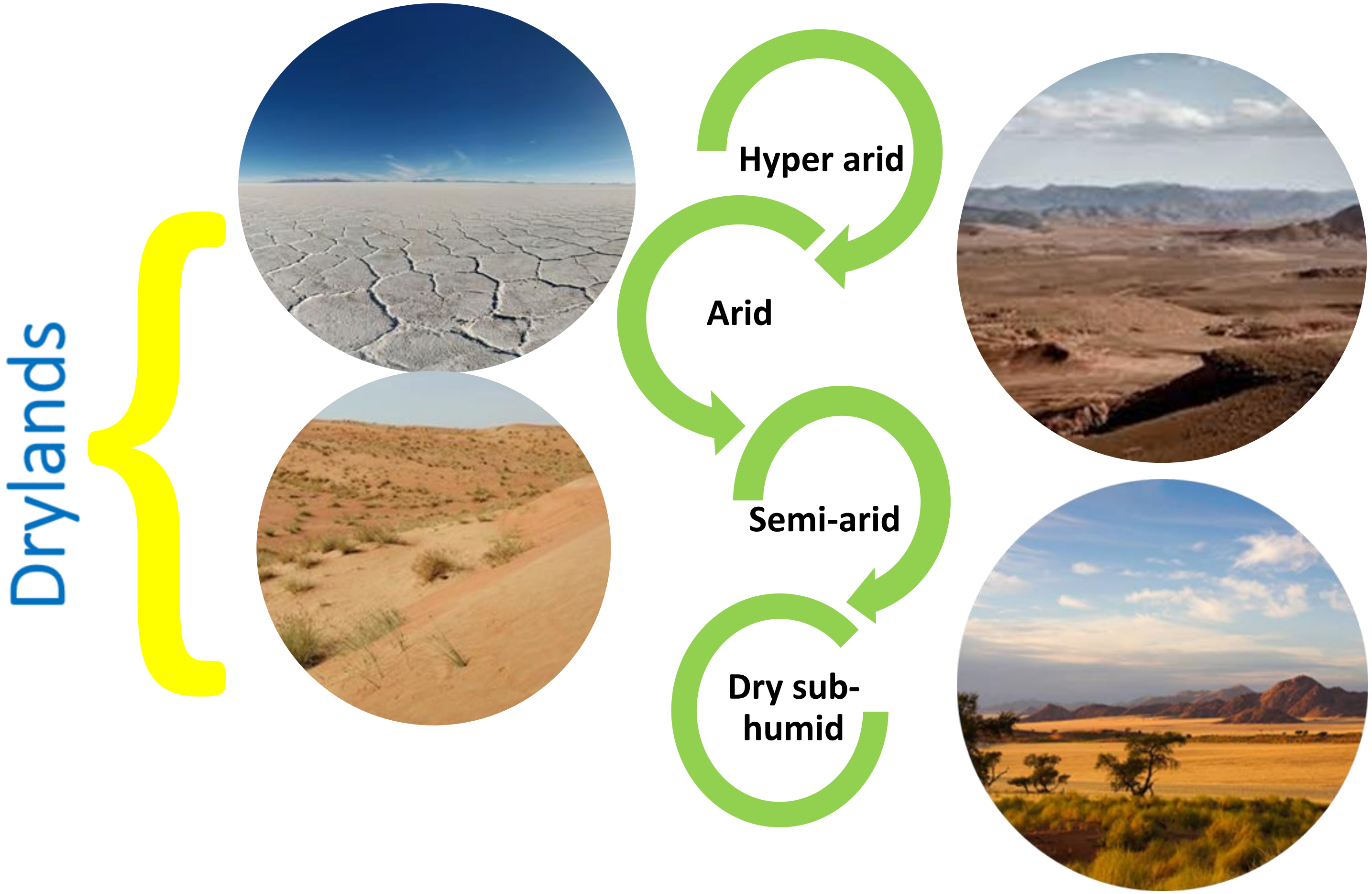
- Land degradation affects almost 2 billion hectares of land worldwide, home to 1.5 billion people.
- Global dry lands cover about 41% of the earth's surface
- Over 90% could become degraded by 2050.
- Every year , 24 billion tons of fertile soils are lost due to erosion.
- Every second, an equivalent of four football fields of healthy land becomes degraded,
- …adding up to a total of 100 million hectares each year.
- Under UNCCD, over 130 countries have already pledged to achieve land degradation neutrality (LDN) by 2030
- Where human activity has a neutral, or even positive, impact on the land.

Sources: UNCCD, FAO

Cont…



(UNCCD, UNEP, FAO)



UNCCD: Arid land (0.05<AI<0.2) Semi arid (0.2<AI<0.5) Dry sub-humid (0.5<AI<0.65)
The United Nations Environment Program defines drylands as tropical and temperate areas with an aridity index of less than 0.65.

A Glimpse of Literature

- Science direct, 1997-2024, almost 20,000 international papers on desertification
- In Pakistan's context 1188 articles
- Only few truly focused on desertification
- A new area of research at PhD level
- Climate change along with anthropogenic factors
- Flagged up for triggering land degradation and resultant desertification
- Continuous water stress…rise in temperature, decrease in number of rainy days and increase in the EL-Nino events

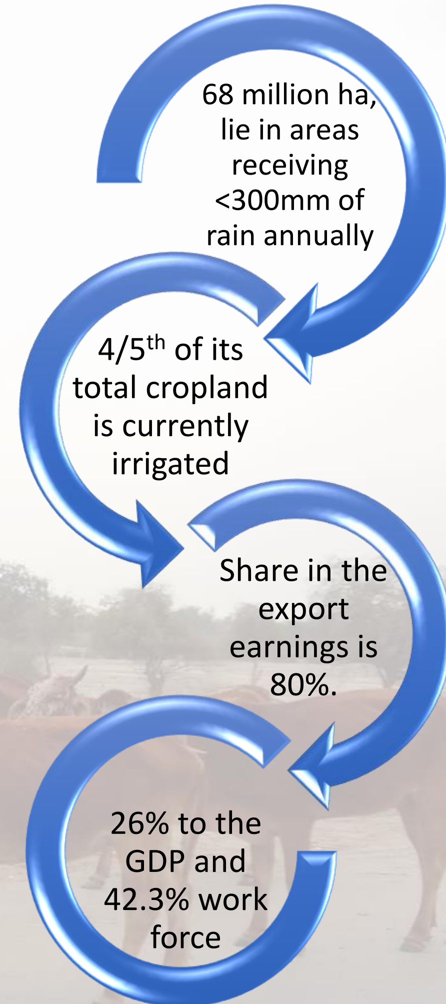
(IPCC, 2019)

Sustainable Development Goal #15 "Life on Land"

"Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, ***combat desertification, and halt and reverse land degradation and halt biodiversity loss****"*

Desertification in Pakistan

- 80% of Pakistan's land is either arid or semi-arid
- 90% currently or vulnerable to it in near future
- Population explosion is a fundamental cause
- 2.4% average annual growth grate for 1998-2017
- 26.77% of the country's land comprises of rangelands
- Livestock sector contributes 11.9% to the GDP
- Foreign exchange share is 3.1%
- Provides source of income to 35-40%
- 8 million rural families rely on livestock for their food security



(Muhammad and Ma, 2020; IUCN, 2017; GoP, 2017; Khan & Ali, 2015; GoP, 2017; Anjum et al., 2010)

Problem Statement

- S. Punjab, 2nd most vulnerable region to climate change [3]

- Bahawalpur & Rahim Yar Khan vulnerable to frequent **droughts** [2]

<carbon storage by soils

Less Agricultural productivity

More GHG emissions

High food insecurity [1]

<water table % quality of aquifers

- 1996-2001 drought led to 59% increase in tube well ownership [4]
- 30% of saline land is in Punjab [4]

- < in growing season's length, quality of the harvest
- Cultivation and harvesting time of major crops is creeping backwards [5]

1 NDMA, 2017; 2 PDMA, 2018; Malik et al., 2012; 4 Wahla et al., 2023; Akram and Hamid, 2015

Photographs taken During Field Survey, Feb 2019

Bakhirpur 29.19 N 70.28 E
Rajanpur

Sanjar, 30.14N 72.35E
Bahawalpur

Chak no.186/P, 28.20 N 70.09E
Rahim Yar Khan

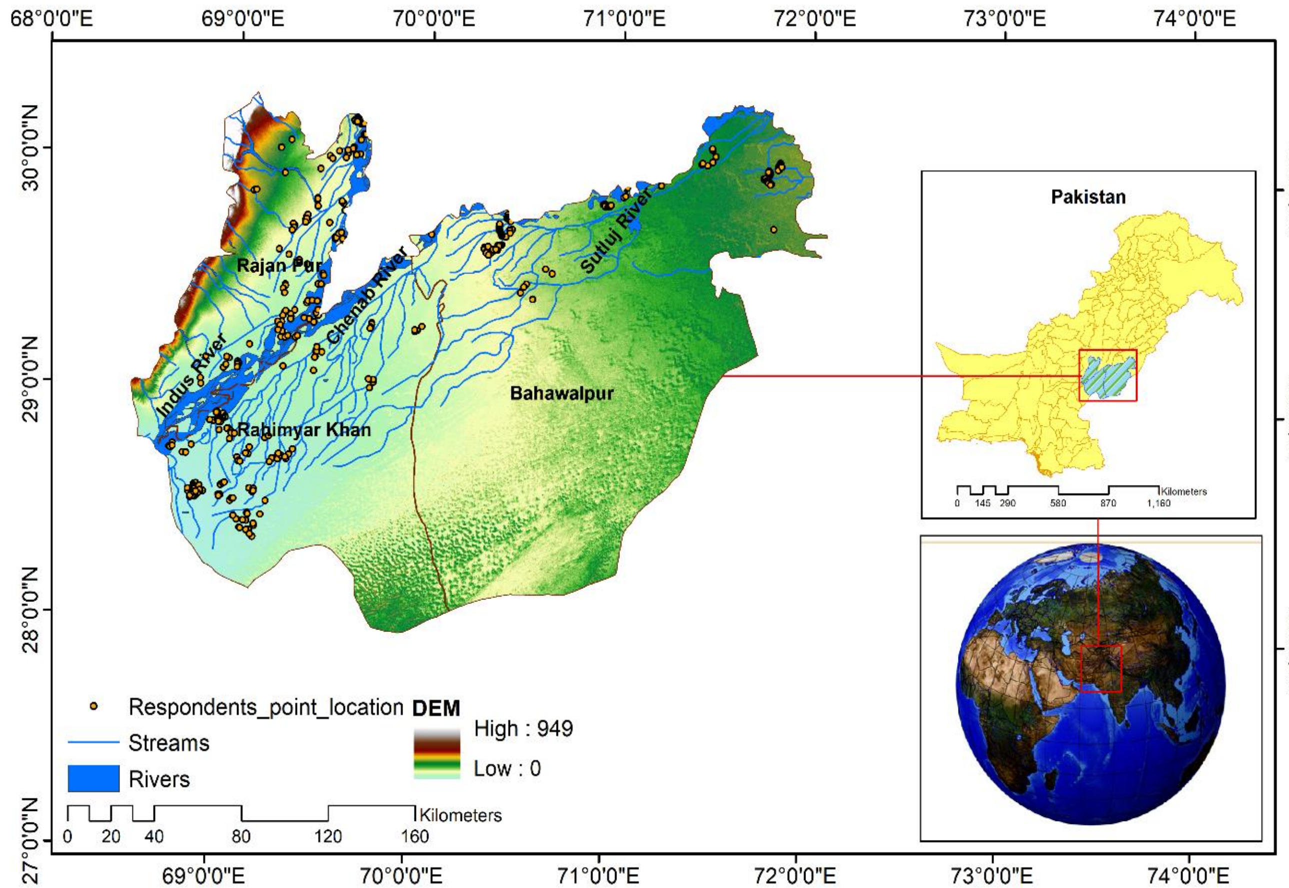
Tibbi Lundan,30.65N 70.87E
Rajanpur

Chak no. 79, 30.28N 73.02E
Bahawalpur

Iqbal Nagar, 29.09 N 70.89E
Rahim Yar Khan

Study Area

- Bahawalpur, Rahimyar Khan and Rajanpur
- Highly rural population Bahawalpur 68%, Rahim Yar Khan 79%, Rajanpur 83%(GoP, 2017)
- Agrarian economy
- Mixed crop-livestock
- Salinization



Objectives of the Study:

1-Spatio-temporal-extent of Desertification in South Punjab

- 1.1 Spatial analysis of the desertification factors, i.e. slope, aspect and Land Use Land Cover (LULC)
- 1.2 Detect Patterns of Land Sensitivity
- 1.3 Land degradation assessment
- 1.4 Identify Patterns of Desertification Vulnerability and Desertification Degree
- 1.5 Identify Environmental Sensitivity to Desertification

2-Major Drivers of Desertification from the Perspective of the Local Residents

3-Impacts of Desertification on the People and Vegetation Conditions, Livestock and Food Security

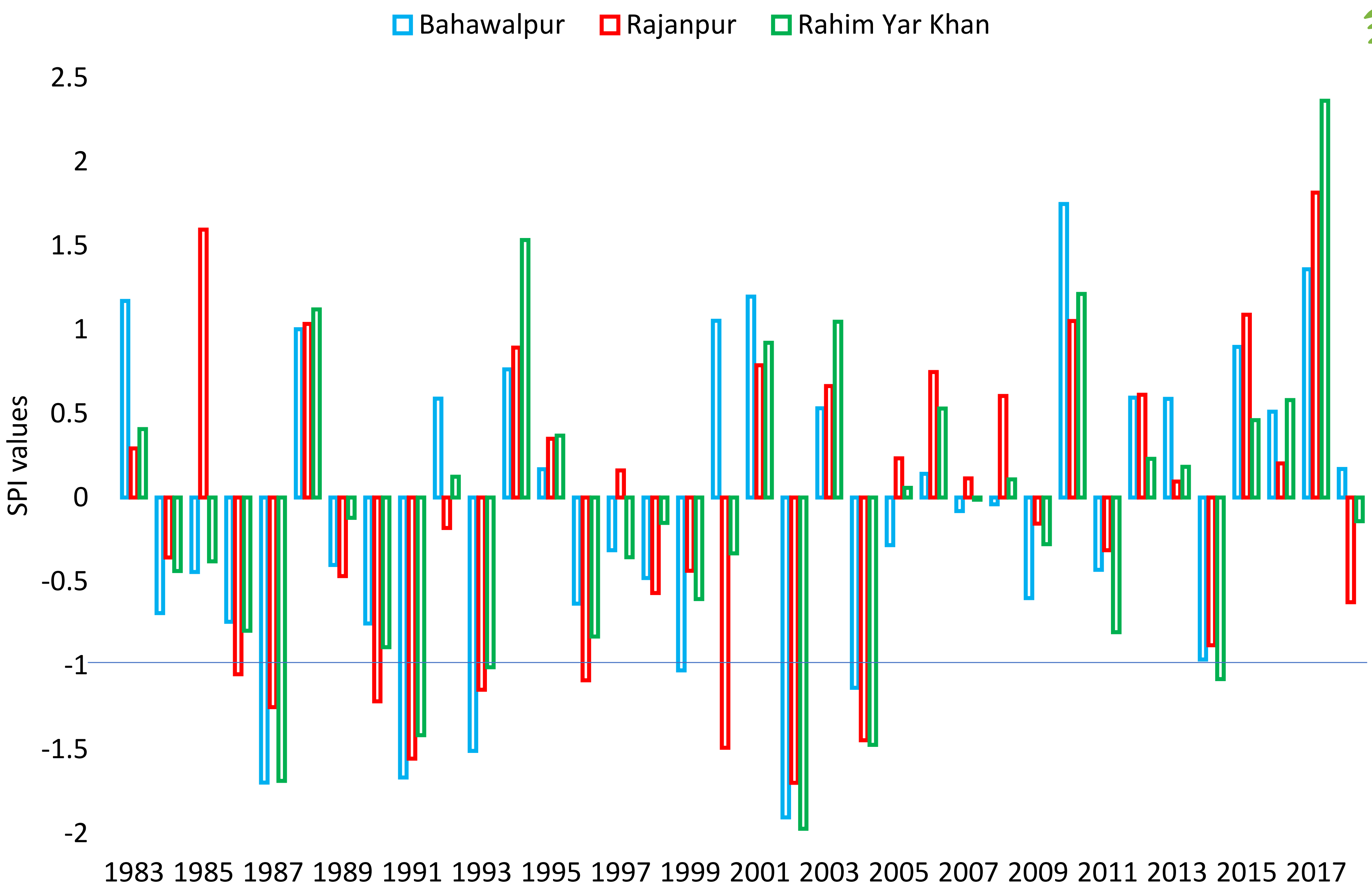
- 3.1 Measure the variability of the stresses the plants in the study area bear

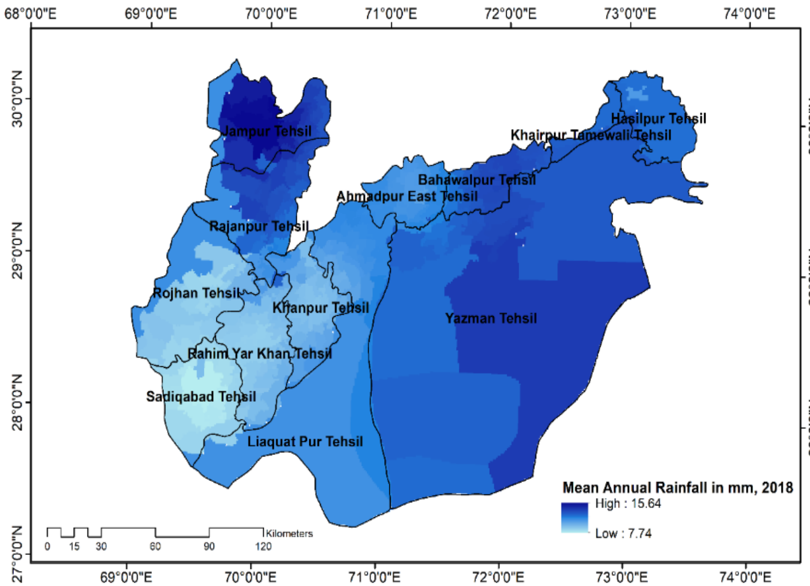
4-Investigate the Adaptive Capacity of the Local Farming Community

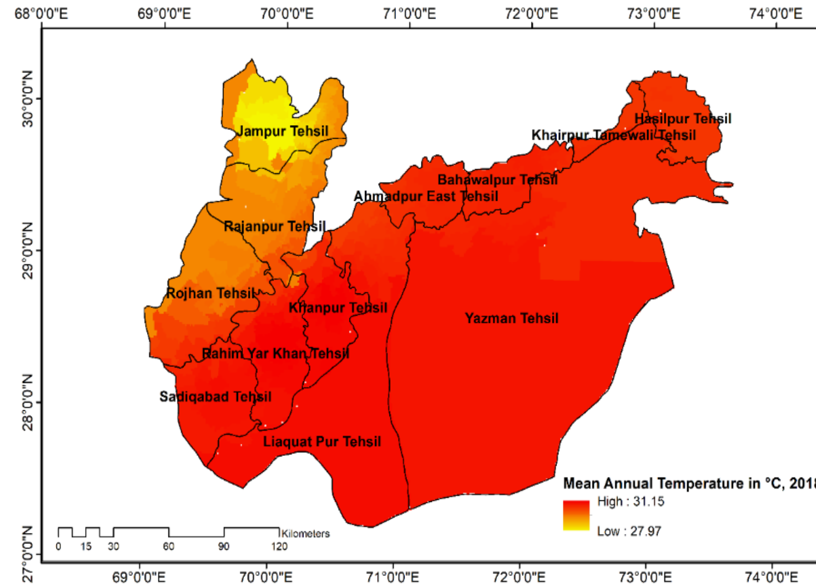
5-Remedial Measures and Management Plan to Combat Desertification

