Mapping of Climate Risk in the WASH Sector of Rajasthan

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Rationale

- Rajasthan in western part of India is one of the most arid & water-scarce regions of the world.
- Most parts of the State experience extreme variability in rainfall and other climatic parameters.
- Remarkable spatial variation in surface hydrology, and there is significant heterogeneity in groundwater conditions
- River basins have limited renewable water resources. Also, groundwater quality is poor in many regions.
- Droughts and flash floods occur with regular frequency in the State; but there is remarkable spatial variation in frequency.

Rationale

- HH access to DW sources in the state varies between regions; Distance to water sources increases the exposure of WASH systems to climate hazards
- Overall, only 38% of the rural HHs have access to improved toilets. Access varies across regions.
- Flash floods in excessively wet years increase health risks from water-borne diseases in the flood-prone areas.
- Socio-economic conditions, which have major bearing on exposure to climate risks and community vulnerability, vary across regions
- These factors together cause major variations in the climate induced WASH risks.

Objectives

- Develop a composite index for mapping climate-induced risks in WASH specific to the Rajasthan context.
- Compute the climate risk in WASH for all districts of Rajasthan, covering distinct geological, hydrological, topographical, socio-economic and cultural settings and different types of WASH systems.
- Ensure robustness of the index and validate it by:
  - Mapping the public health hazards associated with poor WASH services during natural disasters at the district level
  - Understanding the link between this and the computed index values.

Identified variables influencing climate induced risk in rural WASH

Sub-Indices (Factor)	Variable (Indicators)	Impact on severity of Risk
A] Hazard Sub-index		
Natural	Rainfall; Annual Renewable Water Availability; Availability of static, marginal quality groundwater that can turn potable during very wet years	Negative
	Rainfall variability; Flood proneness; Aridity	Positive
B] Exposure Sub-Index		
Natural	Depth to ground water table; Groundwater stock	Negative
	Temperature and Humidity; Presence of saline groundwater in plenty	Positive
Physical	Characteristics of water resources; Condition of the water supply system; Provision of buffer storage of water in reservoirs /capita; % of HHs covered by tap water supply; % of HHs having access to modern toilets; Flood control measures	Negative
Socio-Economic	Proportion of people living in low-lying areas	Positive
	Proportion of people having access to water supply source within the dwelling premise; Hand washing before and after food and after toilet use	Negative
Institutional & Policy	Existence of policy to hire private tankers for emergency water supply; Provision for tanker water supply in rural areas in terms of no. of tankers; Disaster risk reduction measures	Negative
C] Vulnerability Sub-Index		
Natural	Climate	Positive
Socio-Economic	Population density; % of people living under poverty; % of people who are unhealthy	Positive
	Access to primary health services; Percentage of children under the age of 5 with stunting	Negative
Institutional & Policy	Ability to provide R&R measures for floods and droughts (no. of agencies); Social ingenuity and cohesion; Adequate no. of primary and other health infrastructure	Negative

Index for assessing climate-induced risk in WASH

- The composite index for assessing WASH risk has three sub-indices:
  - One to assess the magnitude of hazard
  - One to assess the exposure of WASH systems to the hazard
  - One to assess the vulnerability of the communities to the problems associated with WASH
- Maximum score of ‘3’ was assigned to variable in the case of the worst situation, and the minimum score is ‘1’.
- Value of each sub-index was computed by adding up the scores for all the variables and then normalized.

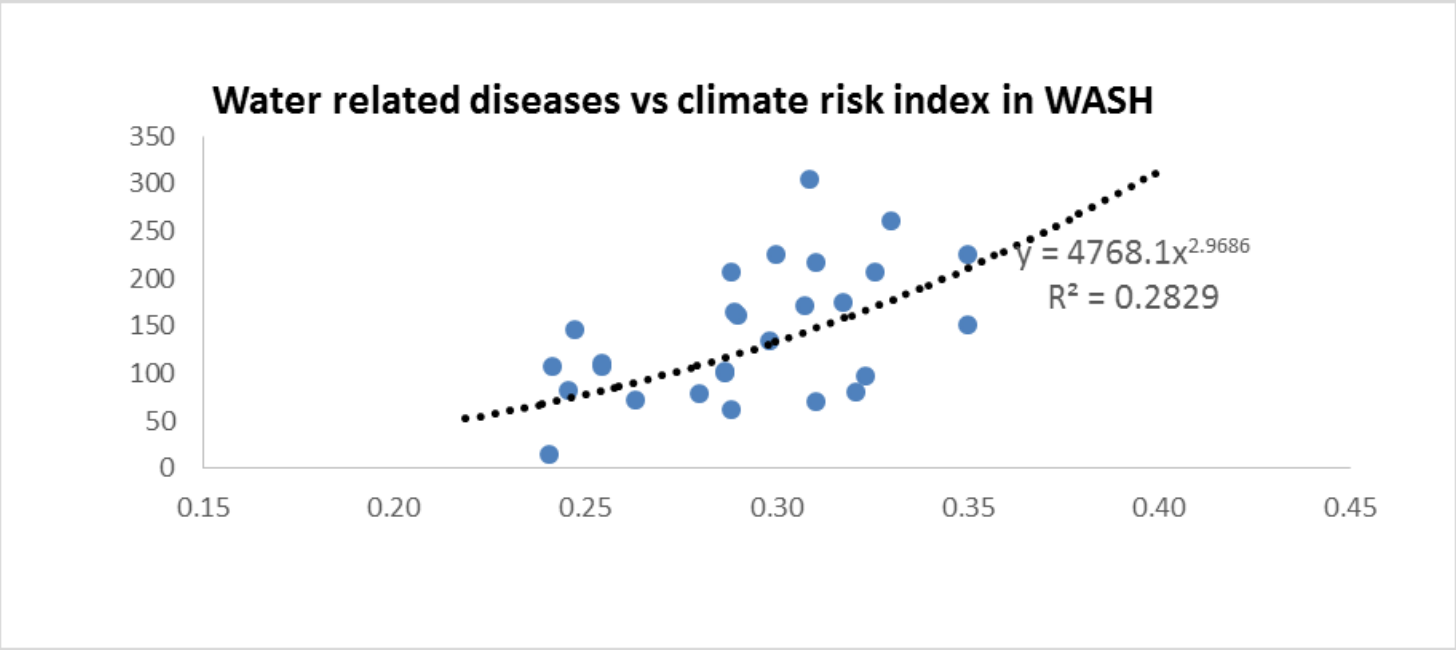
How Does the WASH Risk Vary between Districts?

