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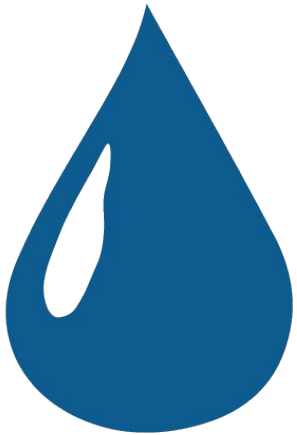
Regional Planning



Analyze the feasibility and need for AguaClara plant in India by gathering data on India's water sources, demographics, geography and economics. Created optimization algorithm on MATLAB to visually display variables in a color-coded map.
More information on - https://www.overleaf.com/4566736tqvggd#/13757353/

This is the framework of the semester.

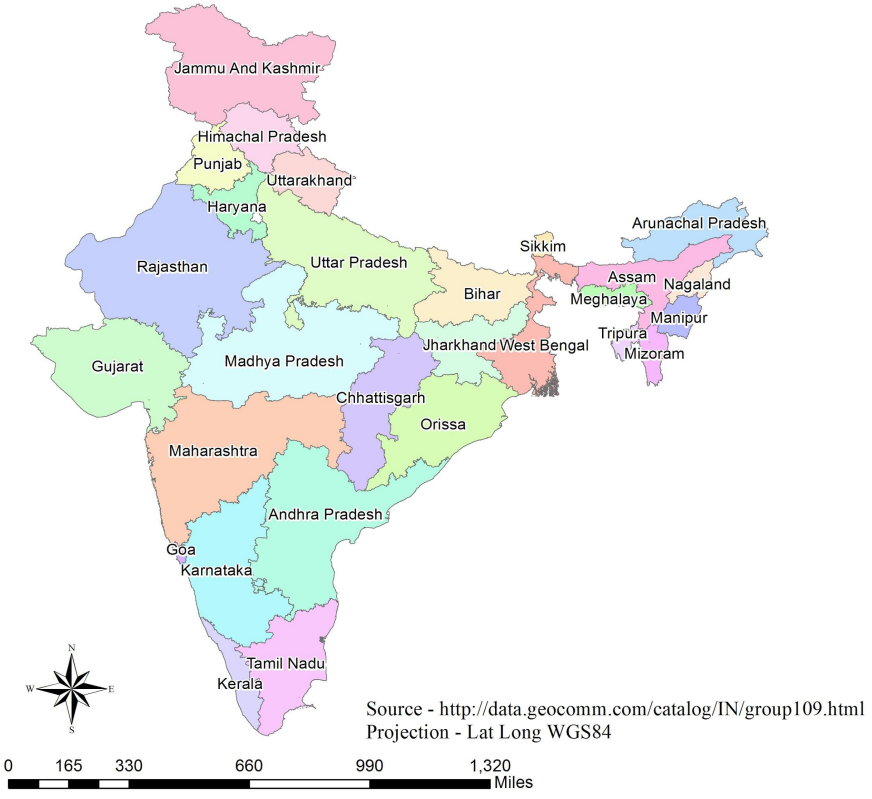
- Location: India
  - Tata-Cornell Initiative
- Site Selection Criteria
- States -> Districts -> Subdistricts -> Towns

There are 11 ideal site characteristics.

- The population is between 5,000 and 25,000.
- Surface water is available consistently all year.
- There is consistent aquifer recharge (rainfall or mountain runoff).
- High proportion of rural population are dependent on surface water for domestic purposes
- The surface water must be between 10 NTU and 1000 NTU.
- There is a distribution system and surface water treatment plants available.
- The consumers are willing to pay the tariff for plant operations.
- The government set up is accepting of the facility.
- There is little political conflict or sufficient stability to allow for community engagement.
- Local partnership is available.
- The Arsenic and Fluoride-contaminated groundwater is present.