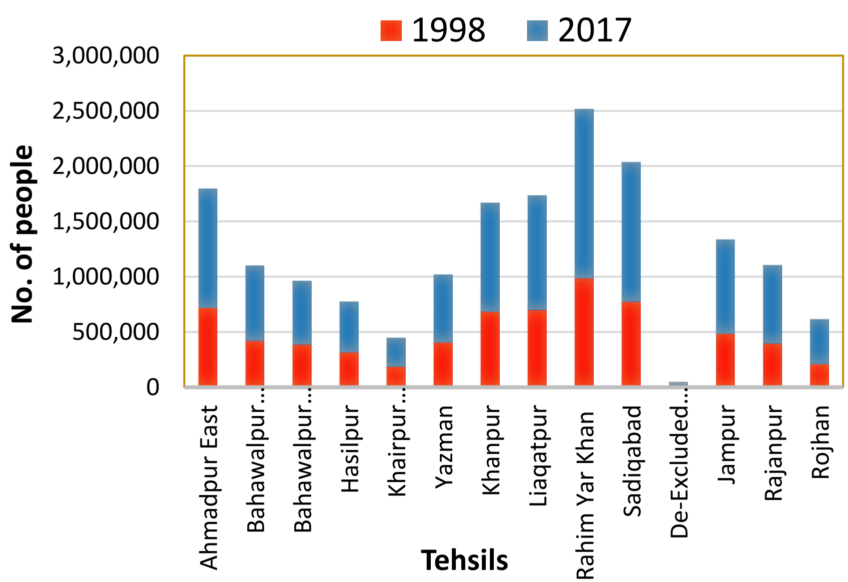
- 5.1 Policies and Strategies to reduce the impact of Desertification in South Punjab

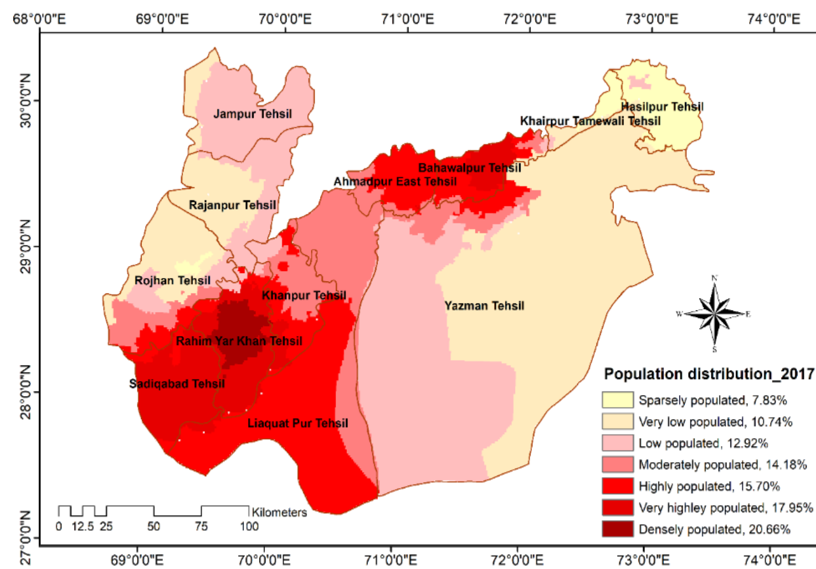
Standard Precipitation Index,1983-2018



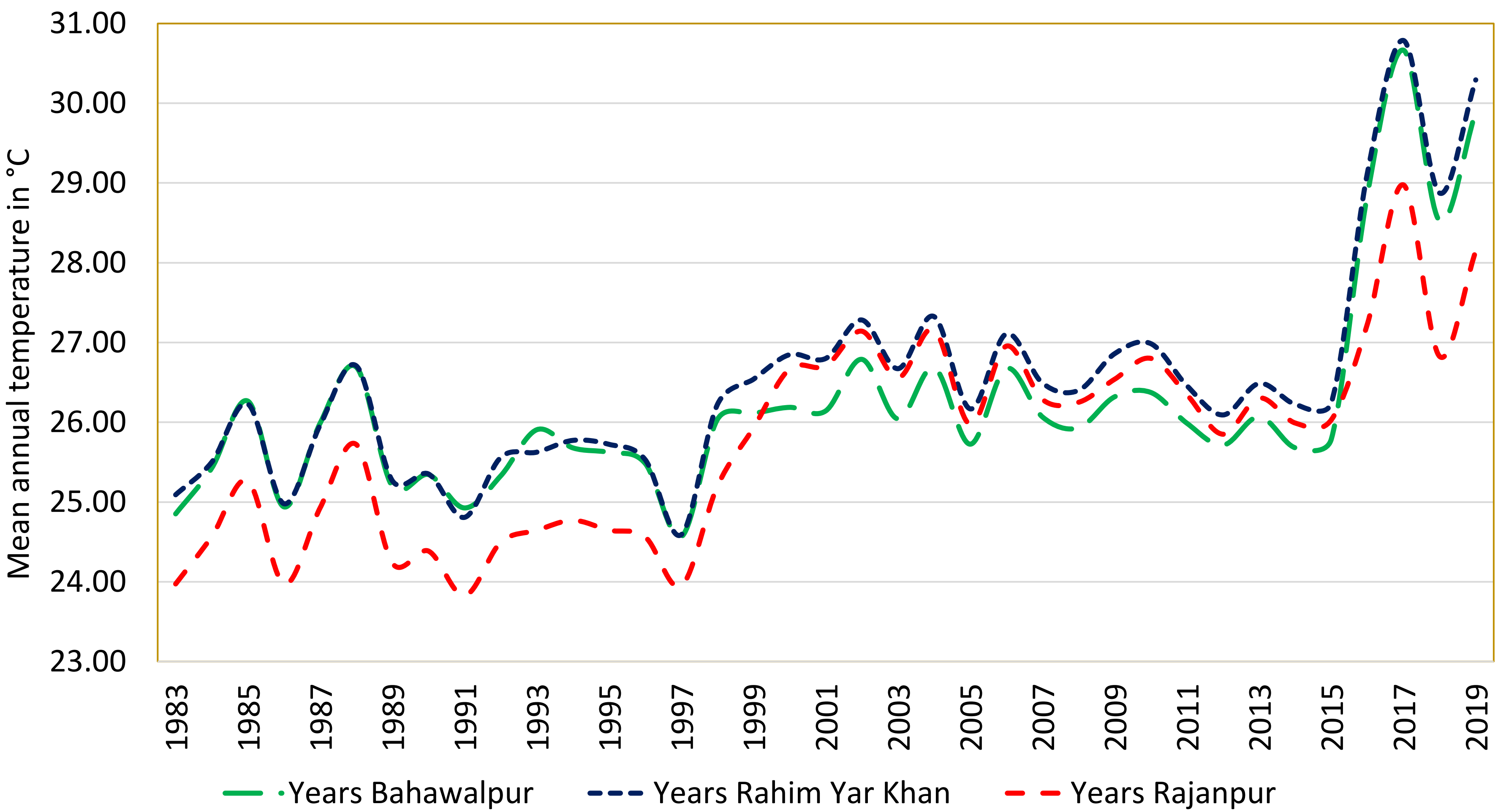

Jampur Tehsil
Hasilpur Tehsil
Khairpur Tamewali Tehsil
Bahawalpur Tehsil
Ahmadpur East Tehsil
Rajanpur Tehsil
Rojhan Tehsil
Khanpur Tehsil
Yazman Tehsil
Rahim Yar Khan Tehsil
Sadiqabad Tehsil
Liaquat Pur Tehsil
Mean Annual Rainfall in mm, 2018
High : 15.64
Low : 7.74
Kilometers
0 15 30 60 90 120


Jampur Tehsil
Hasilpur Tehsil
Khairpur Tamewali Tehsil
Bahawalpur Tehsil
Ahmadpur East Tehsil
Rajanpur Tehsil
Rojhan Tehsil
Khanpur Tehsil
Yazman Tehsil
Rahim Yar Khan Tehsil
Sadiqabad Tehsil
Liaquat Pur Tehsil
Mean Annual Temperature in °C, 2018
High : 31.15
Low : 27.97
Kilometers
0 15 30 60 90 120

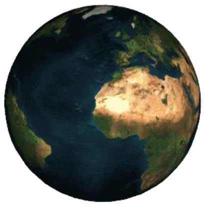

1998
2017
No. of people
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
Ahmadpur East
Bahawalpur...
Bahawalpur...
Hasilpur
Khairpur...
Yazman
Khanpur
Liaqatpur
Rahim Yar Khan
Sadiqabad
De-Excluded...
Jampur
Rajanpur
Rojhan
Tehsils

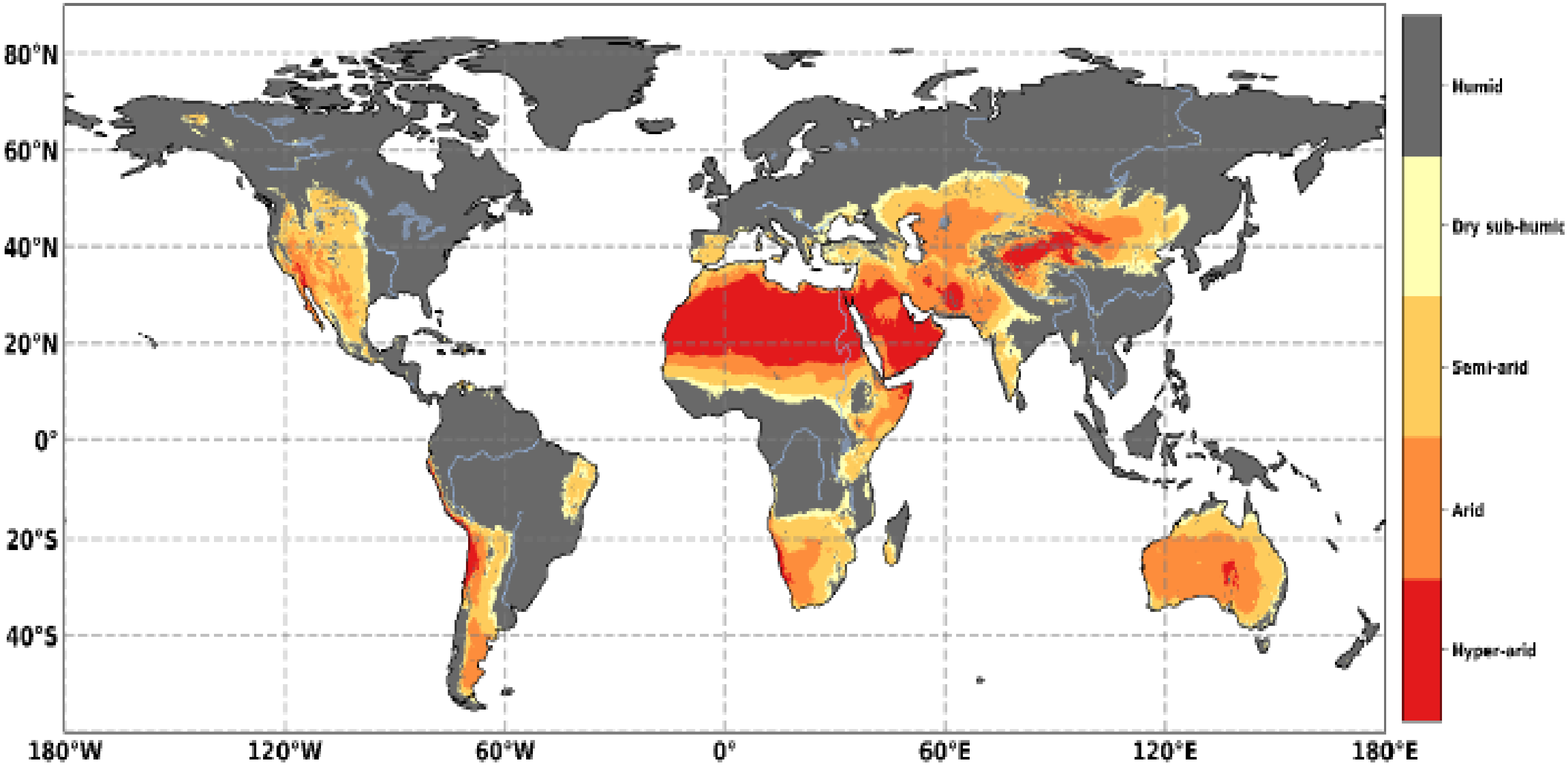

Jampur Tehsil
Hasilpur Tehsil
Khairpur Tamewali Tehsil
Bahawalpur Tehsil
Ahmadpur East Tehsil
Rajanpur Tehsil
Rojhan Tehsil
Khanpur Tehsil
Yazman Tehsil
Rahim Yar Khan Tehsil
Sadiqabad Tehsil
Liaquat Pur Tehsil
Population distribution_2017
Sparsely populated, 7.83%
Very low populated, 10.74%
Low populated, 12.92%
Moderately populated, 14.18%
Highly populated, 15.70%
Very highley populated, 17.95%
Densely populated, 20.66%
Kilometers
0 12.5 25 50 75 100

Mean Annual Temperature 1983-2019



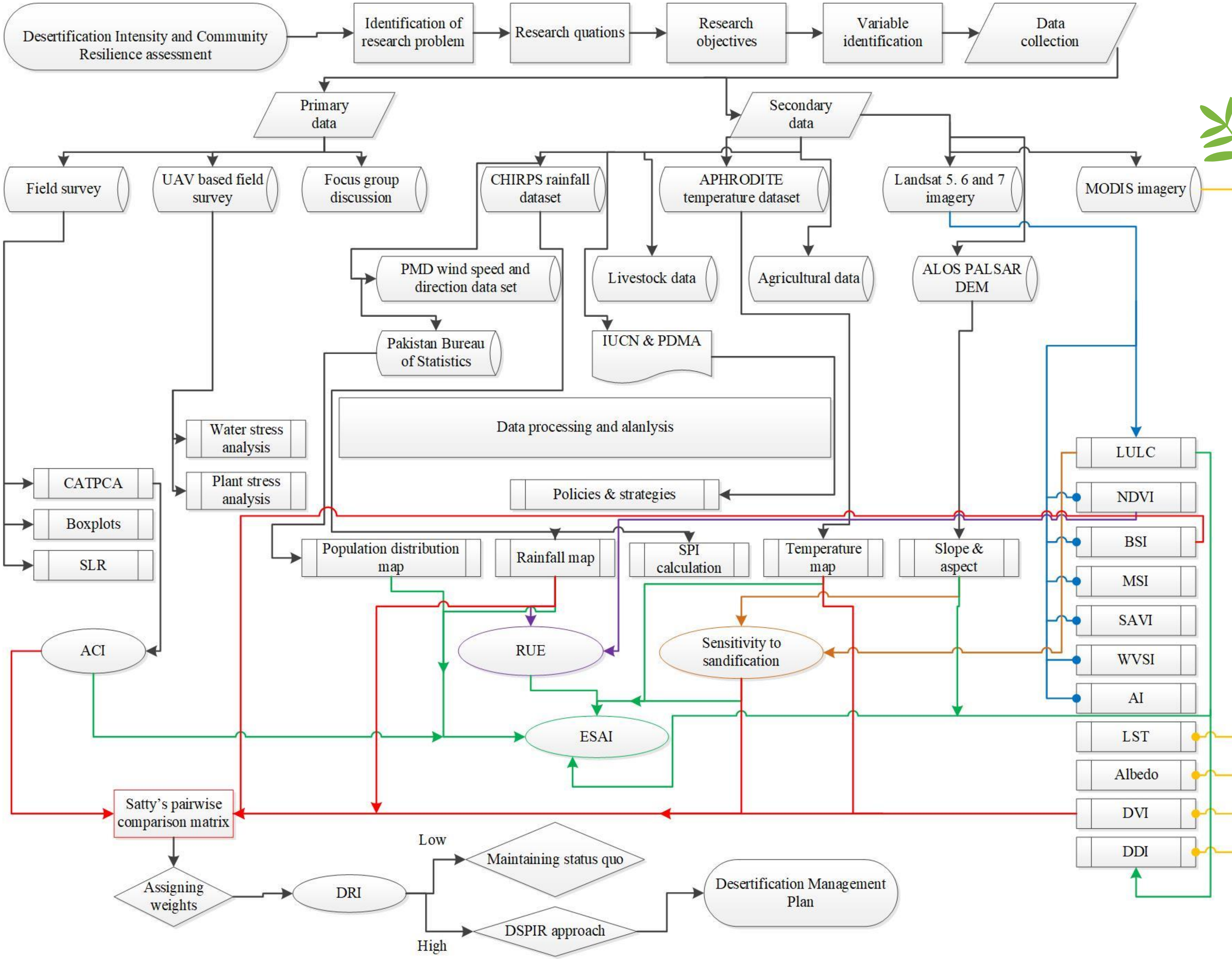
Geographical Distribution of Drylands, Aridity Index (AI).