- A value below 0.04 implies low risk; 0.05 to 0.30 implies moderate risk; and greater than 0.30 implies high risk.
- Overall, the climate-induced WASH risk index value ranges from 0.20 in the case of Jaisalmer to 0.40 in the case of Shirohi.
- Some southern districts (Udaipur & Dungarpur), which are less arid, show relatively higher values of risk index than the districts in western Rajasthan (Jaisalmer, Hanumangarh, Ganganagar)
- Pali, Nagaur and Barmer in the western Thar desert region display high climate risk, mainly due to high variability in rainfall, frequent droughts, and low per capita water availability.

Key factors affecting the climate risk in WASH in Rajasthan districts

- The value of hazard sub-index is lowest (0.61) for Jaisalmer:
  - Surface water import into the region through IGNP
  - Relatively high per capita renewable water availability due to very low population density
- The value of exposure sub-index is lowest (0.53) for Hanumangarh:
  - Relatively high access to tap water and to improved toilets
  - Very high average temperature
- Vulnerability sub-index is also lowest (0.48) for Jaisalmer:
  - High value of HDI
  - Low population density

Climate Induced WASH Risk and Public Health Impacts of Disruptions in WASH Services



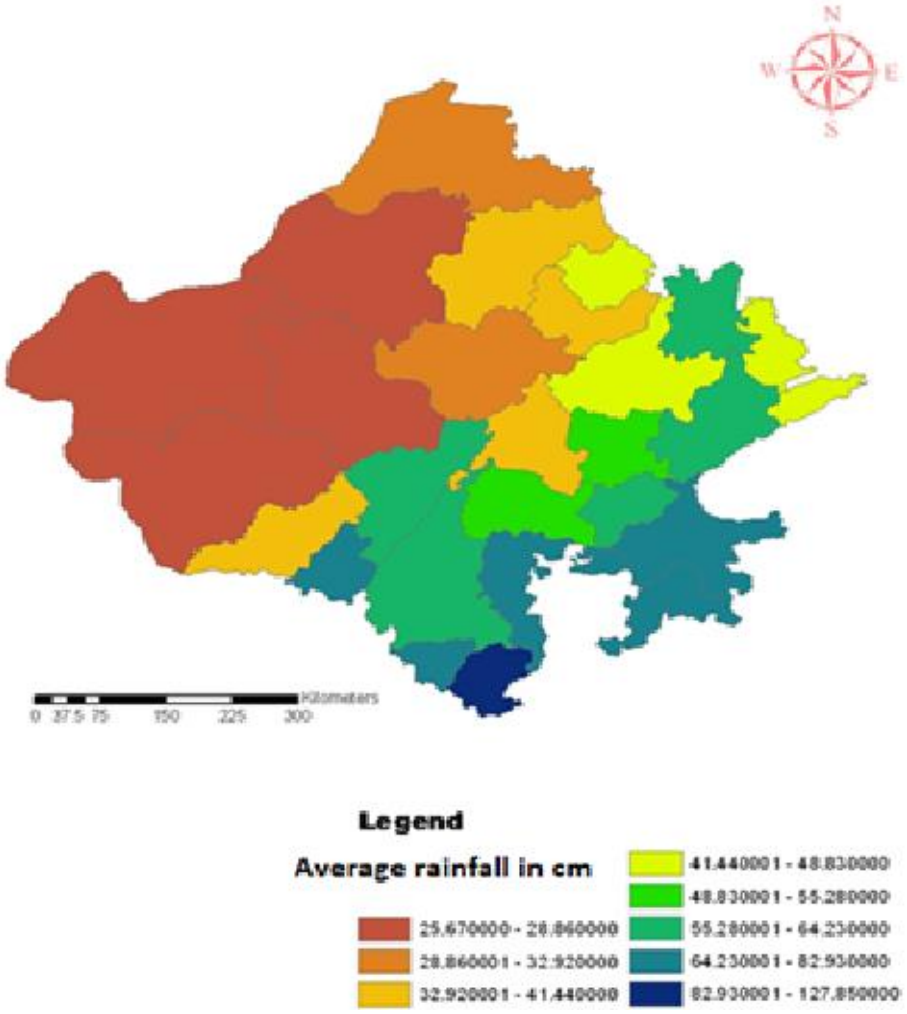
Risk Index Categories	Composite Estimate of WRD*	Composite WRD Index = Composite WRD/Population Density
0.24-0.27	29971	142
0.28-0.31	42371	153
0.32-0.35	42798	166