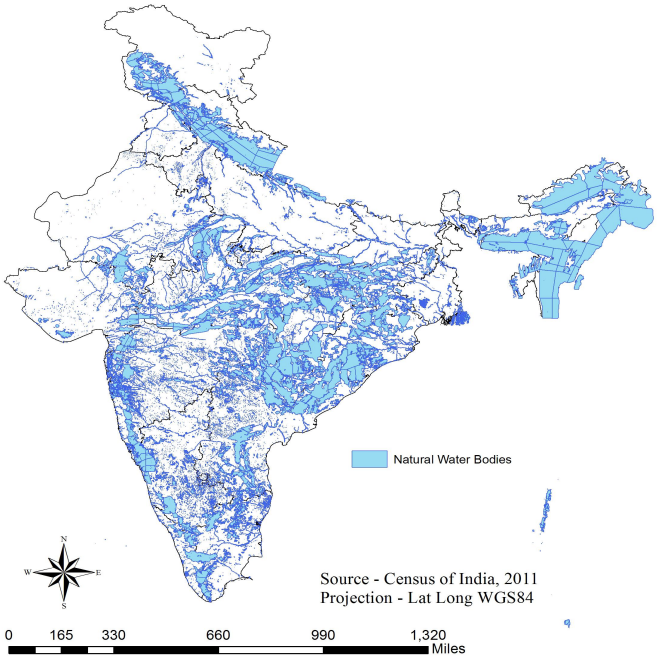
Preliminary analysis was done at the state level

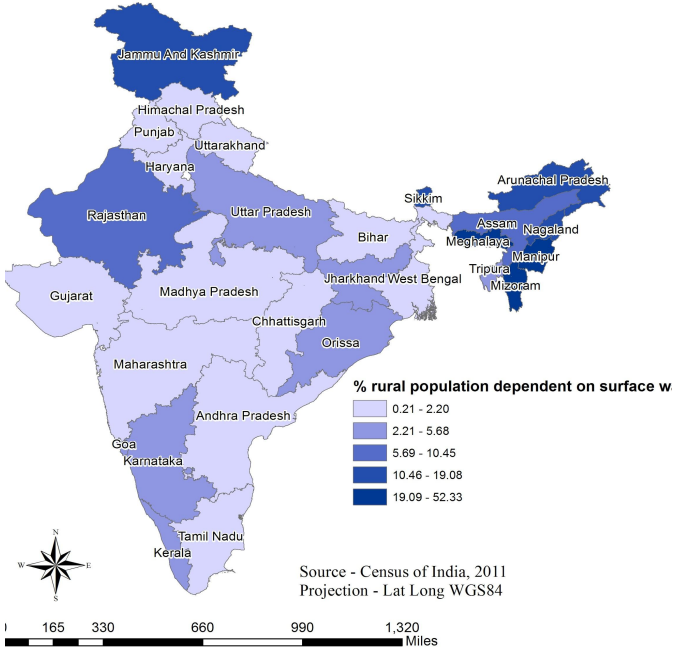
- India consists of 29 states, and 7 Union Territories (not considered)
- Within those states, there are 688 districts and over 600,000 villages



The goal of the Planning team is to choose a village, starting from the state level.

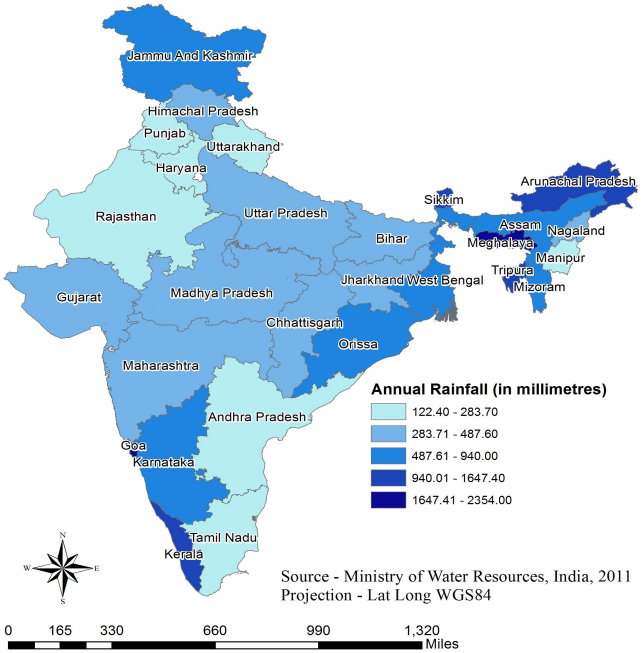
Availability of water correlates with population dependence on surface water