IPCC, (2019)

Methodological Framework



Sources of Data sets

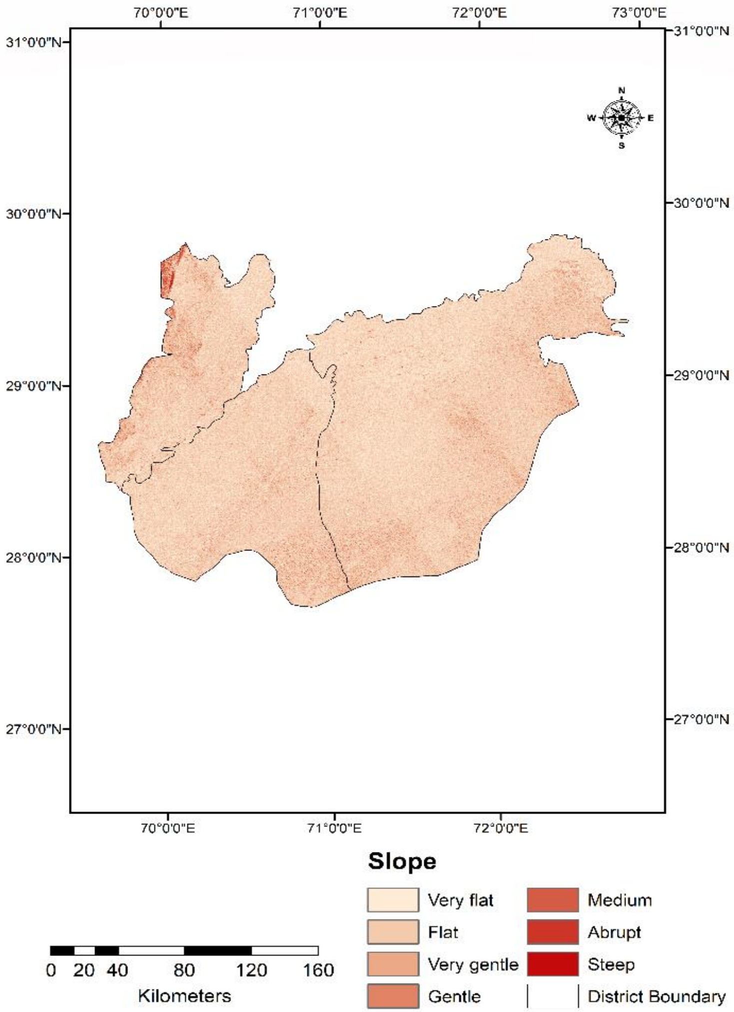
Sr. no	Data sets	Organization name	Time period
1	Landsat 5 TM, Landsat 7 ETM+ and Landsat 8 OLI images 30m	USGS earth explorer	1989, 2001 and 2018
2	MODIS 250 m resolution images of the study area, sensor MOD13Q1 MOD11A2 MOD16A2	USGS earth explorer	2000, 2009 and 2018
3	DEM ALOS PALSAR 12.5m resolution	Alaska Satellite Facility (ASF)	2019
4	Rainfall	CHIRPS	1983-2018
5	Temperature	APHRODITE	1983-2019
6	Wind speed, direction, rainfall and temperature data of Bahawalpur	PMD	1984-2017
6	Area under cultivation, crop yield per hectare and production of cotton, sugarcane, rice and wheat	Agriculture Department (Crop reporting service)	1990-2016
7	Number of Livestock in the study area	Livestock and Dairy Department	2018
8	Current policies of Provincial government to fight desertification in the study area.	PDMA	Obj 5
9	Population distribution in study area, growth rate	Pakistan Bureau of Statistics	1998 and 2017
10	LULC and irrigation network maps of study area	Urban Unit	-
11	Other supportive data sets	Statistical Pocket Book	2018

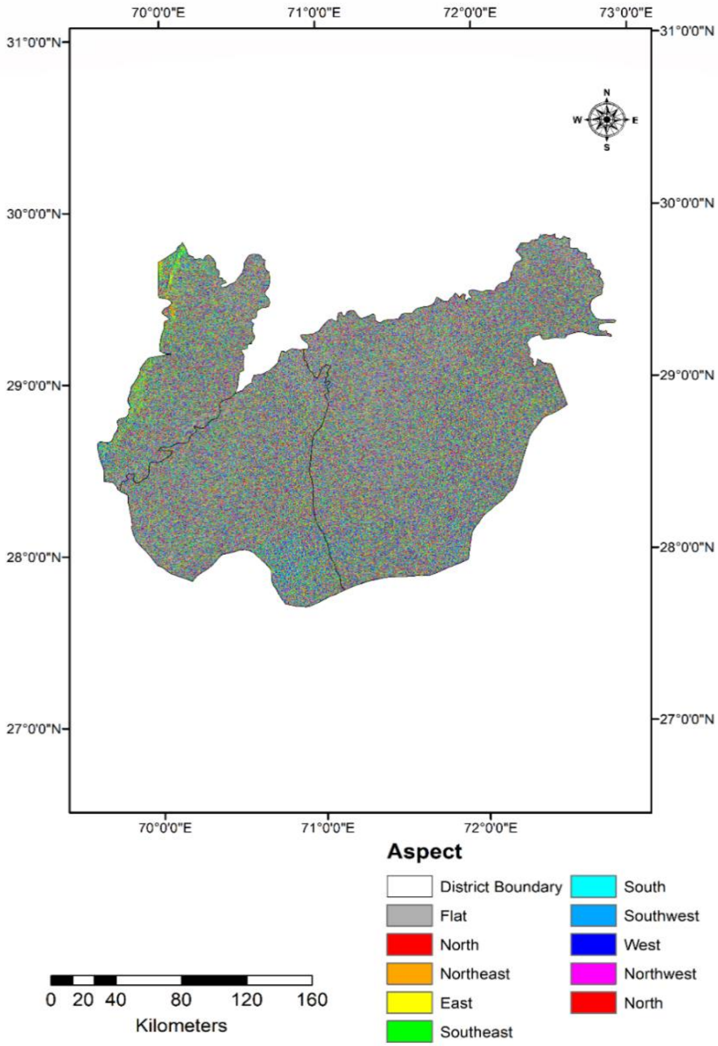
1-Spatio-temporal-extent of Desertification in South Punjab

- **1.1 Spatial analysis of the desertification factors, i.e. slope, aspect and Land Use Land Cover (LULC) in the region under study**

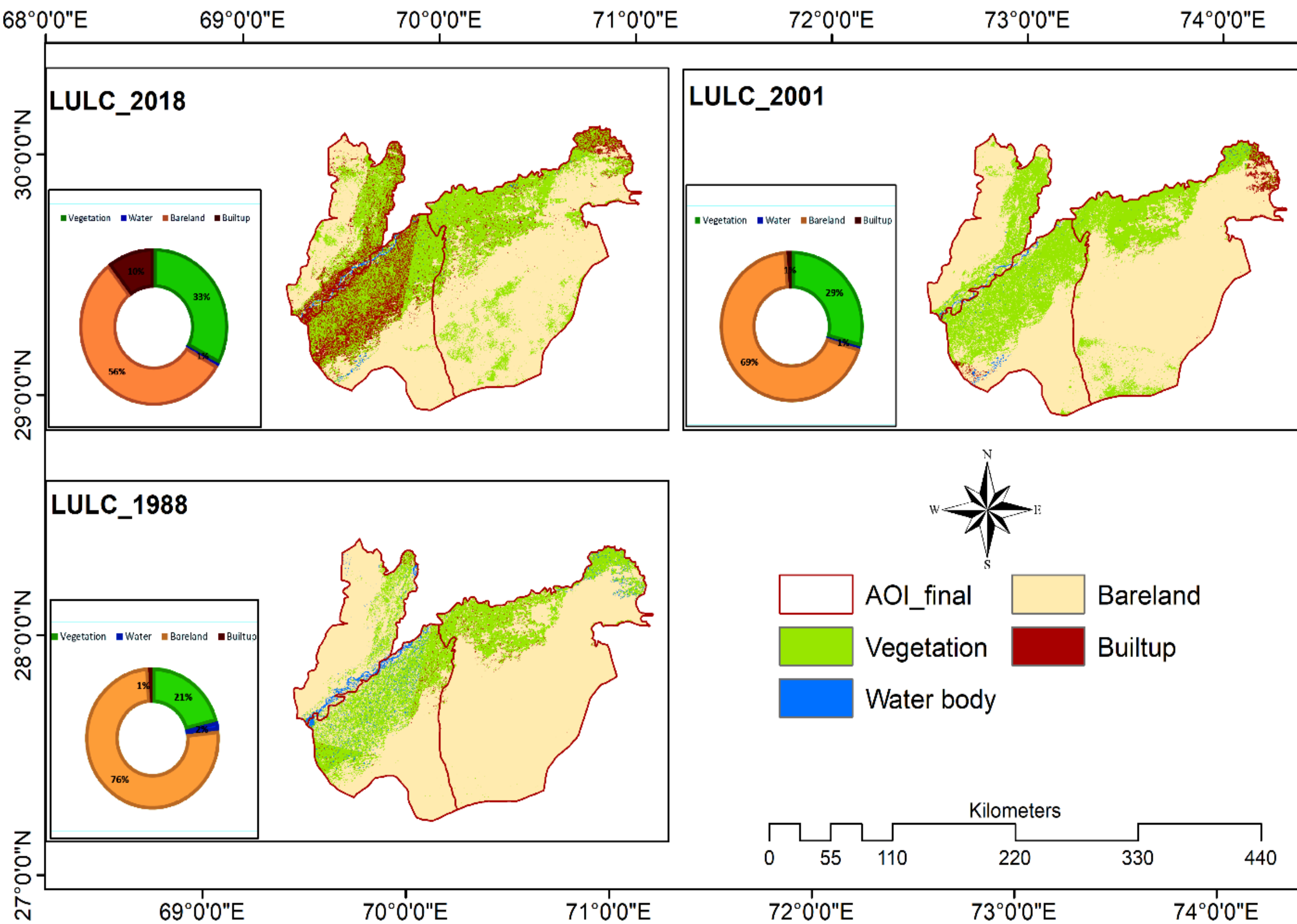
Variables	Data sets	Data sources	Analysis
Slope, aspect (Mostefaoui, 2017)	ALOS PALSAR DEM, 2019, 12.5m	Alaska Satellite Facility (ASF)	Slope and aspect mapping using slope and aspect tools in Arc GIS
Land Use Land Cover (LULC) (Mostefaoui, 2017)	Landsat 5,7 and 8 imagery (1989, 2001, 2018)	USGS earth explorer	LULC mapping using Maximum Likelihood classification

Slope and Aspect





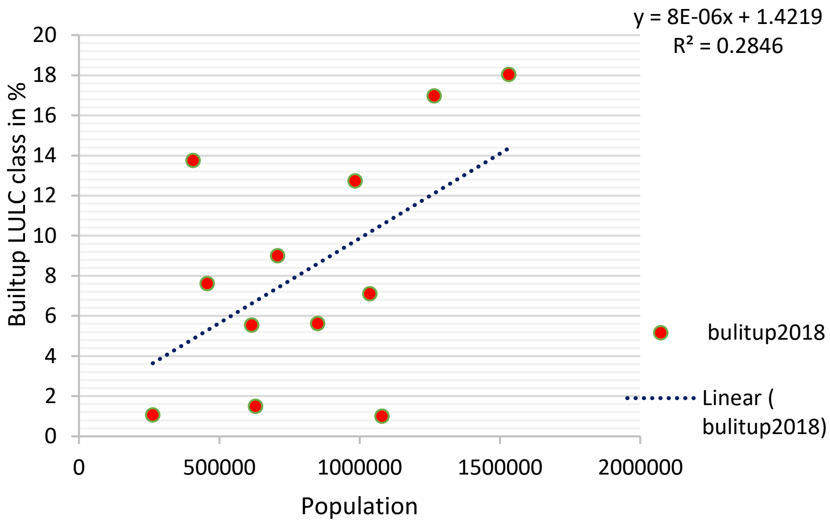
LULC

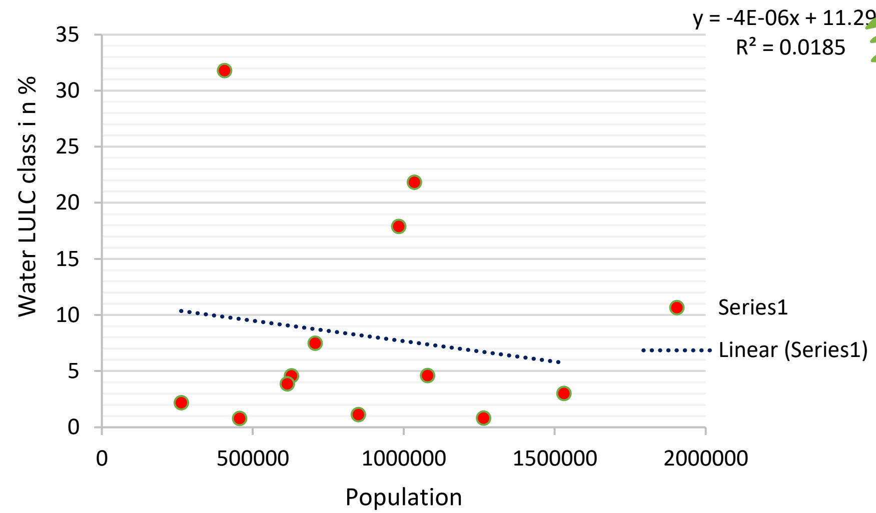

68°0'0"E
69°0'0"E
70°0'0"E
71°0'0"E
72°0'0"E
73°0'0"E
74°0'0"E
30°0'0"N
29°0'0"N
28°0'0"N
27°0'0"N
LULC_2018
Vegetation Water Bareland Builtup
10%
33%
1%
56%
LULC_2001
Vegetation Water Bareland Builtup
1%
29%
1%
69%
LULC_1988
Vegetation Water Bareland Builtup
1%
21%
2%
76%
N
W
E
S
AOI_final
Bareland
Vegetation
Builtup
Water body
Kilometers
0 55 110 220 330 440

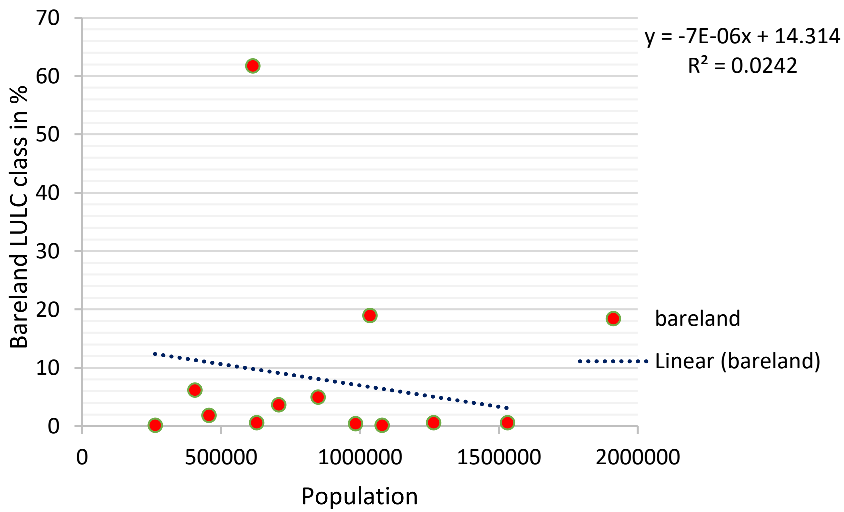
LULC % change

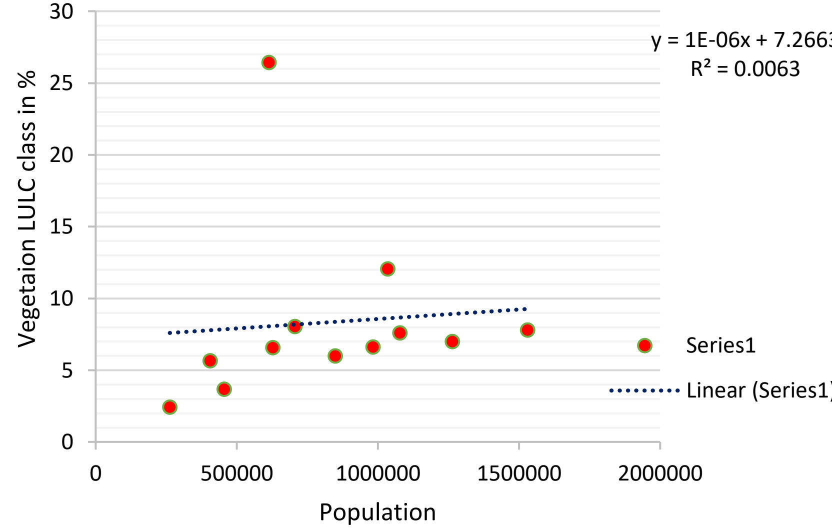
LULC Class	1980	2001	2018	% change	Rate of Change
Vegetation	9384.73	13034.69	14617.96	55.76	174.44
Water	938.02	255.26	243.79	-74.00	-23.14
Bare land	33793.59	30767.51	25065.99	-25.82	-290.92
Built-up	436.13	501.85	4630.60	961.74	139.81
Total	44552.48	44559.32	44558.35	0.013	0.19

Relation between LULC Classes and Population



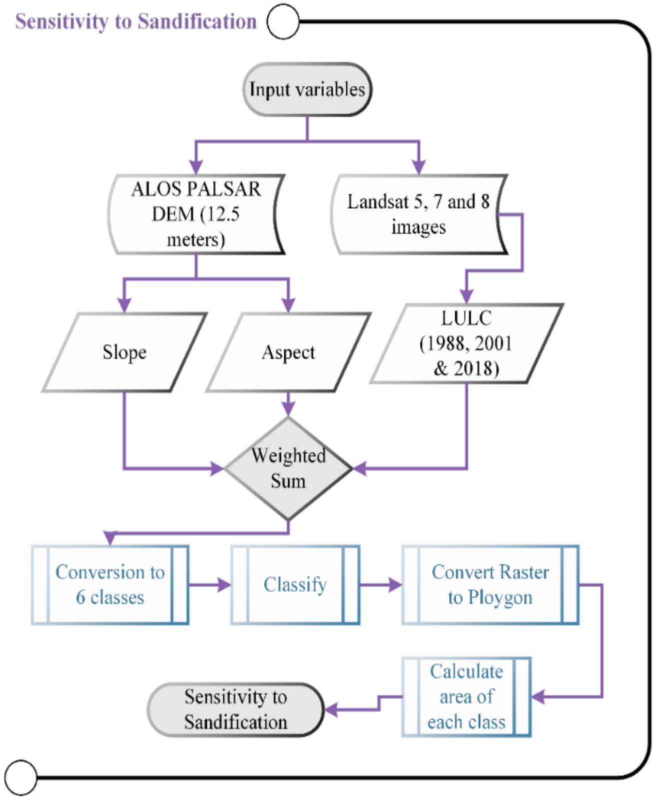


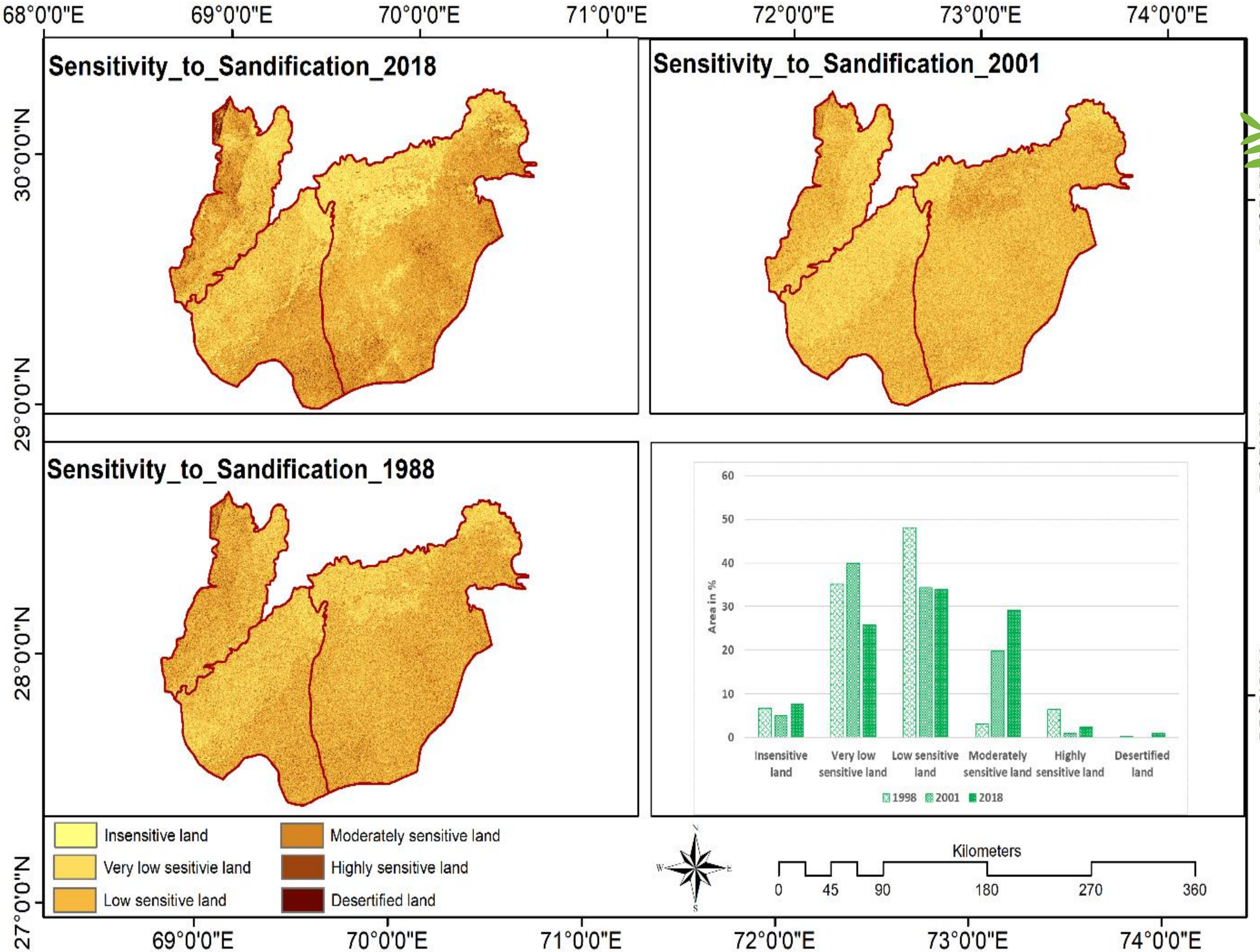




1.2 Detect Patterns of Land Sensitivity

Variables	**Data sets**	**Analysis**
Slope, aspect and LULC (Mostefaoui, 2017)	Slope, aspect and LULC raster layers	Sensitivity to sandification maps using weighted sum technique for 1988, 2001 and 2018