Conclusion

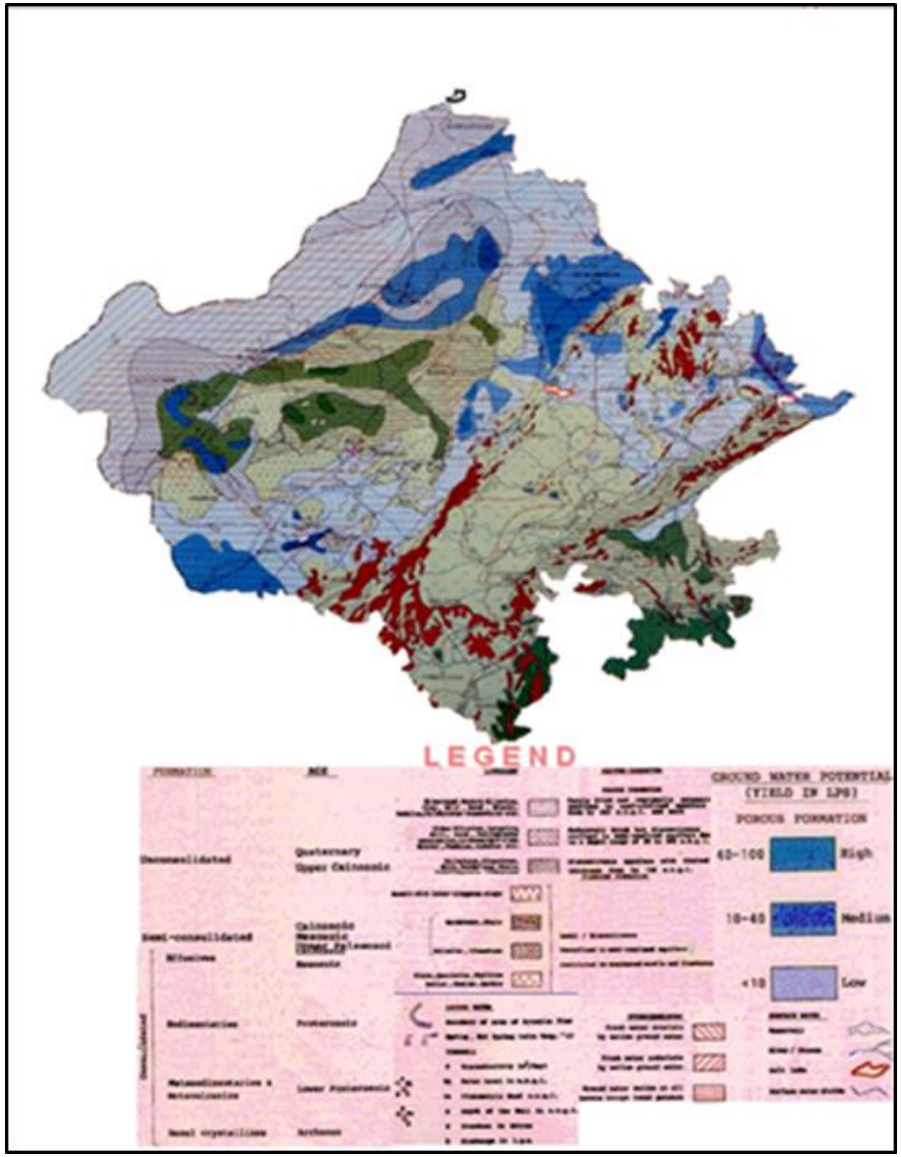
- As per our analysis, Jaisalmer district has the lowest climate induced WASH risk (0.20) and Sirohi has the highest (0.40).
- Some of the southern districts of the state were found to have relatively higher WASH risks as compared to western districts owing **to high degree of exposure and vulnerability**
- Good correlation was found between public health hazards and the computed values of the WASH risk
- Thus, the developed climate risk index in WASH is robust.

Rainfall variability in Rajasthan

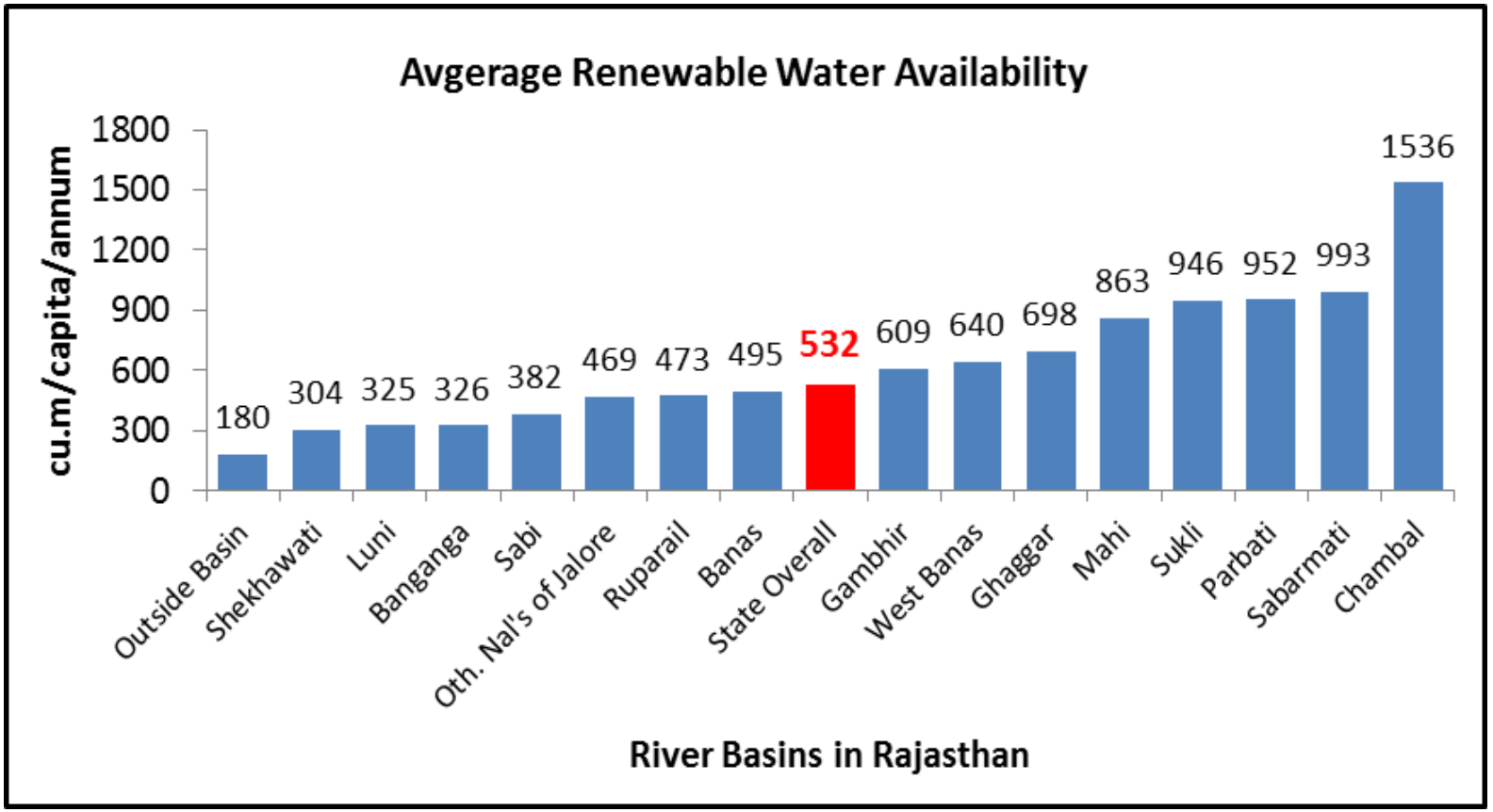
Regions of low mean annual rainfall experience high inter-annual variability in RF and also higher aridity