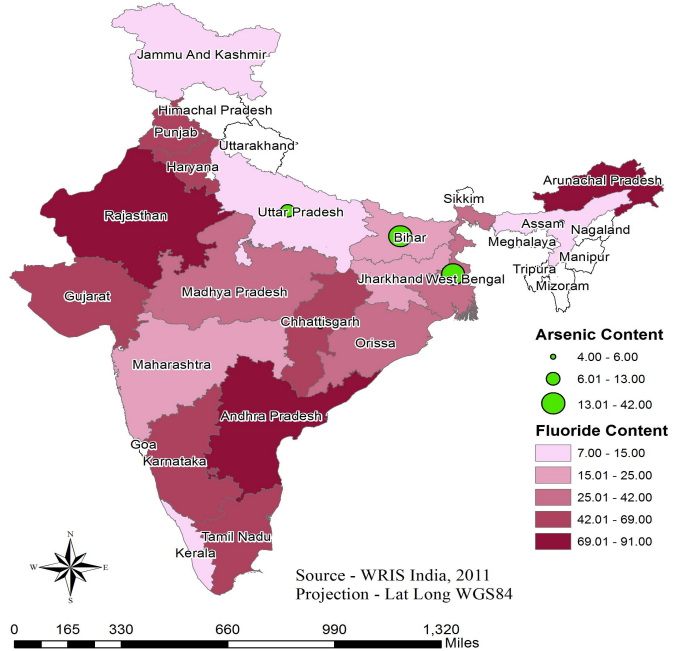




Surface water availability is highly correlated with % of rural population dependent on surface water for drinking purposes.

Also considered are the annual rainfall and arsenic & fluoride content.





These two criterias are not necessary but are correlated with a need for a surface water treatment plant in the area.

Socio-economic characteristics helped with insight on willingness to pay.

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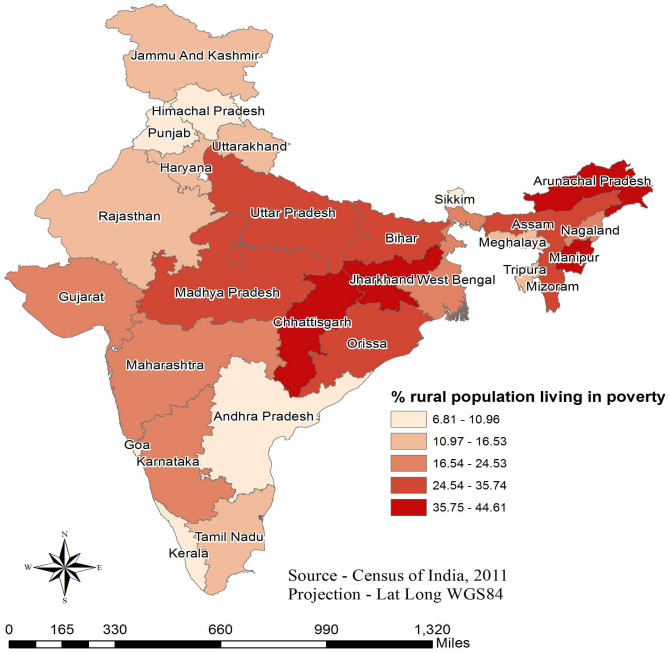
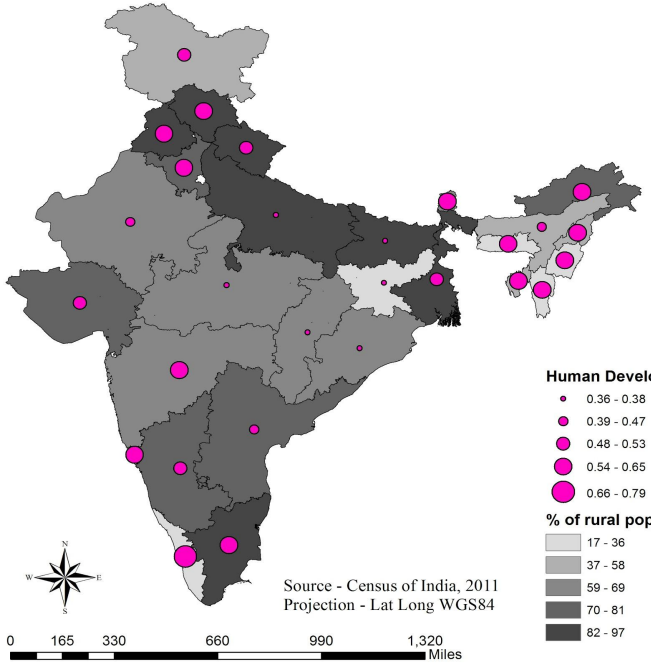
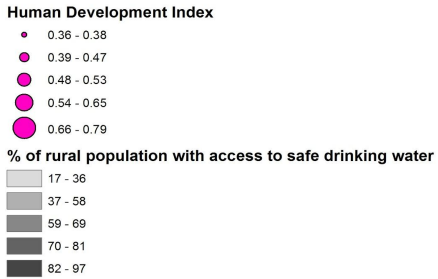