Sensitivity_to_Sandification_2018
Sensitivity_to_Sandification_2001
Sensitivity_to_Sandification_1988
68°0'0"E
69°0'0"E
70°0'0"E
71°0'0"E
72°0'0"E
73°0'0"E
74°0'0"E
30°0'0"N
29°0'0"N
28°0'0"N
27°0'0"N
Area in %
60
50
40
30
20
10
0
Insensitive land
Very low sensitive land
Low sensitive land
Moderately sensitive land
Highly sensitive land
Desertified land
1998
2001
2018
Insensitive land
Very low sesitivie land
Low sensitive land
Moderately sensitive land
Highly sensitive land
Desertified land
Kilometers
0
45
90
180
270
360

Sensitivity to Sandification Rate of Change

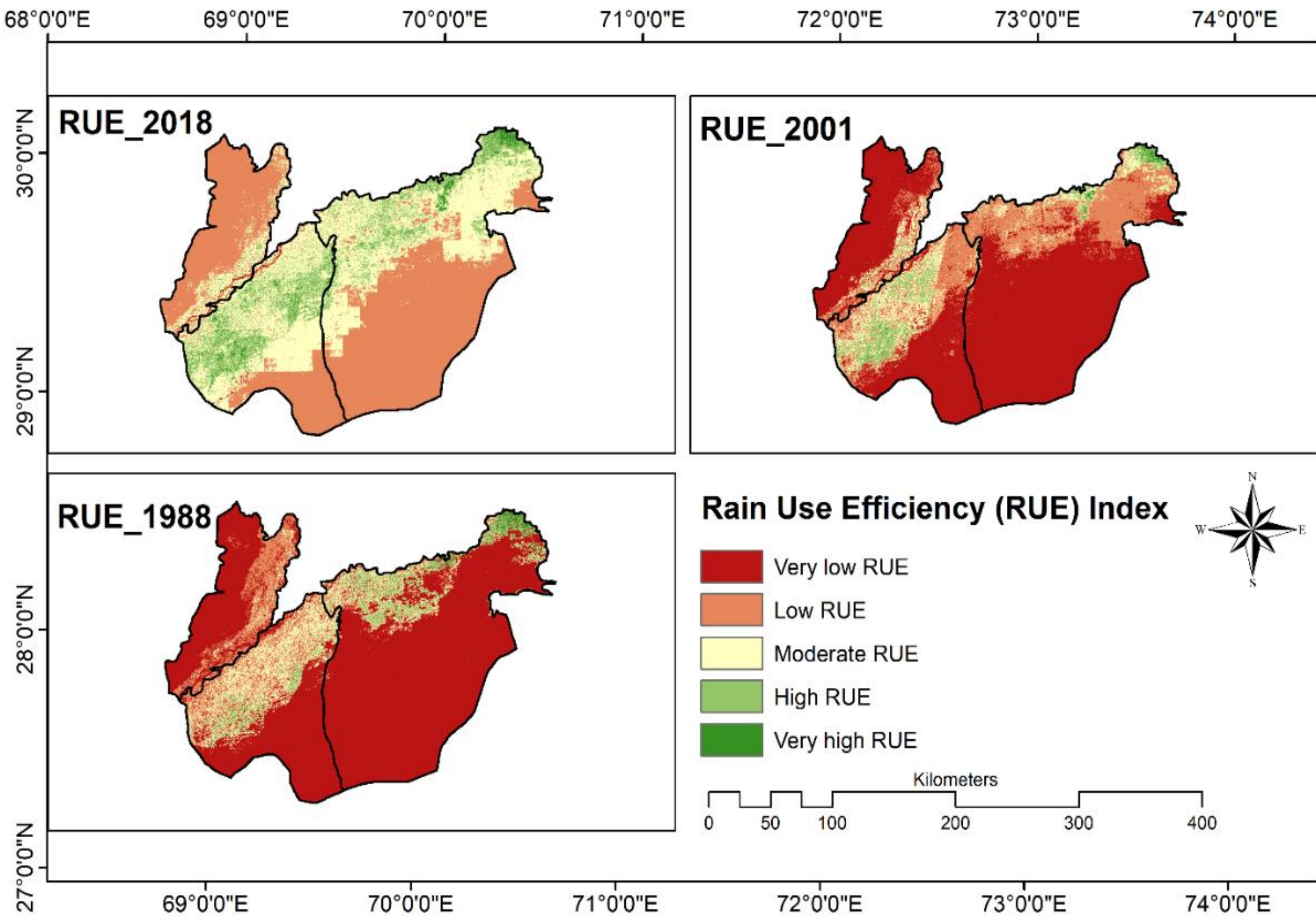
Sensitivity to Sandification	Percentage Change			Rate of Change		
Classes	1988-2001	2001-2018	1988-2018	1988-2001	2001-2018	1988-2018
Insensitive land	-4.29	53.70	47.11	-3.35	40.24	36.88233
Very low sensitive land	45.04	-35.15	-5.95	183.45	-207.67	-24.2243
Low sensitive land	-8.62	-0.66	-9.23	-47.92	-3.35	-51.2717
Moderately sensitive land	712.33	47.17	1095.52	257.80	138.68	396.479
Highly sensitive land	-81.32	148.14	-53.65	-60.58	20.61	-39.968
Desertified land	-97.94	30003.31	521.58	-2.39	15.10	12.71433

1.3 Land degradation assessment

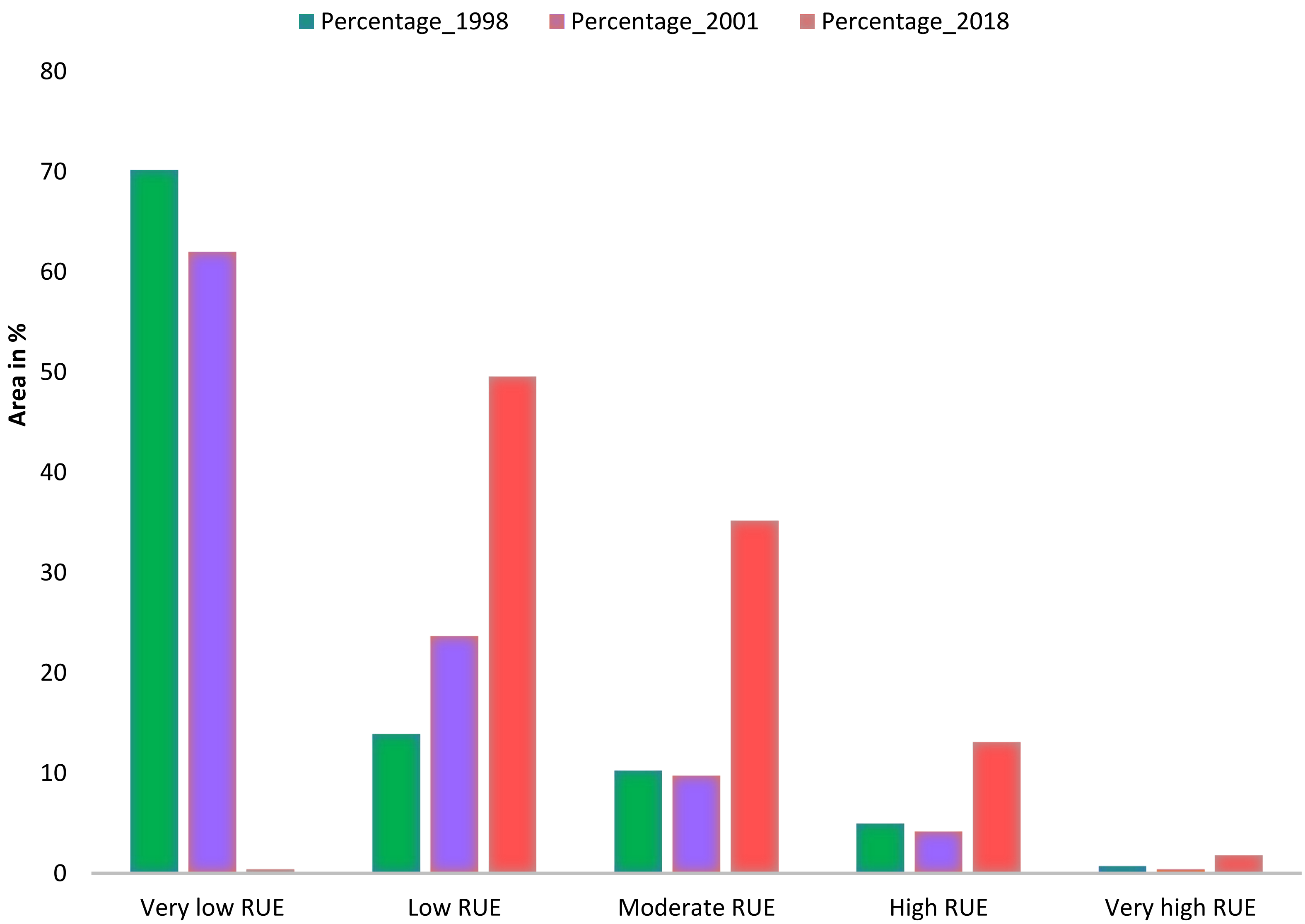
$Rainuse\ efficieny\ (RUE)$=NDVI/Rainfall (Kundu et al., 2017; Zhao et al., 2018)

Variables	Data sets	Data source	Analysis
NDVI and precipitation datasets	• NDVI for the month of April (1987, 2001, 2018) • Precipitation raster data sets for the same months and years	• Landsat 5, 7 and 8 • Climate Hazards Group infrared Precipitation with Station Data (CHIRPS)	Raster calculator used to calculate RUE for 1987, 2001 and 2018

Rain Use Efficiency (RUE)



Area of Rain Use Efficiency (RUE) classes

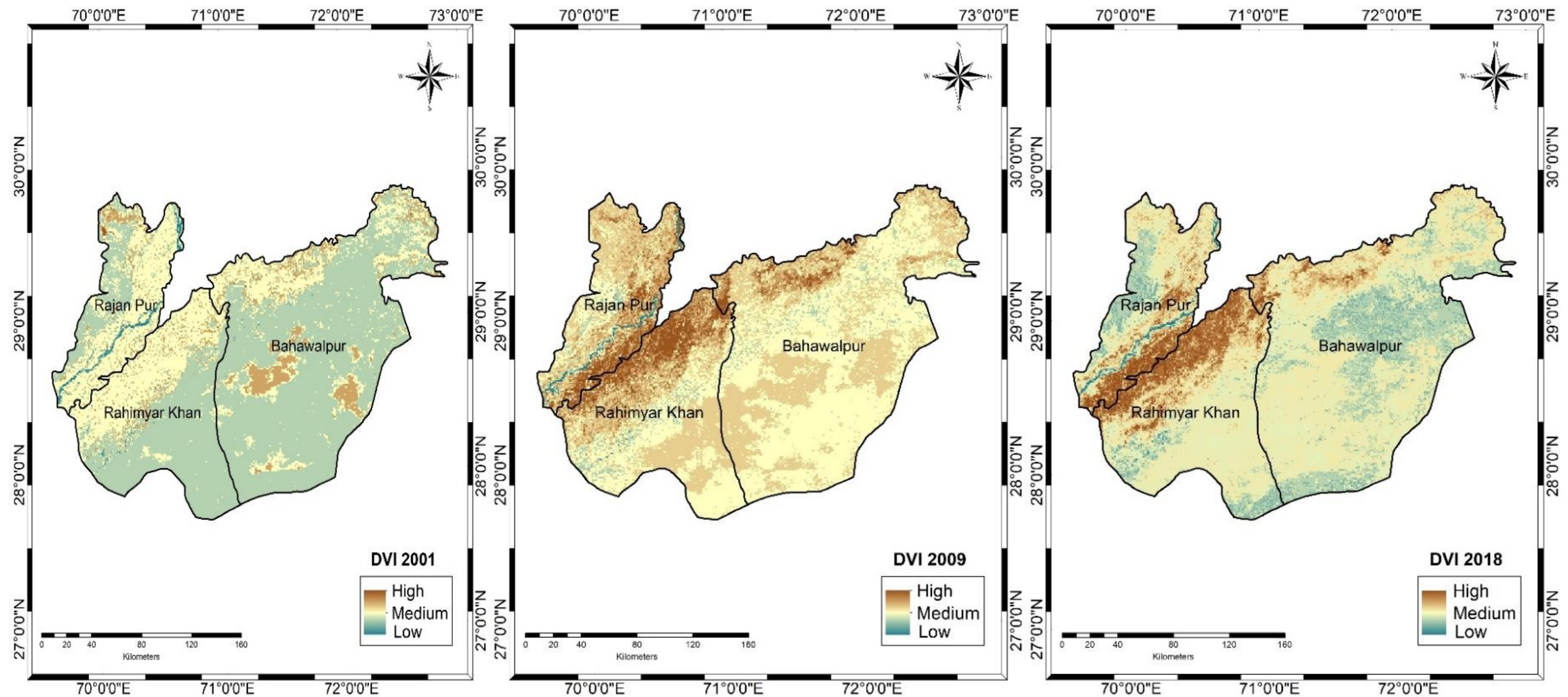


1.4 Identify Patterns of Desertification Vulnerability and Desertification Degree

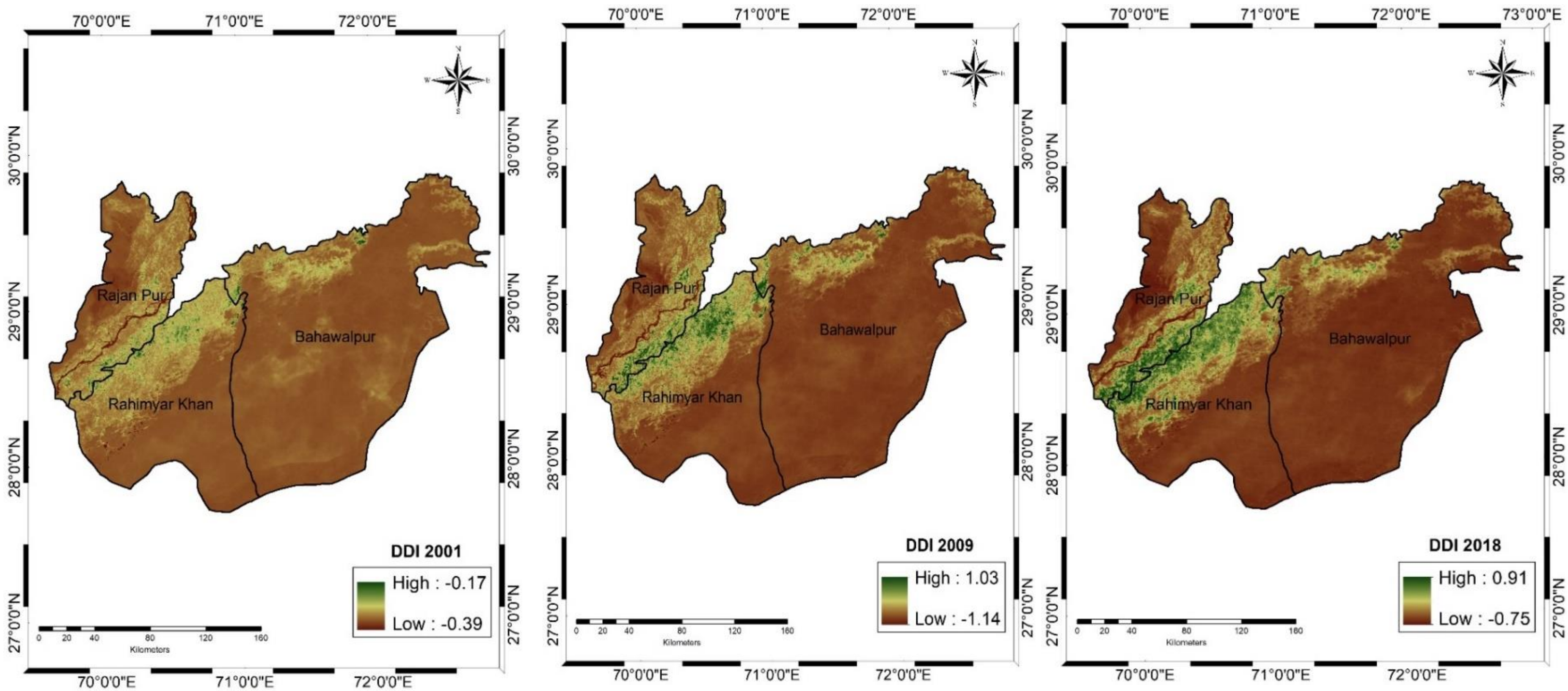
- DDI was calculated to explore the intensity of desertification in the region
- $DDI = 1.4895 \text{ x } NDVI - Albedo$
- $Albedo = \text{-}0.67137 \text{ x } NDVI + 0.38439$ Zeng et al. (2006)
- The DVI calculated in this study is based on physical attributes, Albedo, NDVI, TNDVI, SAVI, MSI, LST, PET