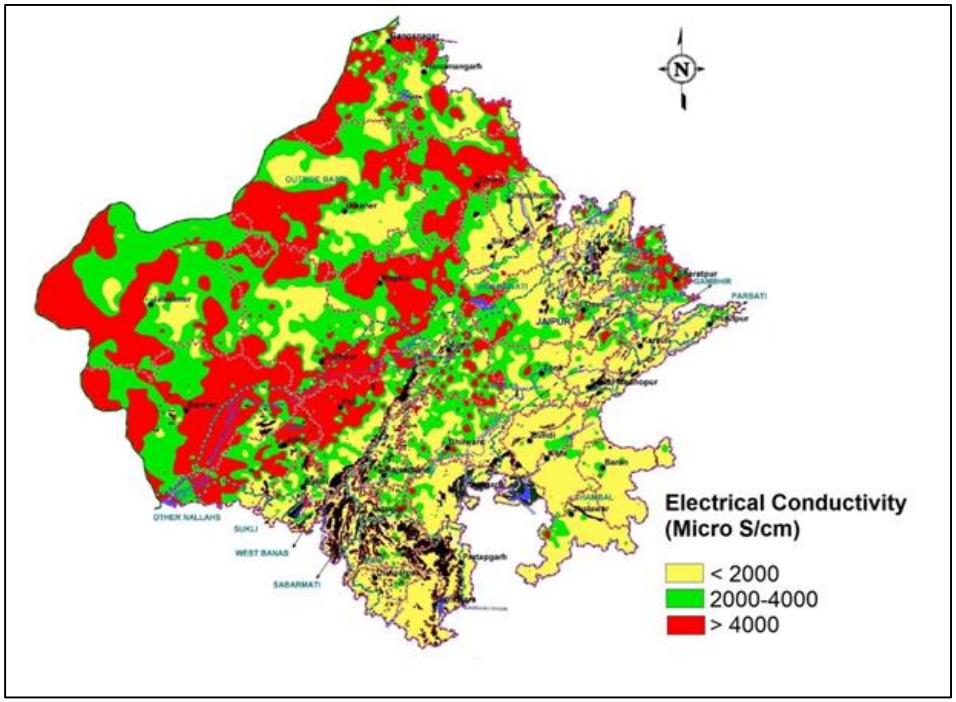
Geo-hydrology

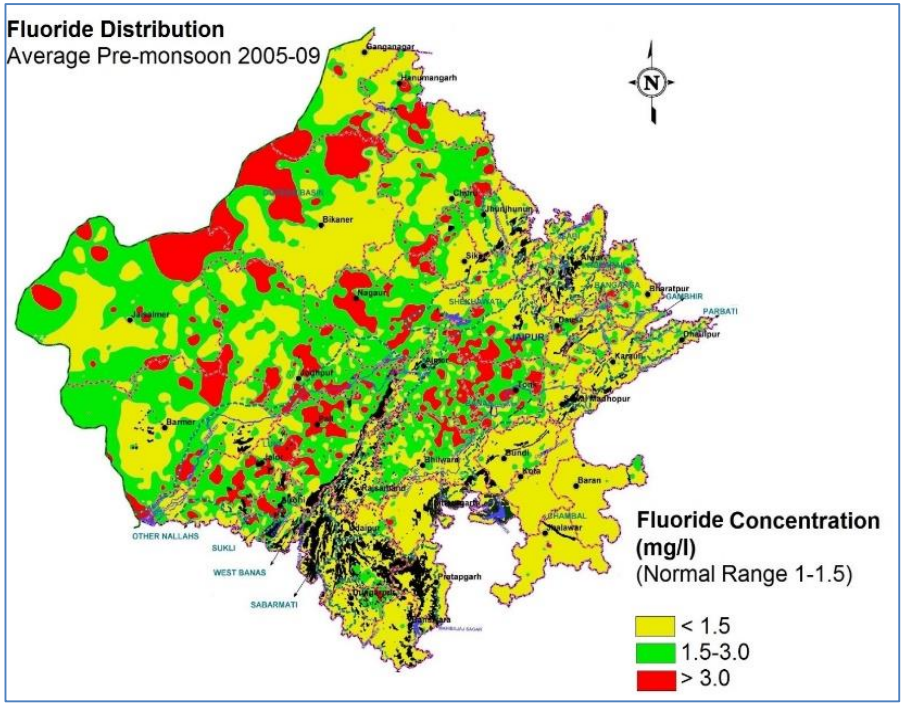


Annual renewable water resources in different river basins of Rajasthan