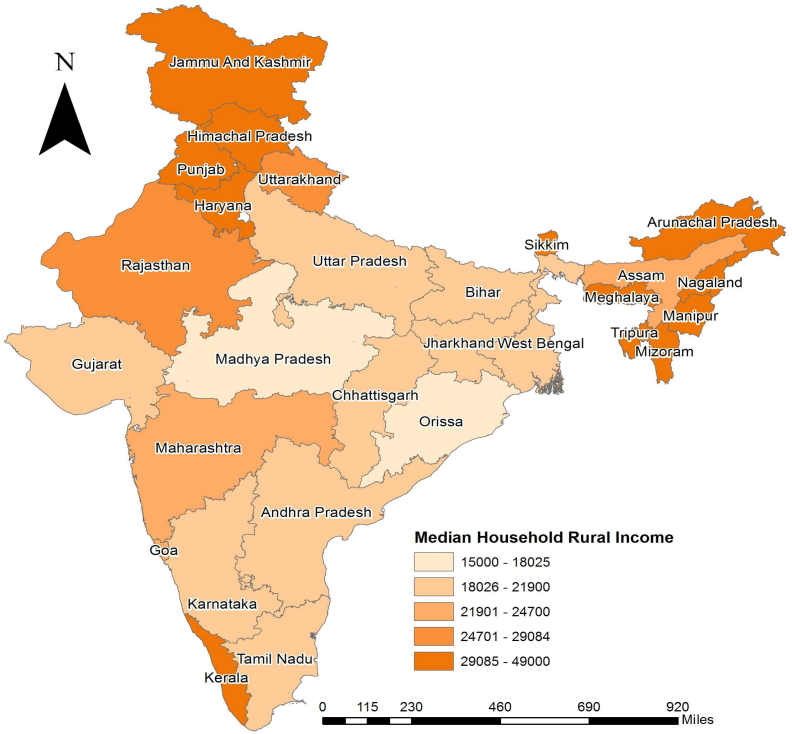


States with higher HDI and lower poverty ratios have higher percentage of rural population without access to safe drinking water that are willing to pay.

The estimated water tariff is too high for rural Indian households.

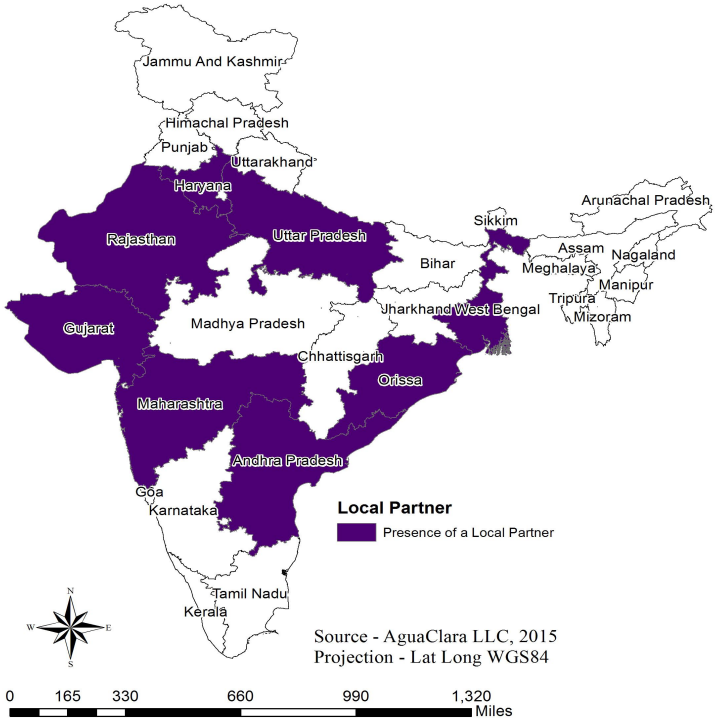
- Current monthly water tariff in Honduras = $3
- Assuming the same range of tariff is used in India
- Average monthly income = INR 22,400 ~ US $28
- US $3-$4 = 10-14% of a rural household's income.
- For developing nations, WTP is between 0.29 and 10.7% of monthly income

The current tariff estimate ($3-$4) is outside the range of willingness to pay for rural Indian households



Aguaclara LLC has contacts with the following local organizations.

- Potential Partners
  - FORCE
  - Swajal
  - CURE
  - TATA Group
  - WASMO
  - Gram Vikas
  - Drinkwell



AguaClara LLC contacts on the ground will be vital to the success of a new AguaClara plant.

The optimization algorithm was coded in Matlab.