Variables	**Data sets**	**Data source**	**Data analysis**
DDI	NDVI, Albedo	MODIS	DDI maps for 2001, 2009 & 2018 prepared by calculating in raster calculator
DVI	Albedo, NDVI, TNDVI, SAVI, MSI, LST, PET	MODIS	DVI maps prepared for 2001, 2009 & 2018 prepared by weighted overlay analysis

Desertification Vulnerability Index (DVI)



Desertification Difference Index (DDI)

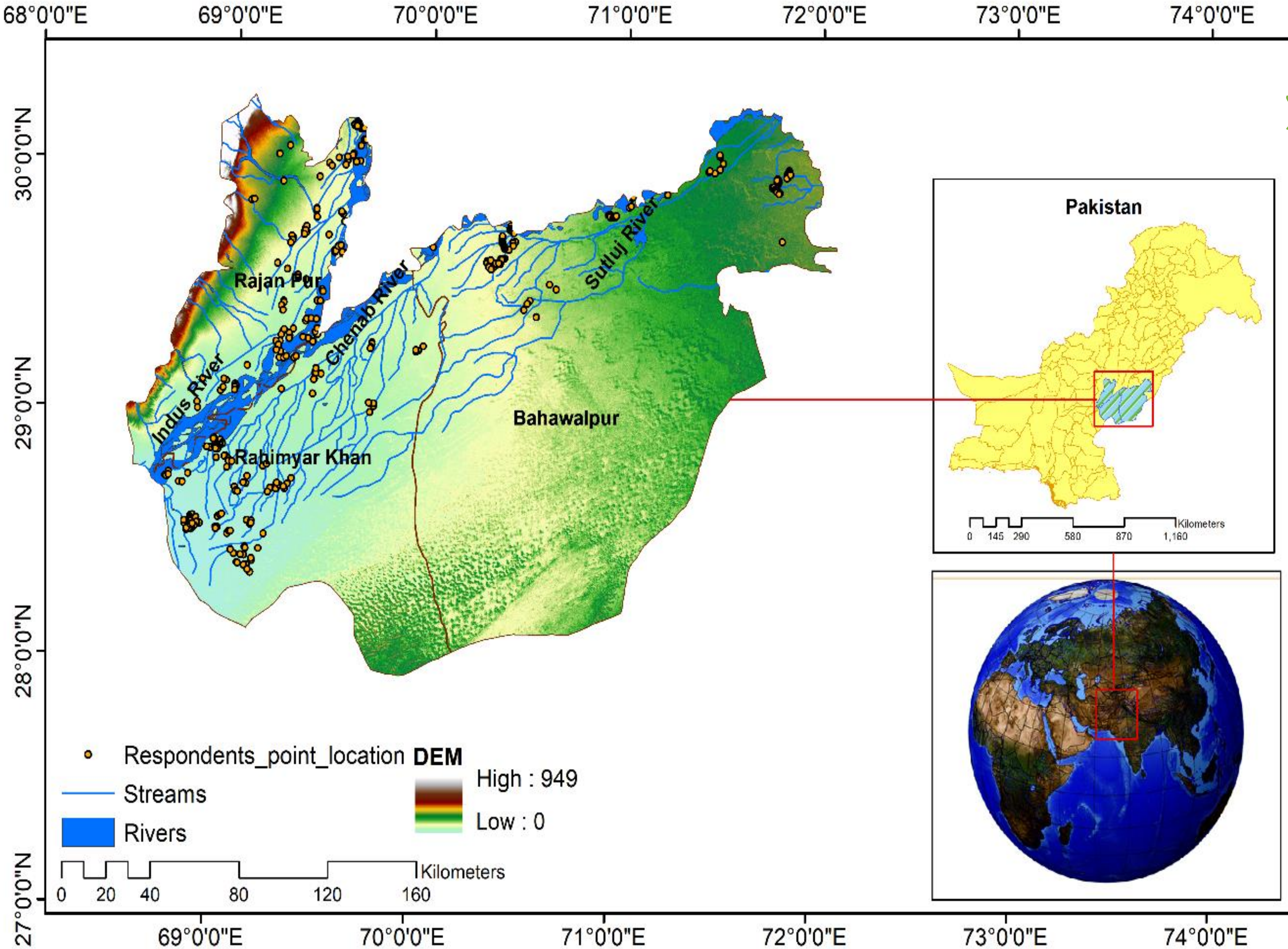


2-Major Drivers of Desertification from the Perspective of the Local Residents

Variables	Data sets	Data source	Data Analysis
Natural drivers • Shift in rainfall pattern • Temperature extremes • Soil moisture loss • Frequent dry spells • Soil salinity • Water scarcity	Survey forms in SPSS	Questionnaire based survey	SLR (Lin et al., 2017; Vanleeuwen, Hartfield, Miranda, & Meza, 2013)
Anthropogenic drivers • Overgrazing • Unsustainable agricultural practices • Over population • Land degradation			Graphical analysis

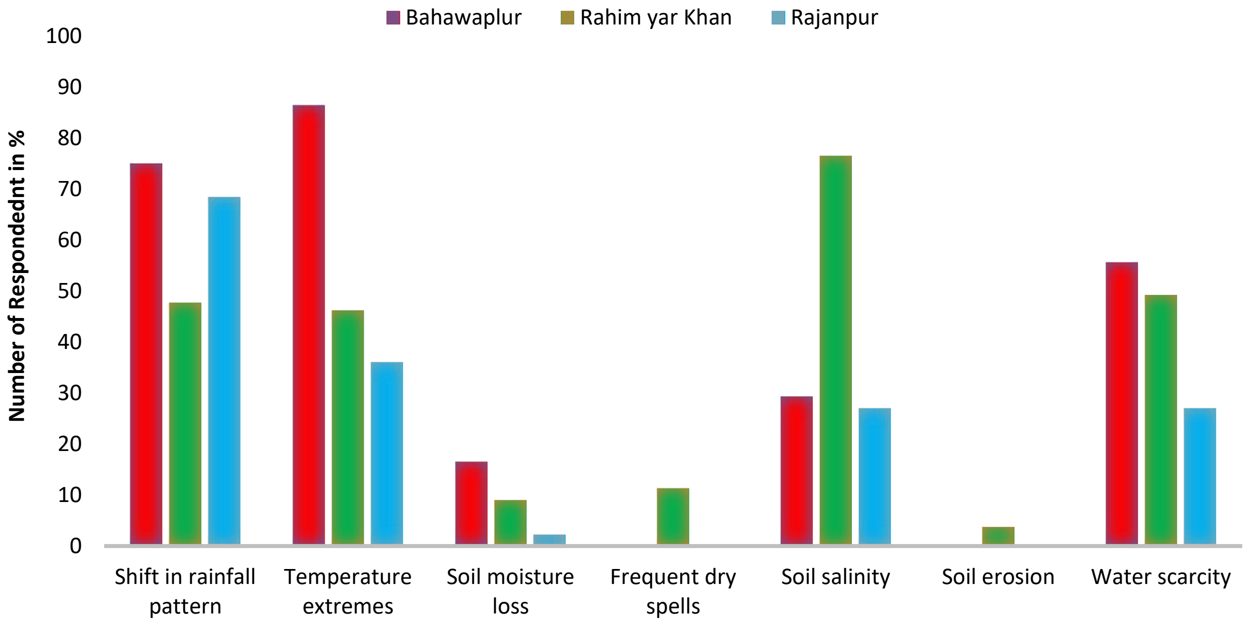
Methodology of Questionnaire based Survey

- 52 indicators
- Close ended questions
- Pilot survey,10% sample size. Jan 2019
- Population: farming community
- Sample size: Slovin’s formula, 399
- Disproportionate stratified random sampling
- 66 UCs, 133 respondents in each district
- One-one interview method
- Group-administered questionnaire based interviews

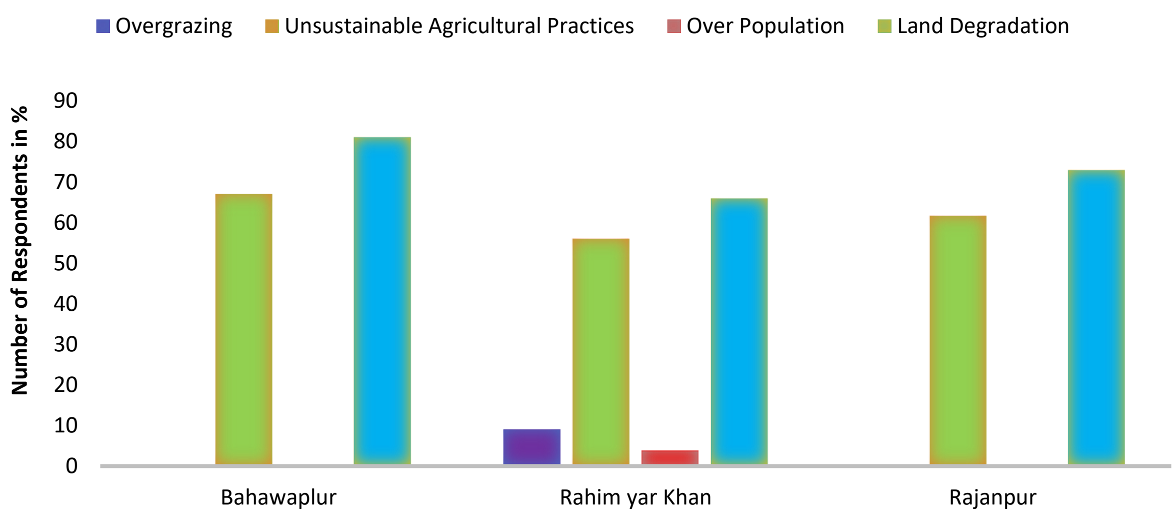

68°0'0"E
69°0'0"E
70°0'0"E
71°0'0"E
72°0'0"E
73°0'0"E
74°0'0"E
30°0'0"N
29°0'0"N
28°0'0"N
27°0'0"N
Rajan Pur
Chenab River
Sutluj River
Indus River
Rahimyar Khan
Bahawalpur
Pakistan
0 145 290 580 870 1,160
Kilometers
Respondents_point_location
Streams
Rivers
DEM
High : 949
Low : 0
0 20 40 80 120 160
Kilometers

Natural & Anthropogenic Drivers of Desertification

Natural drivers



Anthropogenic drivers



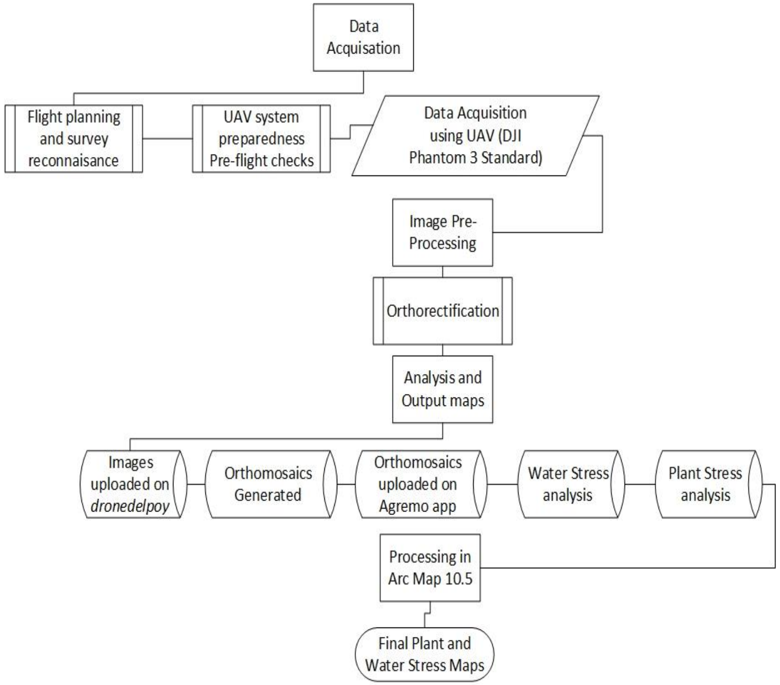
Association b/w Natural and Anthropogenic Drivers

- Anthropogenic drivers, trigger or aggravate the natural drivers of desertification, SLR
- The R^2 = 0.117, significance level of 0.000
- 11.7% of the variance in natural drivers, can be explained by the anthropogenic drivers.
- The ANOVA 0.000, which indicates that the model is a good fit for the data.
- The regression equation is:
- Natural drivers of desertification=0.383 X + 0.180
- 0.383 times increase in the natural drivers of desertification can be explained by a unit increase in the anthropogenic drivers of desertification
- p value 0.000.

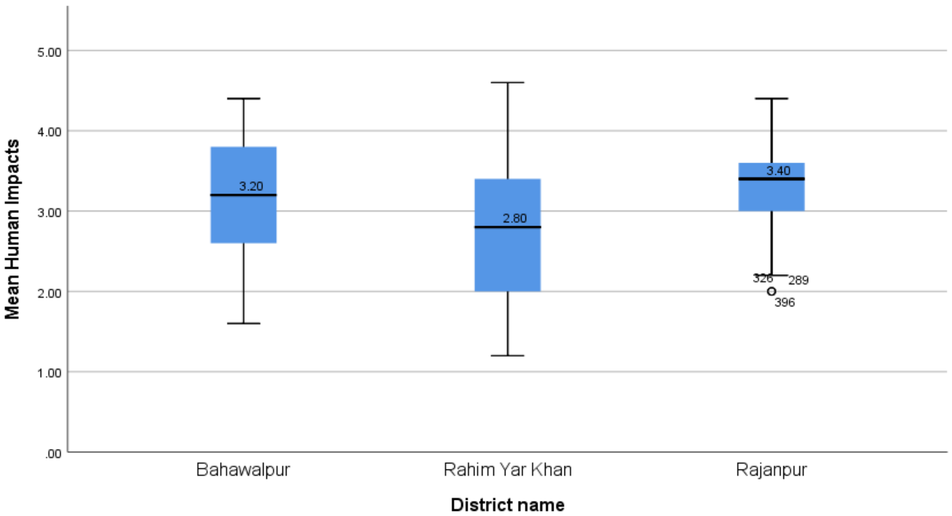
3-Impacts of Desertification

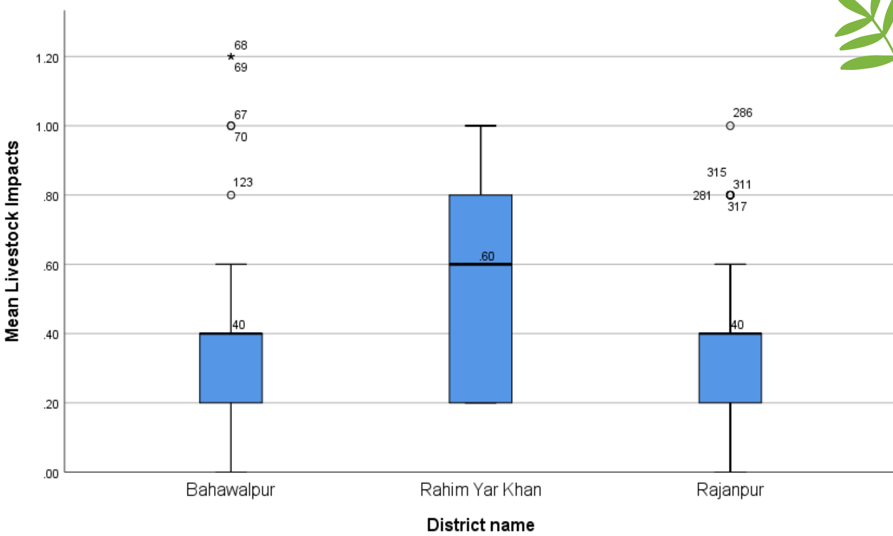
DJI Phantom III, Quadcopter
3-Axis Gimbal, 12MP

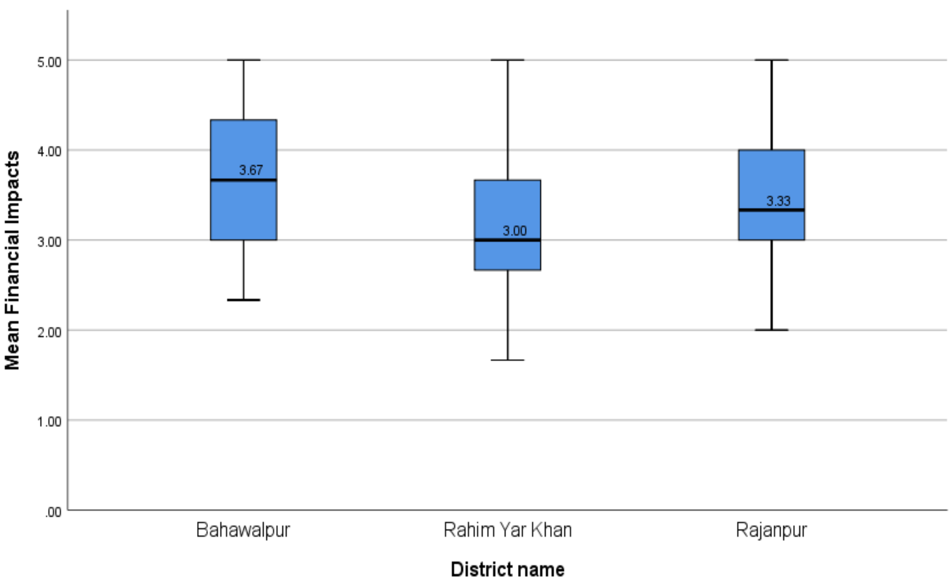
Variables	Data sets	Data source	Data Analysis
• Human impacts • Financial impacts • Impacts on livestock • Environmental impacts	Survey forms in SPSS	Questionnaire based survey	Box plots and cross tabs
• Impacts on plants	Images captured through UAV of wheat fields	UAV based survey of selected wheat fields	Plant and water stress maps prepared using *dji go* app and *Agremo* online application