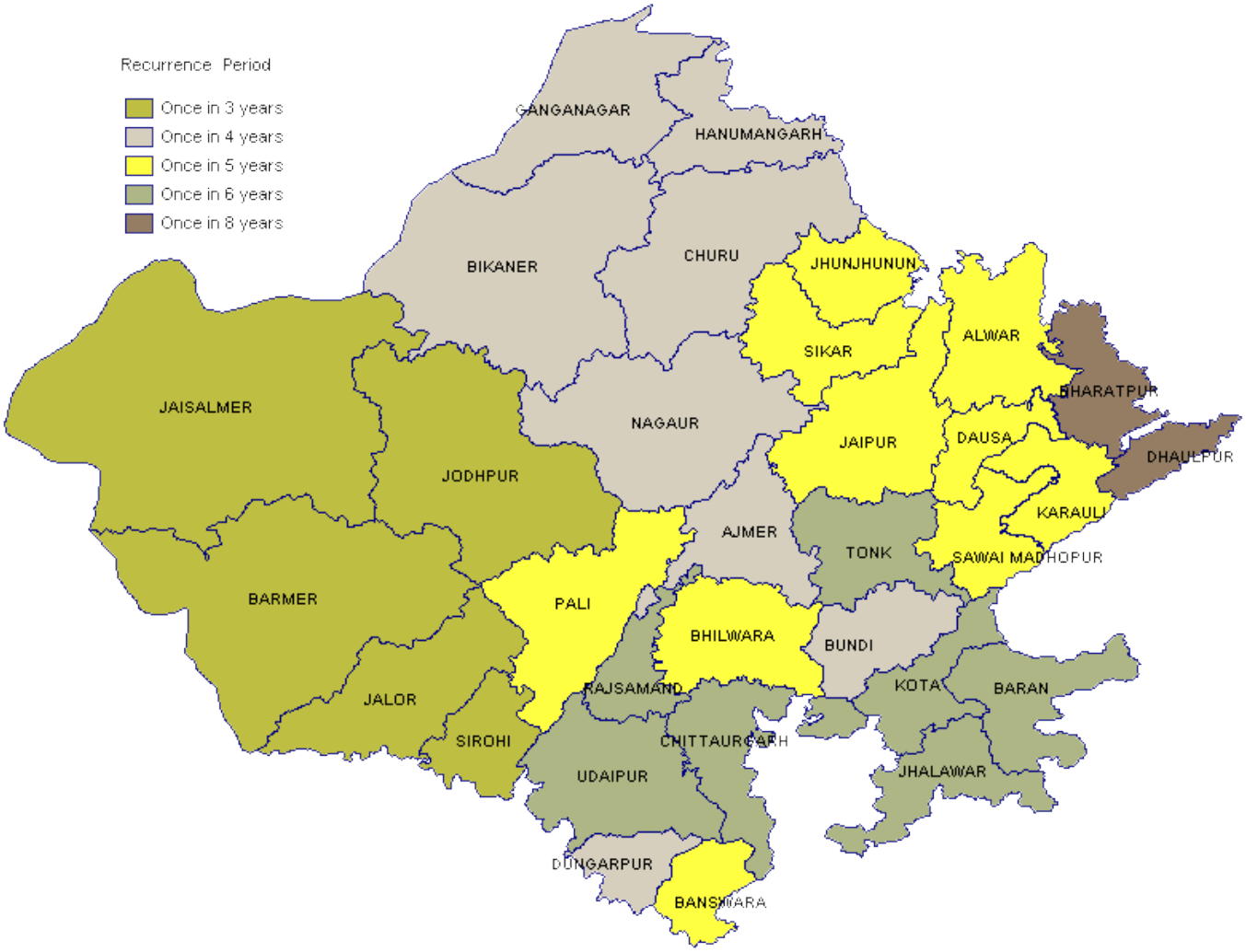


Groundwater contamination problems in Rajasthan





Droughts in Rajasthan

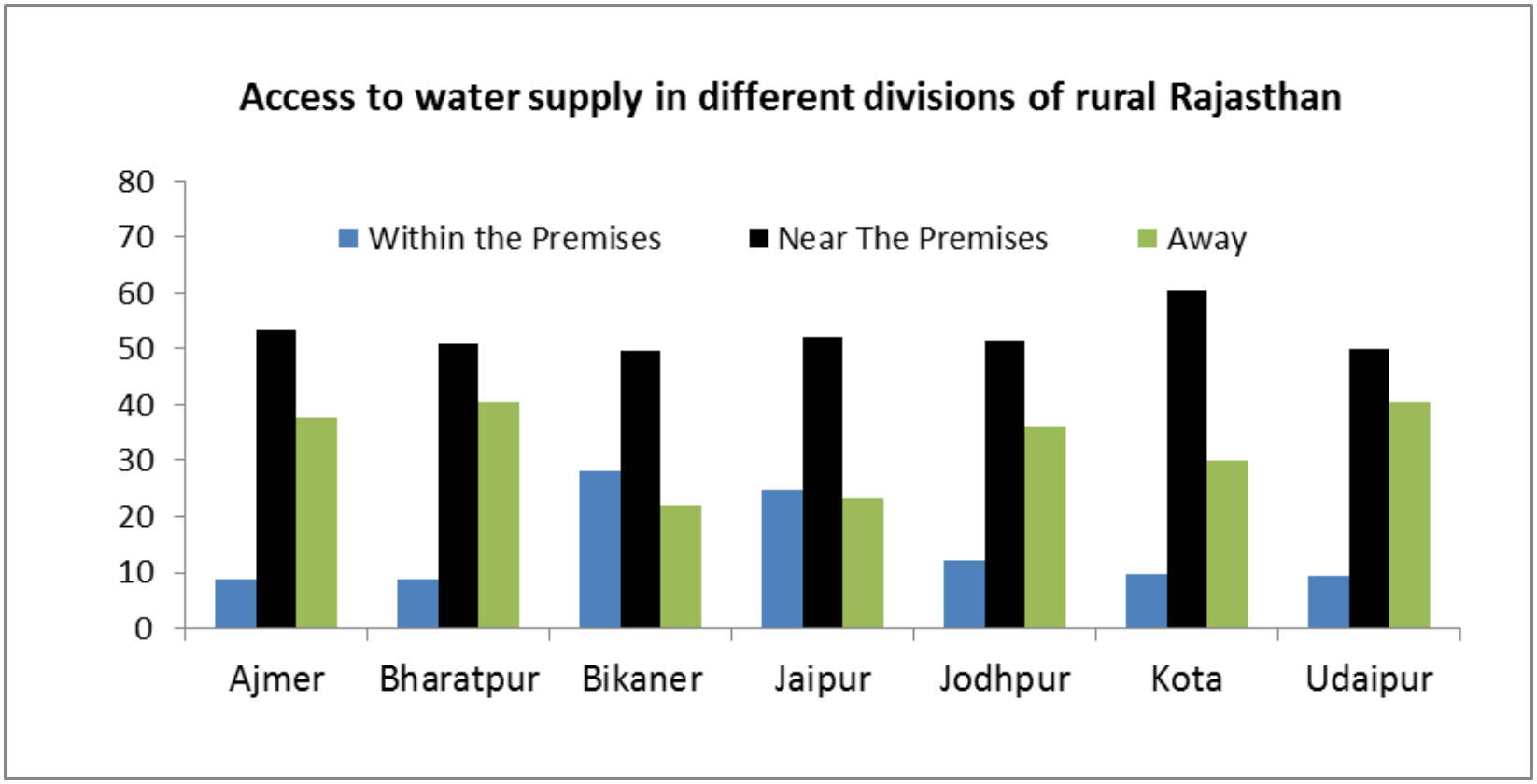


Source: Govt. of Rajasthan

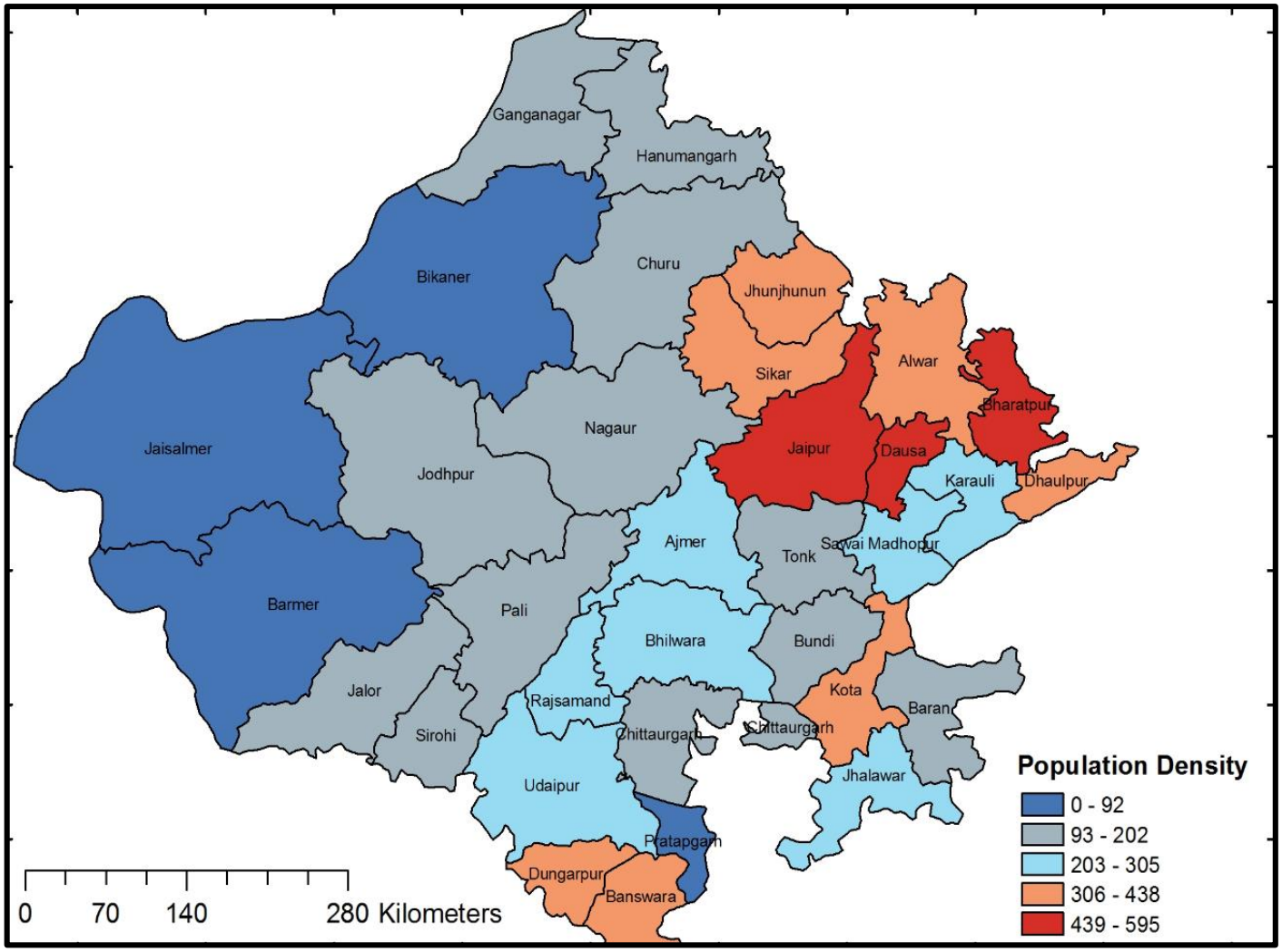
Flood prone area in Rajasthan

Source: Govt. of Rajasthan