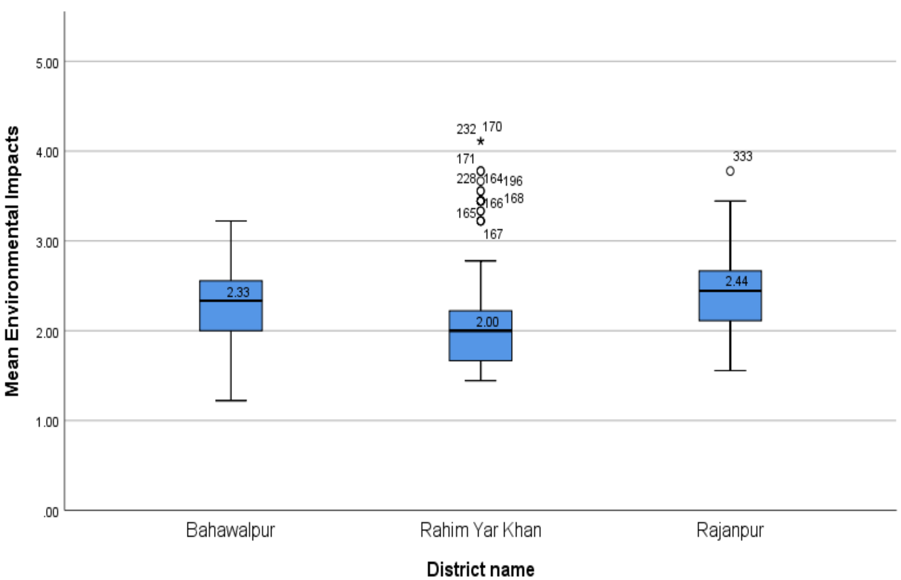


Impacts of Desertification

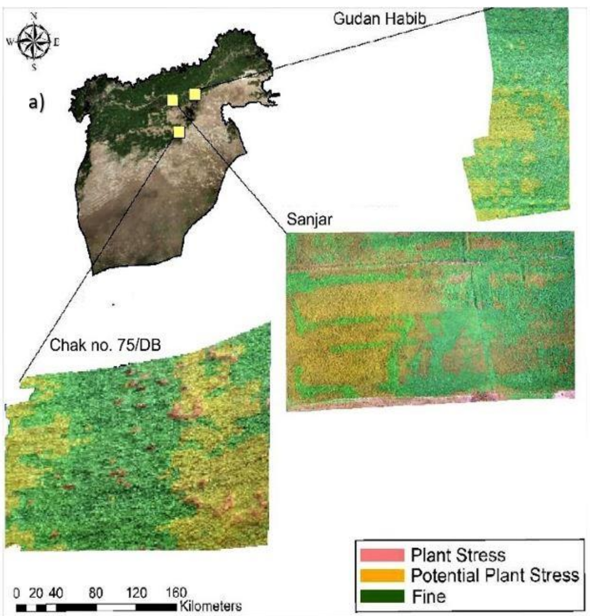




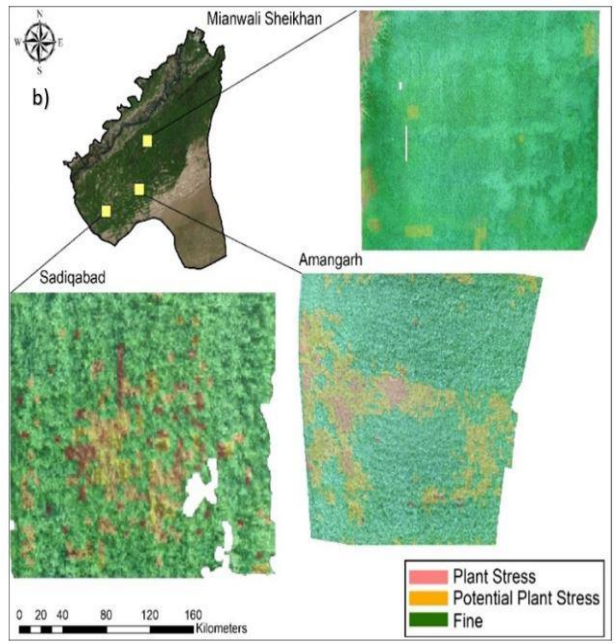




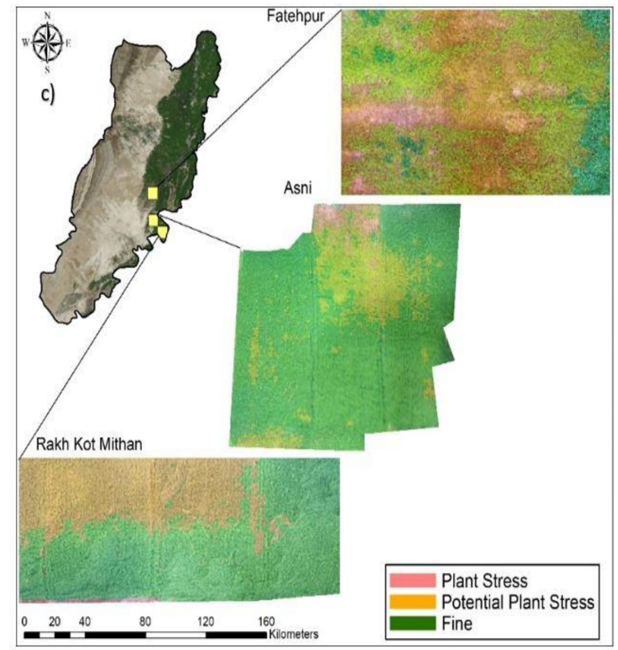
Plant Stress in Wheat Fields



Bahawalpur

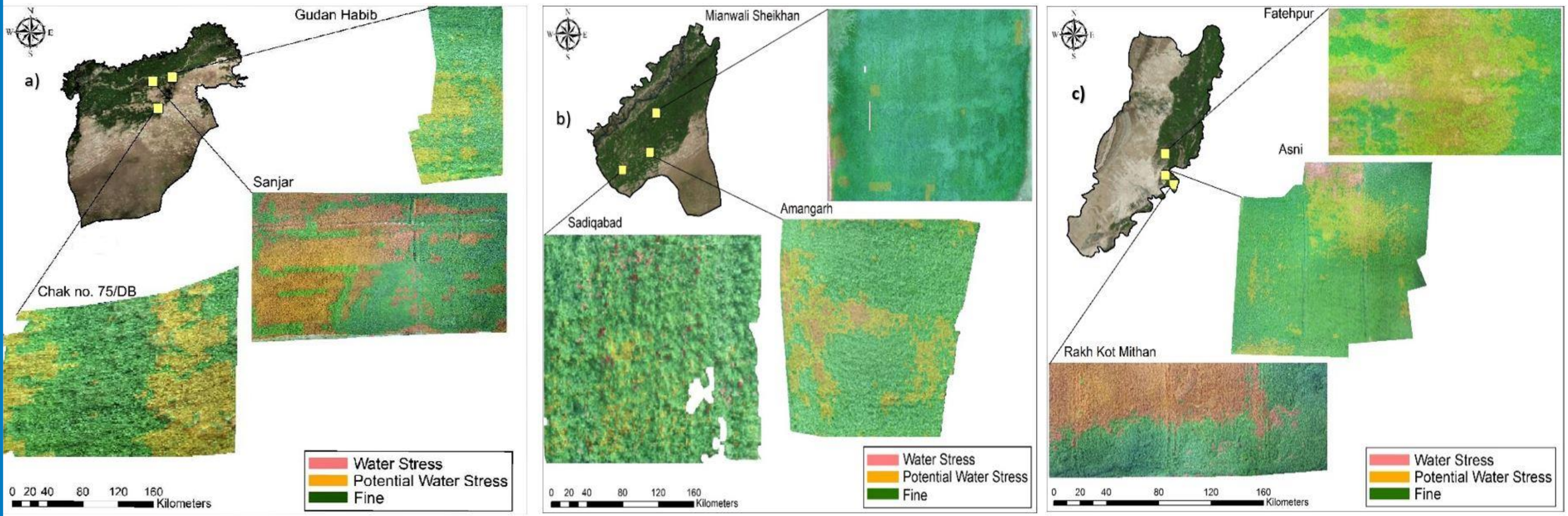


Rahim Yar Khan



Rajanpur

Water Stress in Wheat Fields



Bahawalpur

Rahim Yar Khan

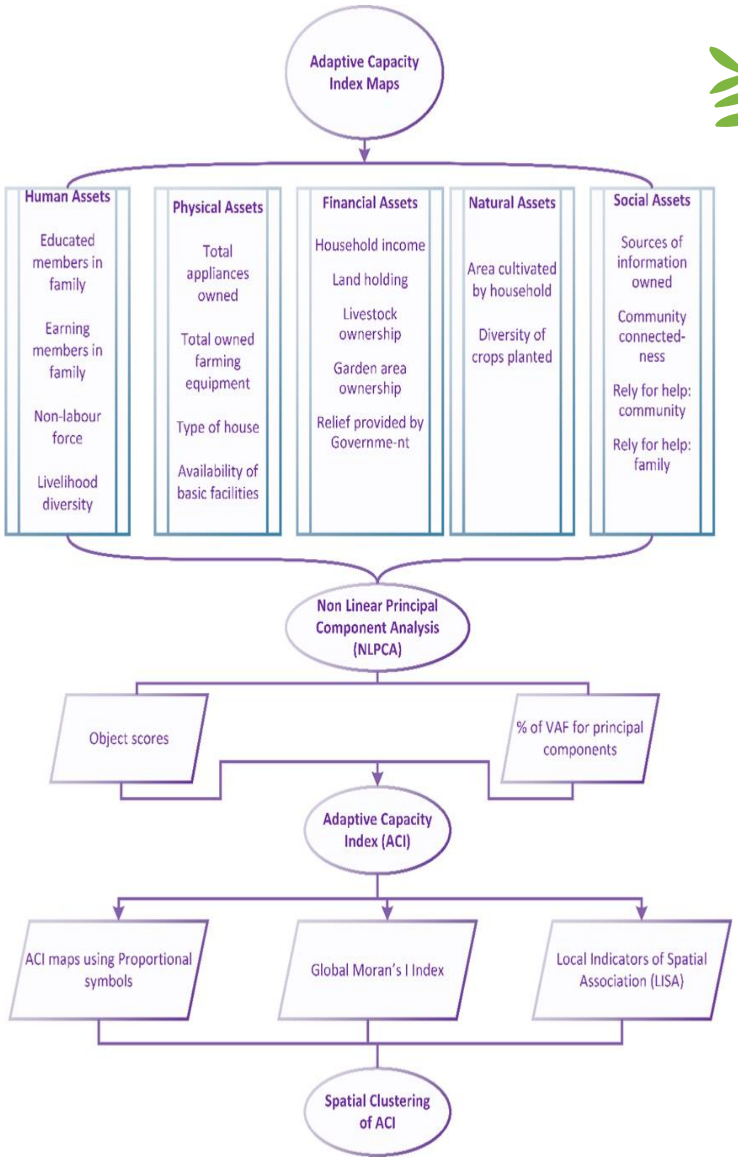
Rajanpur

4-Investigate the Resilience of the Local Farming Community

$$NSACI_j = \sum_{i=1}^{n} F_i C_{ji}$$

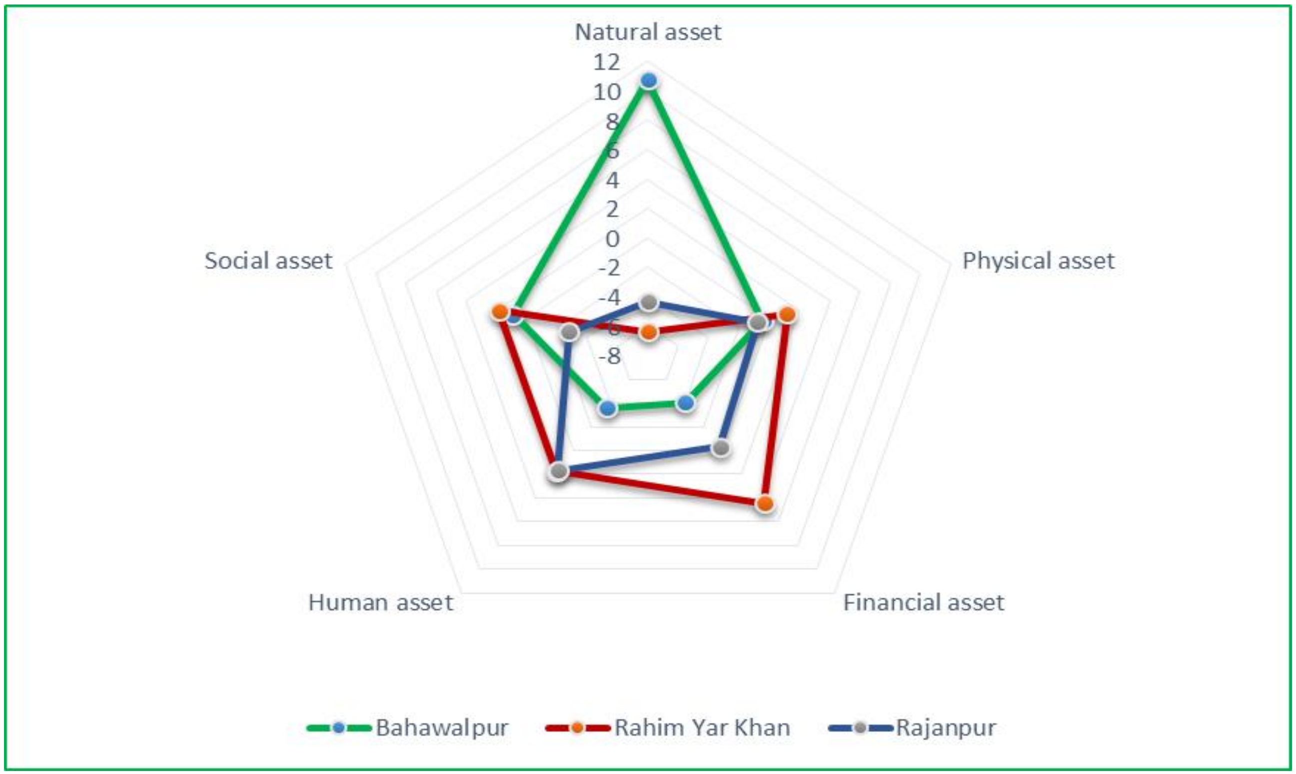
$$SACI_j = \left(\frac{NSACI_j - NSACI_{min}}{NSACI_{max} - NSACI_{min}}\right) \times 100$$ (Rajesh et al., 2018)

Variables	Data sets	Data source	Data Analysis
• Human assets • Physical assets • Financial assets • Natural assets • Social assets	• Object scores • Adaptive Capacity Index (ACI)	Questionnaire based survey	• Sustainable Livelihood Framework (SLF) • Non Linear Principal Component Analysis (NLPCA) • ACI • ACI mapping • Global Moran's I • Anselin's Local Moran's I

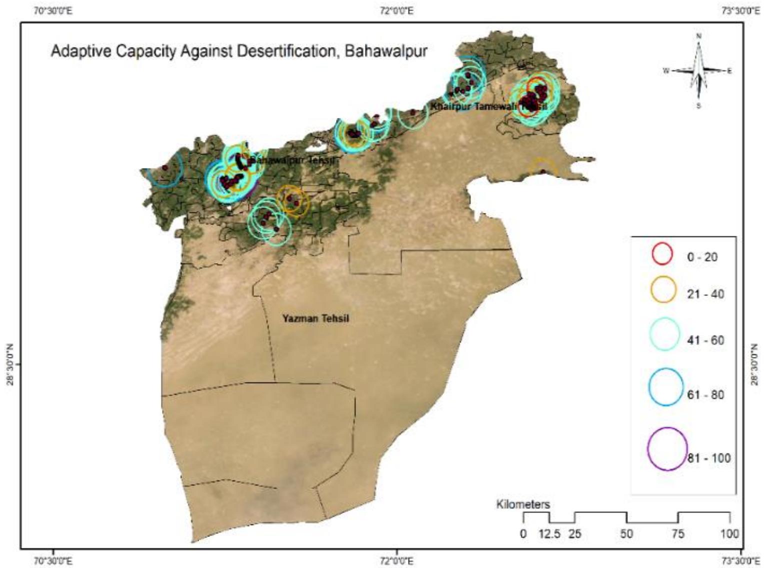


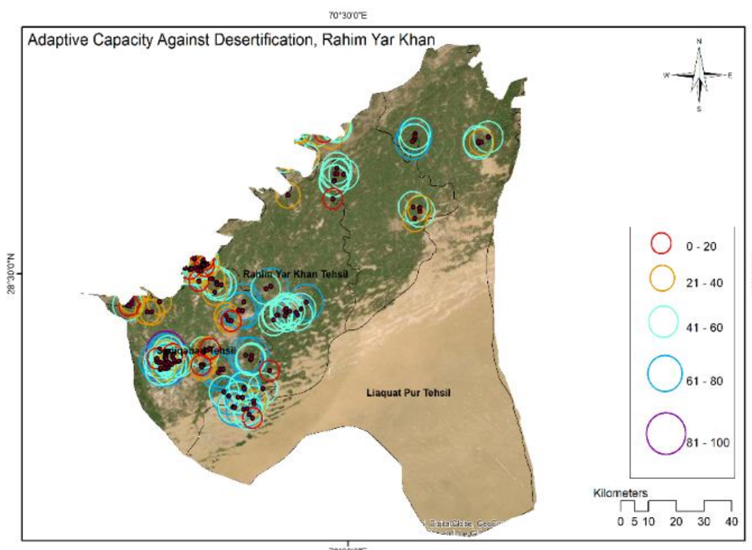
Model summary of CATPCA Using Varimax Rotation with Kaiser Normalization

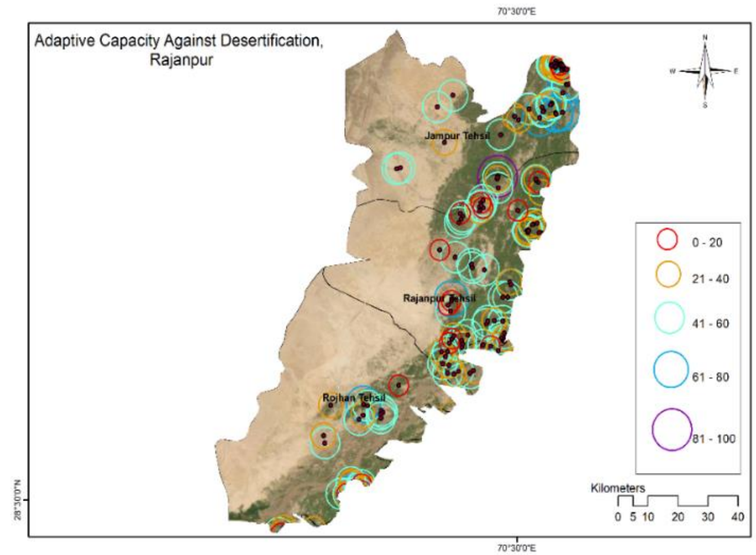
Dimension	Cronbach's Alpha	Variance Accounted For	% of Variance
		Total (Eigenvalue)	
1 Natural asset	0.74	3.08	18.17
2 Physical asset	0.64	2.41	14.22
3 Financial asset	0.62	2.01	11.87
4 Human asset	0.59	1.98	11.68
5 Social asset	0.32	1.33	7.85
Total	0.96[a]	10.85	63.82