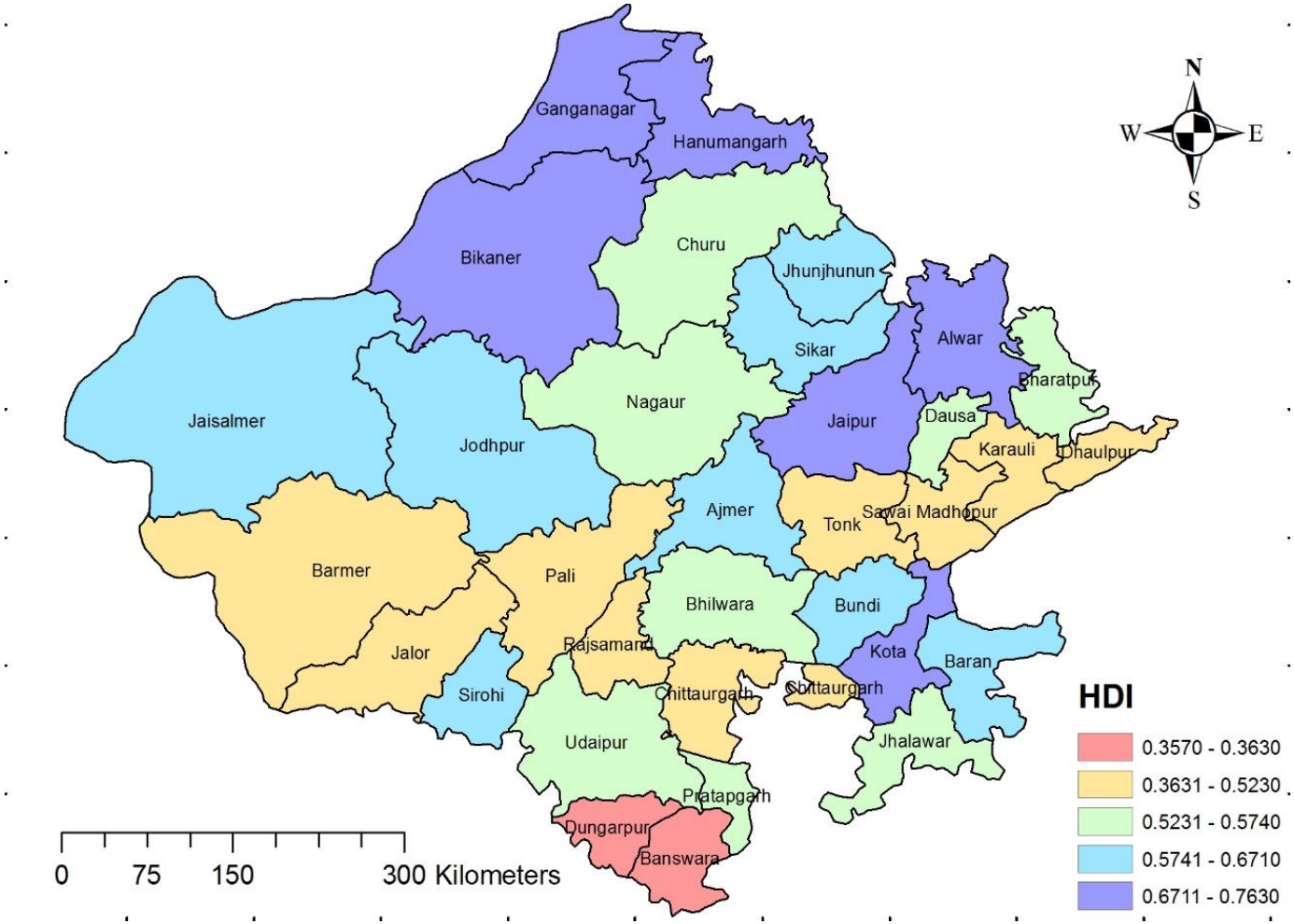
Access to water supply sources



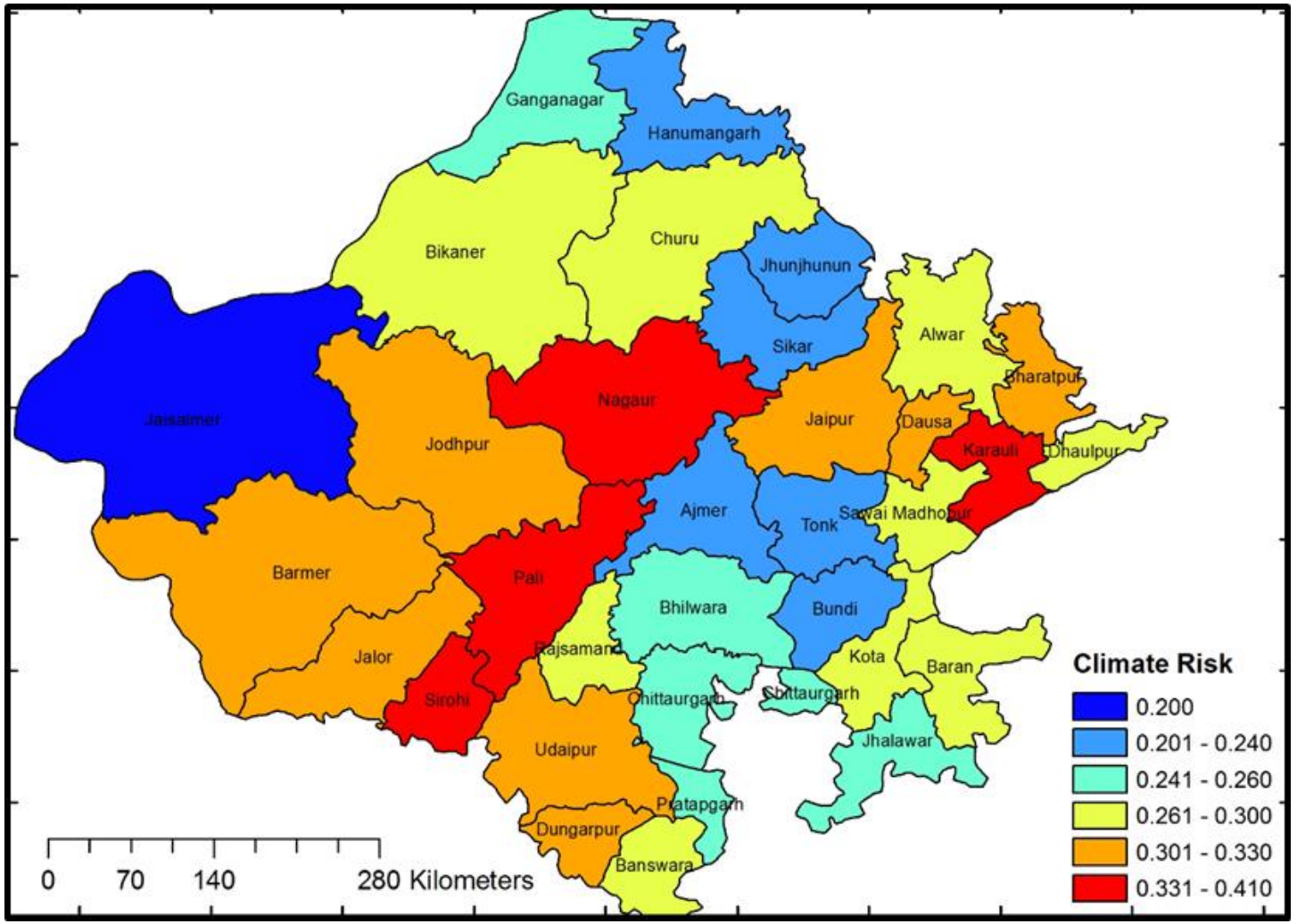
Remarkable variation in population density across districts



Variation in HDI across districts of Rajasthan

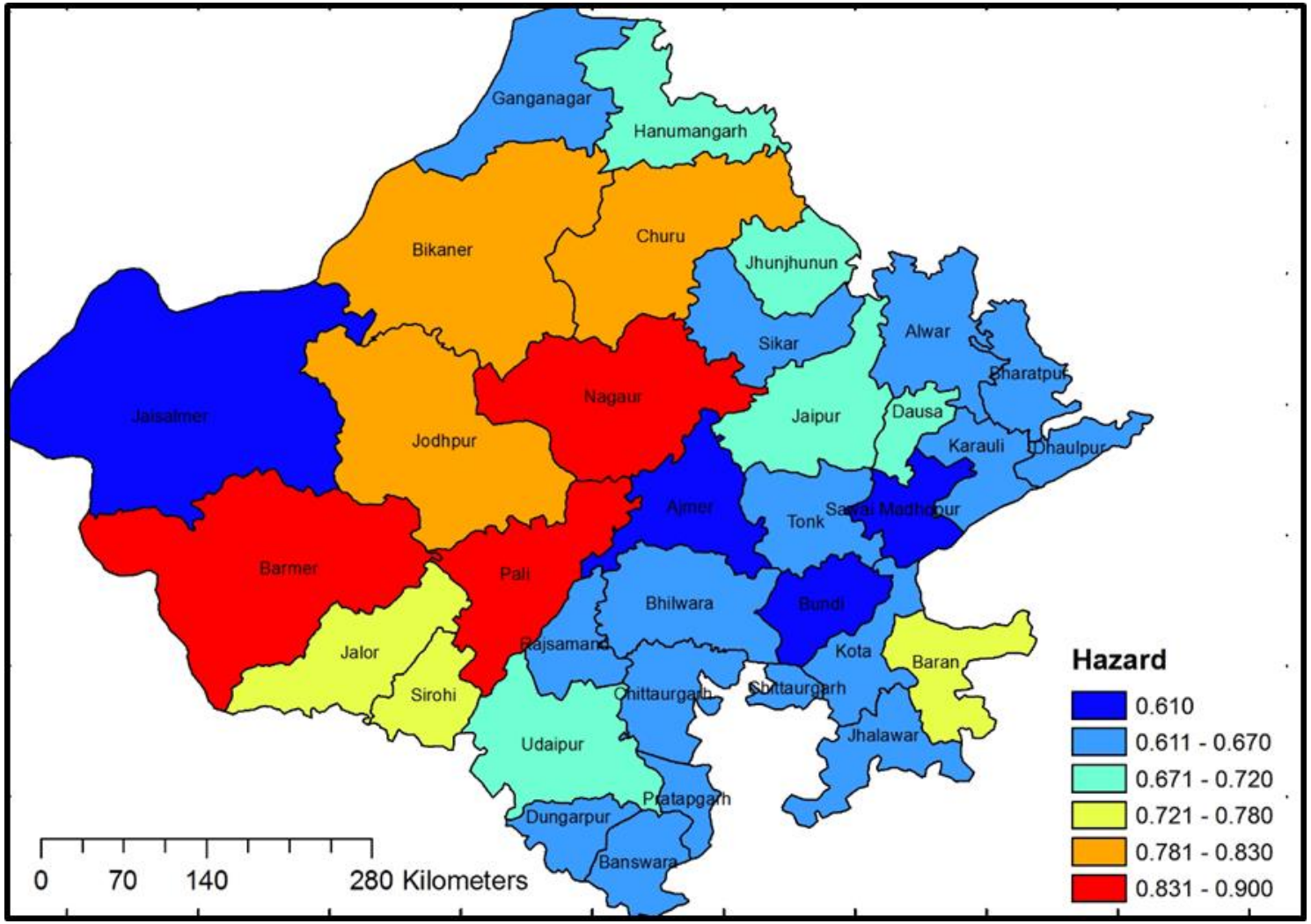


Climate-induced risk in WASH (District-wise)

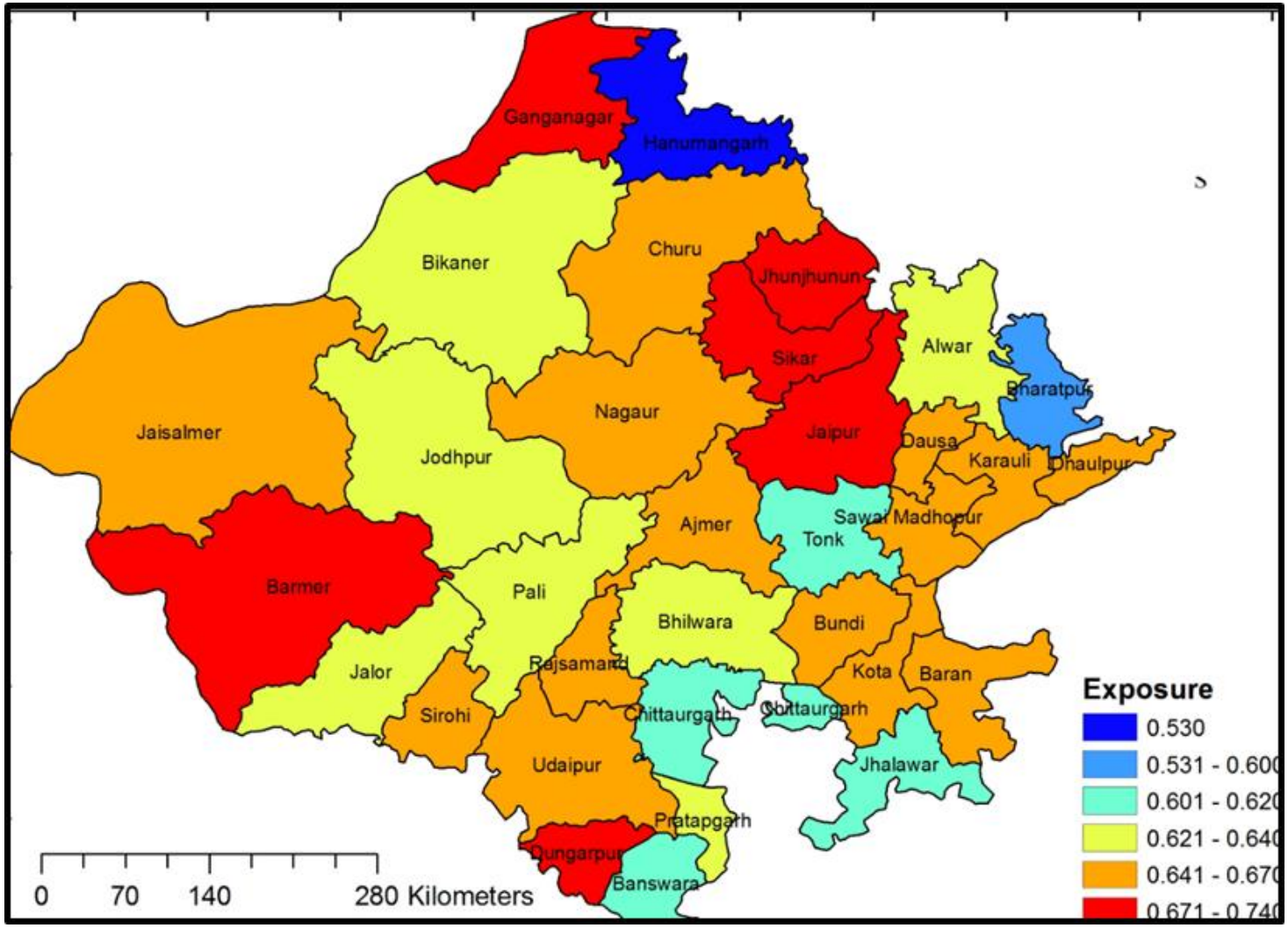


- Higher than 0.30: 12 districts.
- In the range of 0.25 and 0.30: 13 districts.
- Below 0.25: seven districts.

Climate hazard in WASH systems (District-wise)



Exposure of WASH systems to hazard (District-wise)



Community Vulnerability to hazard (District-wise)