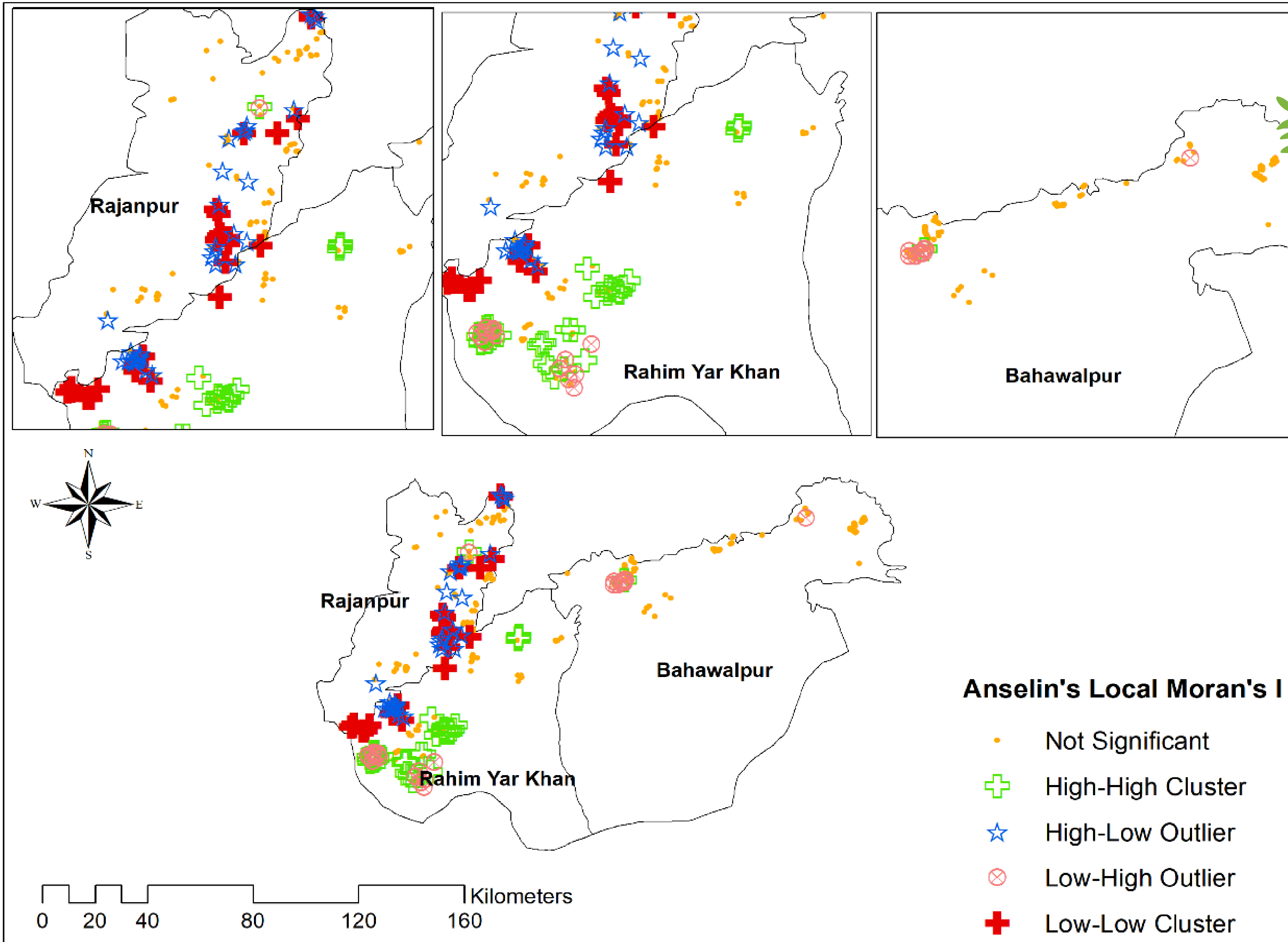


Adaptive Capacity of Households







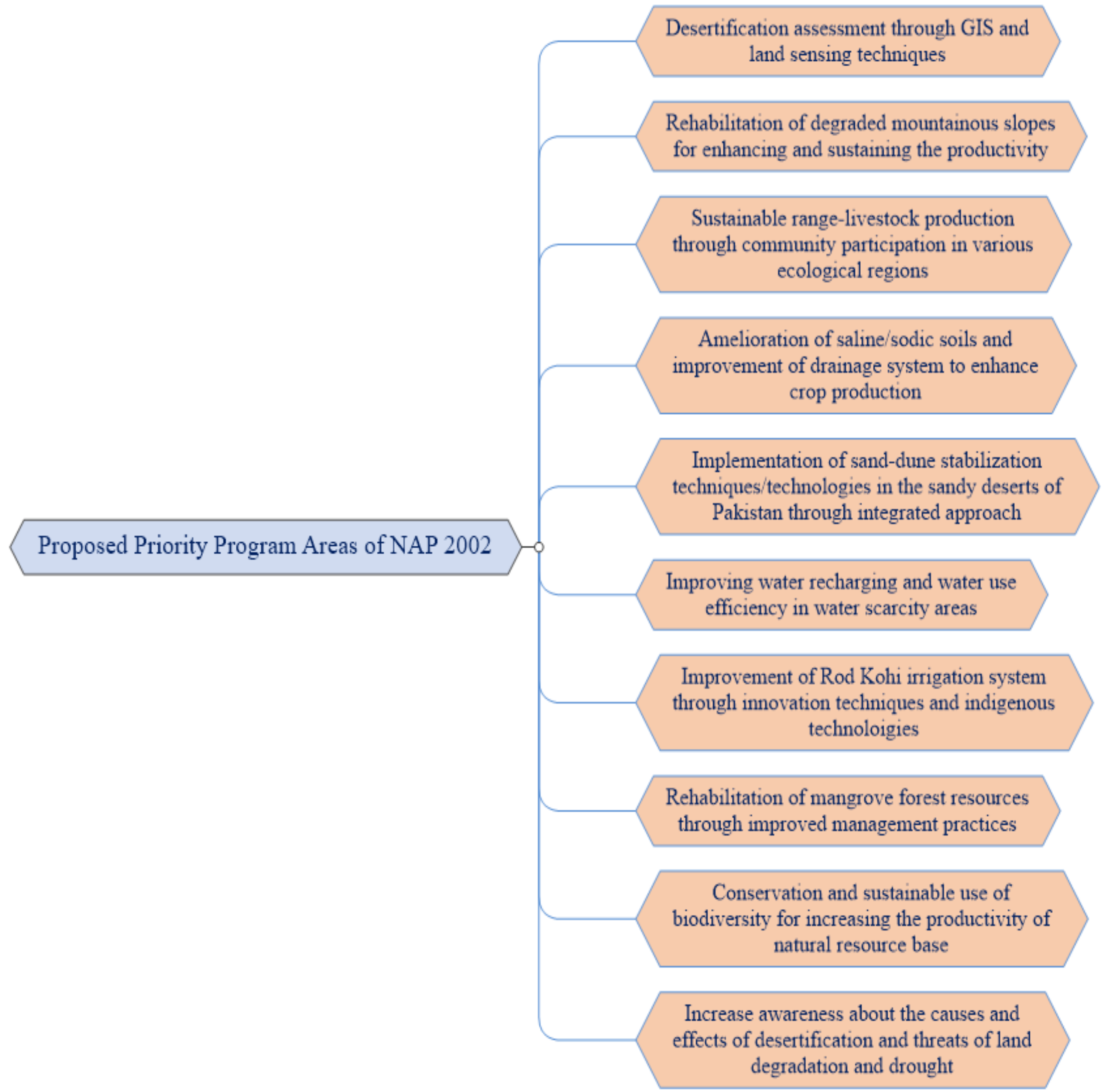


Rajanpur
Rahim Yar Khan
Bahawalpur
N
W
E
S
Rajanpur
Bahawalpur
Rahim Yar Khan
Anselin's Local Moran's I
Not Significant
High-High Cluster
High-Low Outlier
Low-High Outlier
Low-Low Cluster
0
20
40
80
120
160
Kilometers

5.1 Desertification Managing Plans of Government and Non-Government Bodies

Desertification Management in Current National Plans and Policies

- **National Action Plan (NAP) 2002**
- Range Research Institute (RRI) of Pakistan Agricultural Research Council
- **NAP 2017**
- Sustainable Land Management Project (SLMP) II, Ministry of Climate Change, International Union for Conservation Nature (IUCN), Global Environment Facility (GEF) and United Nations Development Program (UNDP).



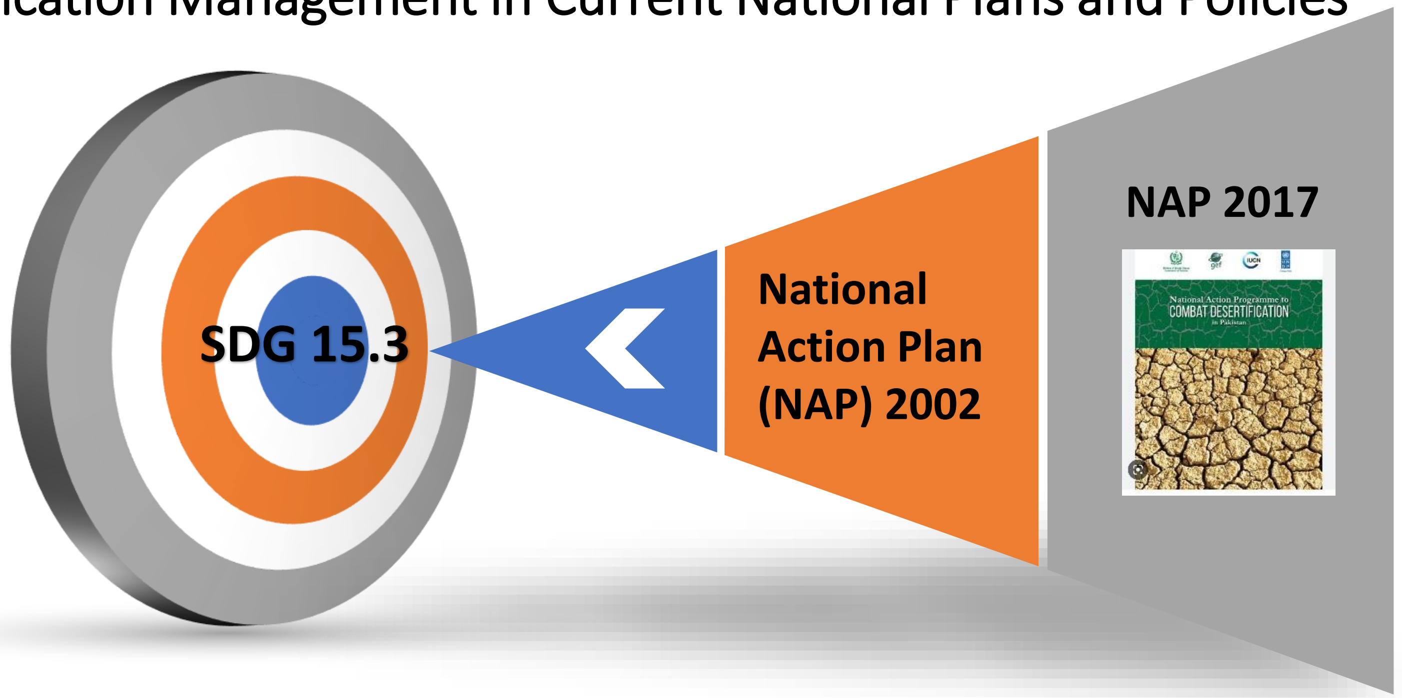
Proposed Government Organizations to get Involved in Desertification Control

Proposed Government Organizations to get involved in Desertification Control

- Leadership for Environment and Development, Pakistan
- Rural Development Foundation
- Pakistan Institute for Environment and Development Action Research
- Aga Khan Rural Support Programme
- Society for the Conservation and Protection Environment
- Sustainable Development Policy Institute
- International Union for Conservation of Natural Resources
- Arid Zone Research Centre (AZRC), Quetta
- Forest Department
- Punjab Forest Department
- Punjab Forestry Research Institute Gatwala, Faisalabad
- Climate Change, Alternate Energy and Water Resources Institute
- Global Change Impacts Study Center
- Pakistan Council of Research in Water Resources
- Pakistan Agricultural Research Council
- International Waterlogging and Salinity Research Institute
- University of Agriculture, Faisalabad
- Agency for Barani Areas Development, Rawalpindi
- Water and Power Development Authority
- Sindh Arid Zone Development Authority, Karachi
- Cholistan Development Authority, Bahawalpur
- Cholistan Institute of Desert Studies, Islamia University, Bahawalpur
- Arid Zone Research Institute, Bahawalpur
- WAPDA Environment Cell
- Pakistan Forest Institute, Peshawar
- Soil Survey of Pakistan, Lahore

Desertification Managing Plans of Government and Non-Government Bodies

Desertification Management in Current National Plans and Policies



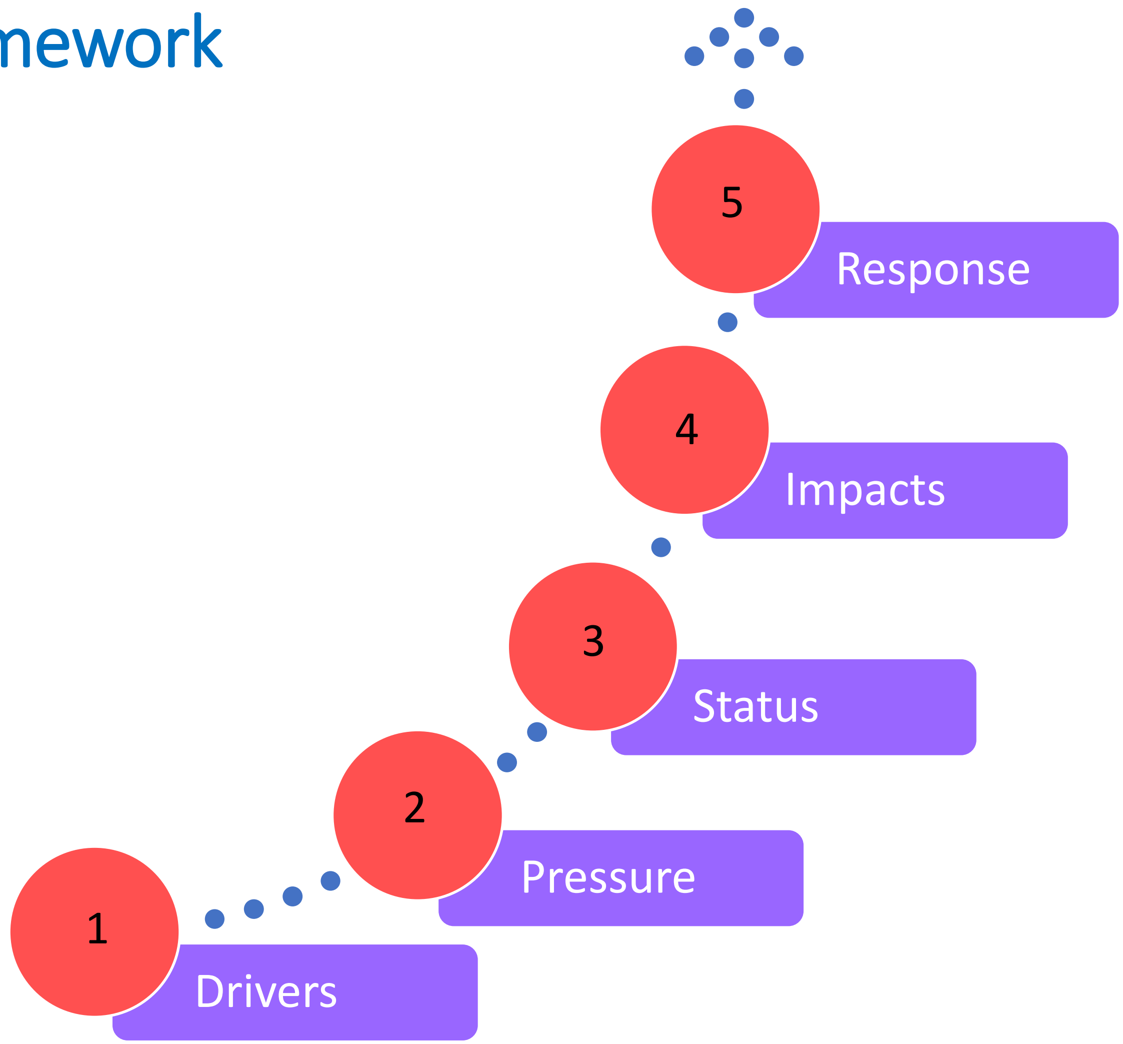
SDG 15.3 "Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss"

Key Organizational Units Proposed in Past and in Recent NAPs to Combat Desertification

Institution	Notification History	Proposed functions
National Desertification Control Unit (NDCU)	• First proposed in NAP of 2002, to be established under Ministry of Environment	1. Responsible for implementation of NAP
National Coordination Committee on Desertification (NCCD)	• First notified in in 1998 • Another notification in 1999 • Proposed to be reconstituted again in NAP of 2002 • Reconstituted again in 2012 • Proposed to be reconstituted again in IUCN's 2017 report	1. Notify and establish National Desertification Control Cell (NDCC) to execute National Action Plan to combat Desertification (NAP) and PAPs 2. Notify and formulate a Technical and Monitoring sub-committee 3. Notify and constitute a Budget and Finance sub-committee 4. Notify and establish a National Desertification Fund and 5. Work for approval of staff and equipment required for NDCC

5-Remedial Measures and Management Plan to Combat Desertification

DPSIR Framework



Policies and Strategies to reduce the impact of Desertification in South Punjab

I) Public awareness and education

- BS degree program in Sustainable Land Management
- Desertification management as a special subject at BS and MS levels
- Grants to universities for researches focused in SLM and LDN

Cont…

- Including community at grass root level in desertification policy making
- Emphasizing diverse, non-agricultural livelihoods
- Creating a NAP website with all information of policies and actions being taken

Cont...

II) Regional development based on land use policies

- Managing fragile ecosystems, utilizing marginal lands, managing rangelands and forests
- Urbanization rate to be checked,
- Identification of natural resources available in the districts

Cont...

- Dry afforestation to be continued to stabilize the sand dunes in Cholistan
- RS/GIS to be used for making land use plans

Cont…

III) Soil and water resource Conservation and reclamation

- Existing forest resource conservation
- Status of rangelands, by UAV based timely monitoring
- Plant and water stress check in main cash crops
- Soil stabilization, use of smart irrigation technologies
- Quantified poverty levels, adaptive capacity assessment

Cont…

- Water quality, drinking water availability, delay action dams, rain water harvesting through lined ponds
- Rangeland management
- Provincial level data base with each district's environmental and anthropogenic parameters
- Reclamation of saline land, rehabilitating water logged soil
- Improved drainage system

Cont…

IV) Building organizational structure to issue early warning for desertification

- Conduct national capacity self-assessment (NCSA)
- National Desertification Control Unit (NDCU), National Coordination Committee to Combat Desertification (NCCD) and NAP Coordination Cell under MoCC must be established on priority basis.
- Creating links between the NDCU, NCCD with National Drought Monitoring Centre

Cont…

- Promoting Desertification management along with drought management
- Preparing atlas of desertification indicators
- Drought advisory to continue providing drought alerts for the region

Cont...

V) Achieving the goals set in The Strategy by UNCCD

- Finalizing the key indicators of desertification operational in the district
- Incorporating indigenous knowledge in national planning for desertification management
- Constant periodic monitoring of the indicators, using RS and GIS

Cont...

- Finalizing benchmarks for land degradation and desertification indices
- Promoting improved livestock management techniques
- Practicing agriculture and horticulture, suitable to drylands

Conclusion

- Practical, region specific plans to manage desertification
- Management plan was proposed for each risk class
- DRI was calculated for study area initially
- (DPSIR) High DRI class was proposed
- Moderate desertification risk class spread over 57.19%
- Community involvement in desertification policy making
- 38.44% spatial coverage by high desertification risk class
- Consistent monitoring is essential

Recommendations

- Agricultural Mechanization Research Institute, Multan: UAV based crop monitoring
- Plantation to control wind speed in high BSI areas
- Revisit Water distribution policy
- Non-farm based income sources
- Manage existing rangelands
- Revival of SCARP project
- Establishing NDCU, NCCD and NAP Coordination Cell under MoCC

Journey continues…

Journal of Arid Environments 194 (2021) 104610

Contents lists available at ScienceDirect

Journal of Arid Environments

journal homepage: www.elsevier.com/locate/jaridenv

ELSEVIER

Check for updates

Spatial patterns in the adaptive capacity of dryland agricultural households in South Punjab, Pakistan

Nausheen Mazhar [a,b,c,1,*], Safdar Ali Shirazi [b], Lindsay C. Stringer [c,d], Rachael H. Carrie [c], Martin Dallimer [c]

[a] Department of Geography, Lahore College for Women University, Lahore, Pakistan
[b] Department of Geography, University of the Punjab, Lahore, Pakistan
[c] Sustainability Research Institute, School of Earth and Environment, University of Leeds, UK
[d] Department of Environment and Geography, University of York, York, UK

ARTICLE INFO

Keywords:
Sustainable livelihoods framework
SLF
Desertification
Land use
Assets

ABSTRACT

Climate change and desertification continue to threaten livelihoods in drylands across the globe. This study explores the relative importance of Sustainable Livelihoods Framework components in explaining variation in the adaptive capacity of agricultural households in three districts in the drylands of south Punjab, Pakistan, and to identify spatial patterns in adaptive capacity distribution. Questionnaire generated data were analyzed using Non-Linear Principal Component Analysis and spatial cluster mapping using the Global Moran's I and Anselin

Asia-Pacific Journal of Regional Science (2023) 7:549–568
https://doi.org/10.1007/s41685-022-00270-7

CLIMATE CHANGE IMPACTS ON REGIONAL ECONOMICS IN SOUTH ASIA

Check for updates

Community perceptions of the impacts of desertification as related to adaptive capacity in drylands of South Punjab, Pakistan

Nausheen Mazhar[1] · Safdar Ali Shirazi[2]

Received: 19 June 2022 / Accepted: 24 November 2022 / Published online: 13 December 2022

Abstract
Anthropogenic activities and climatic variations continue to aggravate desertification in the drylands of the world. This study is aimed to explore the perceptions of local residents in the drylands of Bahawalpur, Rahim Yar Khan and Rajanpur districts, lying in the drylands of South Punjab, regarding the impacts of desertifica-

GeoJournal (2024) 89:15
https://doi.org/10.1007/s10708-024-11014-9

Check for updates

Spatio-temporal patterns and dynamics of sensitivity to sandification, in the Drylands of South Punjab, Pakistan

Nausheen Mazhar · Muhammad Nasar-u-Minallah · Safdar Ali Shirazi · Peyman Mahmoudi · Fatemeh Firoozi

Accepted: 15 November 2023

Abstract One of the most serious ecological problems affecting drylands worldwide is sandification, due to exacerbation of the desertification process. As sandified land grows larger, the potential for agriculture decreases. Particularly in Pakistan, desertification is also a significant issue, with numerous natural and human-caused contributors. Desertification land cover (LULC), slope, and aspect as the determining variables. These variables were separately integrated into ArcGIS using the weighted sum approach for the years 1988, 2001, and 2018. The analysis of sensitivity to sandification found that insensitive land expanded by 47 percent between 1988 and 2018, whereas very low sensitive and low sensitive classi-

Pak. J. Agri. Sci., Vol. 58(3), 1041-1050;2021
ISSN (Print) 0552-9034, ISSN (Online) 2076-0906
DOI: 10.21162/PAKJAS/21.648
http://www.pakjas.com.pk

USING UAV IMAGERY TO MEASURE PLANT AND WATER STRESS IN WINTER WHEAT FIELDS OF DRYLANDS, SOUTH PUNJAB, PAKISTAN

Nausheen Mazhar[1,2,3,*], Safdar A. Shirazi[2], Lindsay C. Stringer[3] and Sohail Manzoor[4]

[1]Department of Geography, Lahore College for Women University, Lahore, Pakistan [2]Department of Geography, University of the Punjab, Lahore, Pakistan; [3]Sustainability Research Institute, School of Earth and Environment, University of Leeds, UK; [4]Livestock and Dairy Department, Punjab, Pakistan.
[*]Corresponding author's e-mail: nausheen.mazhar@lcwu.edu.pk

Unmanned Aerial Vehicles (UAVs) can help farmers to monitor their crops and provide irrigation and inputs as and when the crops need, reducing risks to yields. This study uses UAV imagery to measure water and plant stress in the winter wheat fields, lying in high, medium and low Desertification Vulnerability Indexed (DVI) zones of South Punjab, a region that has an agrarian economy subject to severe desertification. UAV flights were conducted in nine wheat fields in three districts of Bahawalpur, Rahim Yar Khan and Rajanpur. Flights were operated at 15 m altitude above ground level at midday, February 2019, presenting good resolution images of 30.48ppi, in RGB, with a pixel depth of 16 Bit, from a DJI Phantom 3 Standard quadcopter. *Dronedeploy* was used for image pre-processing and generating orthomosaics of the nine fields. Orthomosaics were uploaded on the Agremo app, where water stress and plant stress analysis of the sampled fields was performed. Agremo generated maps were reclassified in Arc Map 10.5. Fatehpur Union Council, lying in the High DVI zone, was found to suffer most severe plant stress, potential plant stress, and water stress with 34.83%, 51.16% and 42.35% of the crop affected respectively. The sample fields in high DVI zones in two of the three study districts suffered the highest amounts of plant stress and water stress. The conclusions offer guidance to policy makers on where water redistribution may need to be considered so that exacerbating

J. Bio. & Env. Sci. | 2018

Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 12, No. 6, p. 273-282, 2018
http://www.innspub.net

INNSPUB

RESEARCH PAPER | OPEN ACCESS

Desertification vulnerability and risk analysis of Southern Punjab Region, Pakistan using geospatial techniques

Nausheen Mazhar*, Safdar Ali Shirazi, Kanwal Javid[1]

Department of Geography, Lahore College for Women University, Lahore, Pakistan
[1]Department of Geography, University of the Punjab, Lahore, Pakistan

Article published on June 30, 2018

Key words: Desertification vulnerability assessment, Desertification difference index, Desertification degree, NDVI, LST

Abstract

Pakistan remains a frequent victim of desertification. This study aims to conduct an assessment of desertification vulnerability and desertification degree of district Bahawalpur, Rahim Yar Khan and Rajanpur, South Punjab, Pakistan, for the period 2001-2018. The datasets of three sensors of MODIS, namely MOD13Q1, MOD11A2 and MOD16A2, with a spatial resolution of 25m, were acquired for 2001, 2009 and 2018, for the study area, from USGS. The assessment of desertification vulnerability has been done by calculating Normalized Difference Vegetation Index (NDVI), Soil Adjusted Vegetation Index (SAVI), Transformed Normalized Difference Vegetation Index (TNDVI), Moisture Stress Index (MSI), Potential Evapotranspiration (PET), Land Surface Temperature (LST) and Weighted Overlay analysis (WOL). The Desertification Difference Index (DDI) analysis concluded a 7.84% increase in area under vegetation and 7.74% decrease in barren land, from 2001 to 2018. However, a 6.87 rise in Max LST and a 3.06 rise in Min LST, from 2001-2018, left most of the increase in area under vegetation to be unhealthy, or dead. The Desertification Vulnerability Index (DVI) analysis presented an increase of 11.09% in the area covered by High desertification vulnerability category, i.e. from 7.4% in 2001 to 18.49% in 2018, whereas a 39.88% decrease was witnessed in the area covered by the Low desertification

Int. J. Econ. Environ. Geol. Vol. 11 (1) 102-107, 2020
Journal home page: www.econ-environ-geol.org

Open Access
ISSN: 2223-957X

The Preliminary Study of Anthropogenic and Natural Drivers of Desertification in Drylands of South Punjab, Pakistan

Nausheen Mazhar [1,3] Safdar Ali Shirazi [2]

[1]Department of Geography, Lahore College for Women University, Lahore, Pakistan
[2]Department of Geography, University of the Punjab, Lahore, Pakistan
[3]Sustainability Research Institute, School of Earth and Environment, University of Leeds, UK

*Email: nausheen.mazhar@lcwu.edu.pk

Received: *07 May, 2020* ***Accepted:*** *11 June, 2020*

Abstract: This study aims to investigate the perceptions of farmers residing in the drylands of south Punjab regarding the drivers of desertification mainly associated with meteorological and anthropogenic factors. Dataset of 399 respondents was collected using disproportionate stratified sampling technique from Bahawalpur, Rahim Yar Khan and Rajanpur districts. Pearson correlation and cross tabulation were performed to explore relation between variables. Simple Linear Regression (SLR) helped in investigating the association between natural and anthropogenic causes of desertification. The findings of this study indicate the significant variability in natural causes of desertification such as increasing temperature extremes, soil salinization and variation in rainfall patterns, while extensive land degradation, caused by anthropogenic factor, as leading to desertification in the study area. For Rajanpur, mean rainfall variation, supports the perception regarding major natural driver of desertification. Small-scale farmers were found to be most vulnerable to climatic extremes. SLR concluded that anthropogenic factors trigger or intensify the natural drivers of desertification in the study area. Useful insights are provided regarding the perceptions of the local farming community regarding causes of desertification as appropriate perception of a risk leads to fruitful adaptation measures.

Key words: Perceptions, climate extremes, desertification, drylands, land degradation.

Introduction

Across the globe, fragile ecosystems and their

arid climatic zones, the need for mirroring farmer's perceptions with climatic data can be emphasized. Pakistan has a highly agrarian economy and variability

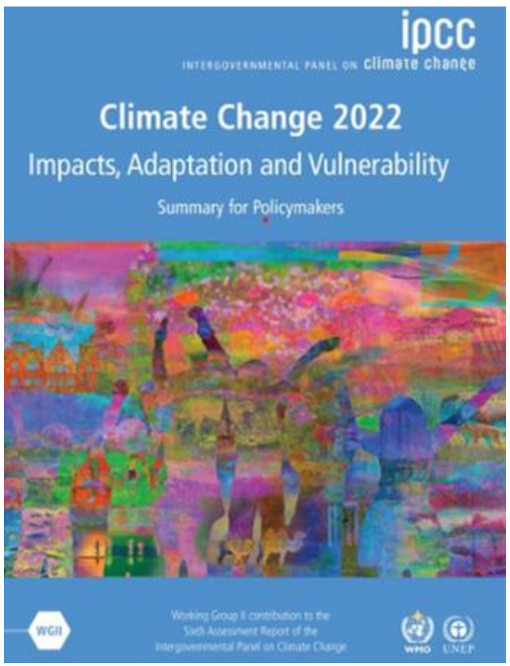
6TH INTERDISCIPLINARY
OXFORD DESERT CONFERENCE
MARCH 16 & 17, 2023

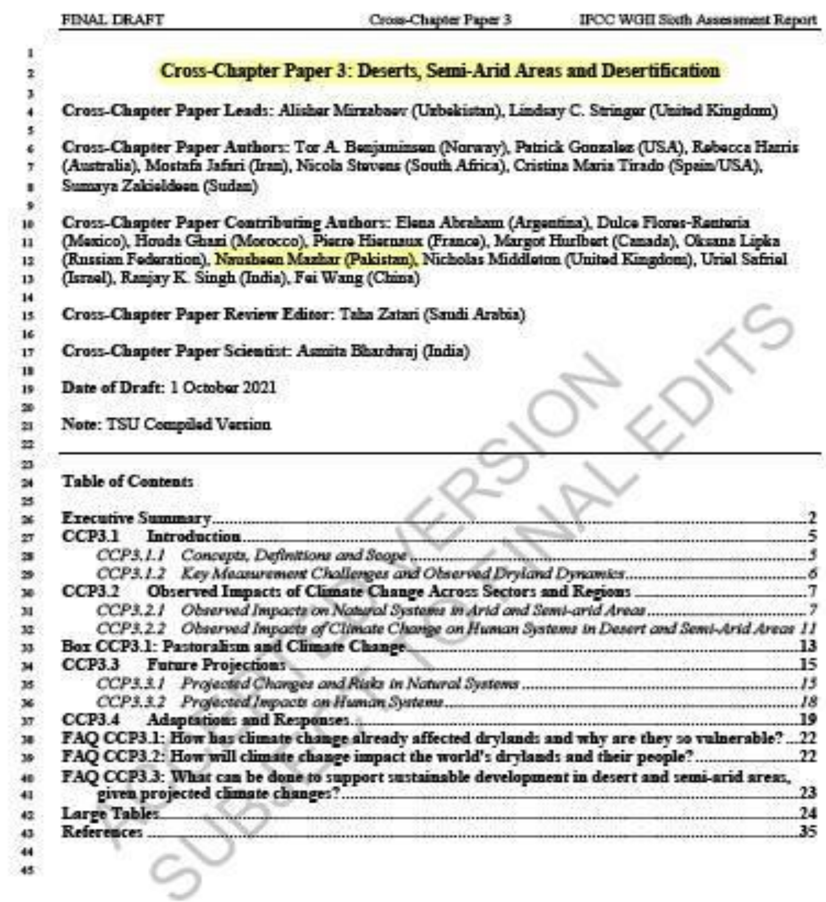
TEDxLCWU COUNTDOWN Conference

Talk uploaded on TEDx official website:
https://www.ted.com/talks/dr_nausheen_mazhar_the_need_for_sustainable_land_management_to_reverse_desertification

IPCC Contributing Author in WG 2 AR6 Report

- Represented Pakistan in Desertification studies as a Contributing author of Inter-Governmental Panel for Climate Change (IPCC) WG 2 report





Cross-Chapter Paper 3: Deserts, Semi-Arid Areas and Desertification

Cross-Chapter Paper Leads: Alisher Mirzabaev (Uzbekistan), Lindsay C. Stringer (United Kingdom)

Cross-Chapter Paper Authors: Tor A. Benjaminsen (Norway), Patrick Gonzalez (USA), Rebecca Harris (Australia), Mostafa Jafari (Iran), Nicola Stevens (South Africa), Cristina Maria Tirado (Spain/USA), Sumaya Zakieldeen (Sudan)

Cross-Chapter Paper Contributing Authors: Elena Abraham (Argentina), Dulce Flores-Renteria (Mexico), Houda Ghazi (Morocco), Pierre Hiernaux (France), Margot Hurlbert (Canada), Oksana Lipka (Russian Federation), Nausheen Mazhar (Pakistan), Nicholas Middleton (United Kingdom), Uriel Safriel (Israel), Ranjay K. Singh (India), Fei Wang (China)

Cross-Chapter Paper Review Editor: Taha Zatari (Saudi Arabia)

Cross-Chapter Paper Scientist: Asmita Bhardwaj (India)

Date of Draft: 1 October 2021

Note: TSU Compiled Version

Table of Contents

Member Panel of Experts, Punjab Climate Change Policy

Strategic Planning and Implementation Unit, Environment Protection and Climate Change Department, Govt. of Punjab

Punjab Climate Change Policy
(Draft 1.10)

Thank You!

Questions are welcomed!

?

A Positive Note!

Lets play our part and begin with conserving water!

Each drop counts!!!

United Nations
Convention to Combat
Desertification

References

- Ahmad Muhammad, I., & Ma, H. (2020). Climate Change and Livelihood Vulnerability in Mixed Crop–Livestock Areas: The Case of Province Punjab, Pakistan. *Sustainability, 12*(2), 586. doi:doi:10.3390/su12020586
- Amin, A. A. (2004). The extent of desertification on Saudi Arabia. *Environmental geology, 46*(1), 22-31. doi: https://doi.org/10.1007/s00254-004-1009-0
- Anjum, S. A., Wang, L.-c., Xue, L., Saleem, M. F., Wang, G.-x., & Zou, C.-m. (2010). Desertification in Pakistan: Causes, impacts and management. *Journal of Food, Agriculture and Environment, 8*(2), 1203-1208. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.1028.9468&rep=rep1&type=pdf
- GoP (2017). *Press Release on Provisional Summary Results of 6th Population and Housing Census-2017*. Retrieved from http://www.statistics.gov.pk/assets/publications/Population_Results.pdf
- Guan, Y., He, B., Li, X., Yin, C., & Qiu, S. (2017). *Desertification assessment and trend analysis using modis data*. Paper presented at the Geoscience and Remote Sensing Symposium (IGARSS), 2017 IEEE International. doi: 10.1109/IGARSS.2017.8128311.

Cont…

- IPCC. (2014). *Climate change 2014: Synthesis report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (R. K. Pachauri & M. R. Allen Eds.). Geneva, Switzerland.
- IPCC. (2019). *Desertification In: Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems*.
- IUCN. (2017). *National Action Programme to Combat Desertification in Pakistan*. Retrieved from https://www.iucn.org/sites/dev/files/pk_nap_desertification_report.pdf
- Kundu, A., Patel, N. R., Saha, S. K., & Dutta, D. (2017). Desertification in western Rajasthan (India): an assessment using remote sensing derived rain-use efficiency and residual trend methods. *Natural Hazards, 86*(1), 297-313. doi:10.1007/s11069-016-2689-y
- Khan, A. N., & Ali, A. (2015). Desertification Risk Reduction Approaches in Pakistan. In *Disaster Risk Reduction Approaches in Pakistan* (pp. 161-173). Tokyo, Japan: Springer. doi: 10.1007/978-4-431-55369-4_9.
- Lin, S., Jiang, Y., He, J., Ma, G., Xu, Y., & Jiang, H. (2017). Changes in the spatial and temporal pattern of natural forest cover on Hainan Island from the 1950s to the 2010s: implications for natural forest conservation and management. *PeerJ, 5*(5). doi:10.7717/peerj.3320

Cont…

- Saaty, T. L. (1980). The analytic hierarchy process, planning, priority setting, resource allocation. *M cGraw-H ill*.
- Rajesh, S., Jain, S., & Sharma, P. (2018). Inherent vulnerability assessment of rural households based on socio-economic indicators using categorical principal component analysis: A case study of Kimsar region, Uttarakhand. *Ecological Indicators, 85*, 93-104. doi:https://doi.org/10.1016/j.ecolind.2017.10.014
- Vanleeuwen, W., Hartfield, K., Miranda, M., & Meza, F. (2013). Trends and ENSO/AAO Driven Variability in NDVI Derived Productivity and Phenology alongside the Andes Mountains. *Remote Sensing, 5*(3), 1177-1203. doi:10.3390/rs5031177
- Zhao, Y., Wang, X., & Vázquez-Jiménez, R. (2018). Evaluating the performance of remote sensed rain-use efficiency as an indicator of ecosystem functioning in semi-arid ecosystems. *International Journal of Remote Sensing, 39*(10), 3344-3362. doi:10.1080/01431161.2018.1439598
- Zeng, Y., Feng, Z., & Xiang, N. (2006). Albedo-NDVI space and remote sensing synthesis index models for desertification monitoring. *Scientia Geographica Sinica, 26*(1), 75.