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Equation (1)

Weight = Weight1, Weight2, Weight3, Weight4, Weight5, Weight6, Weight7

Equation (2)

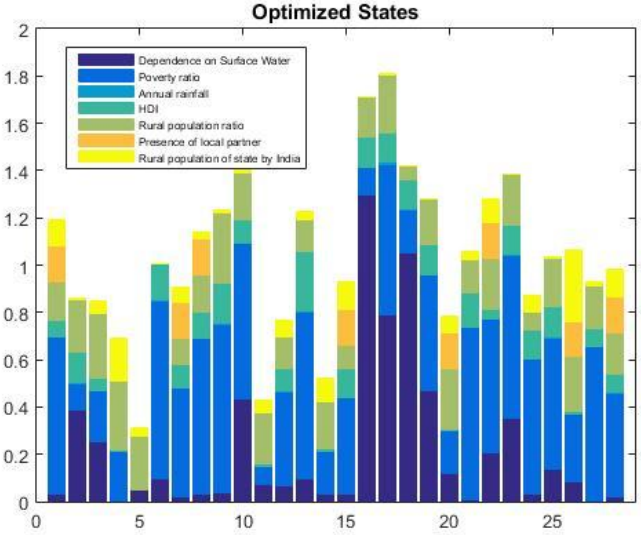
$$Data_N = \frac{Data_p - \min(Data_N)}{\max(Data_N) - \min(Data_N)}$$

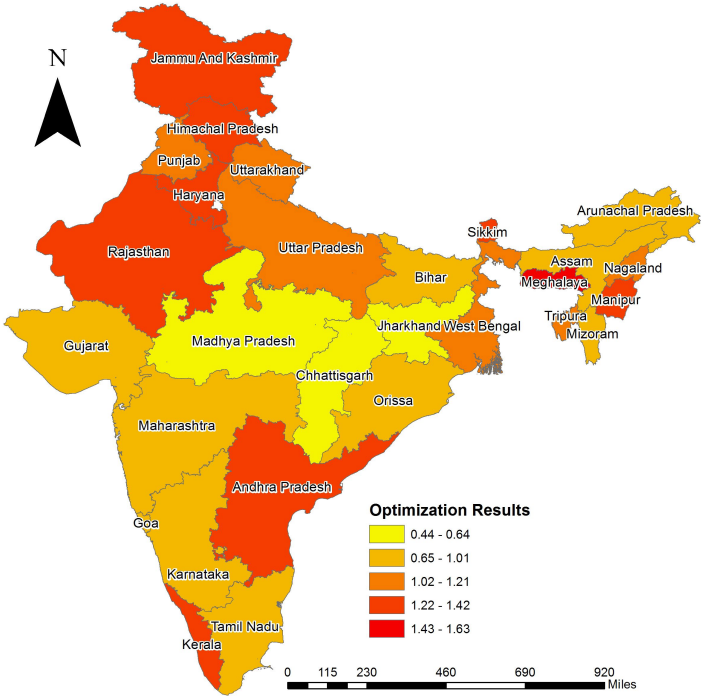
Equation (3)

$$Data_S = \sum Weight \times Data_N$$

Attributes	Weights
Dependence upon surface water	1.3
Poverty Ratio	0.75
Annual Rainfall	0.01
HDI	0.25
Rural Population % per state	0.3
Presence of a Local Partner	0.15
Rural population in state by total rural population in India	0.3

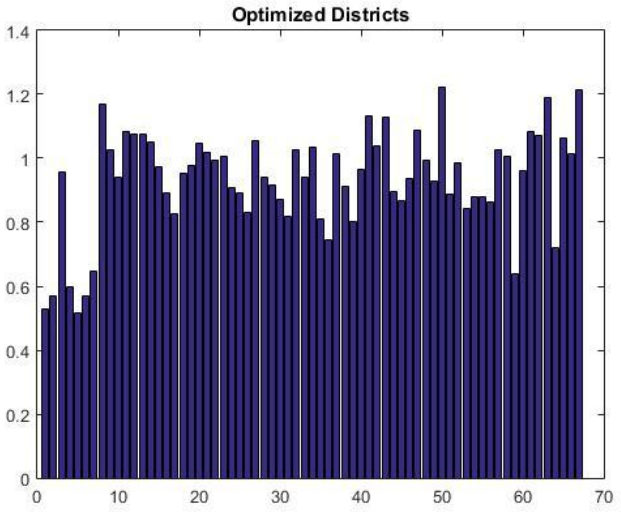
The optimization results are represented by a color-optimized map.

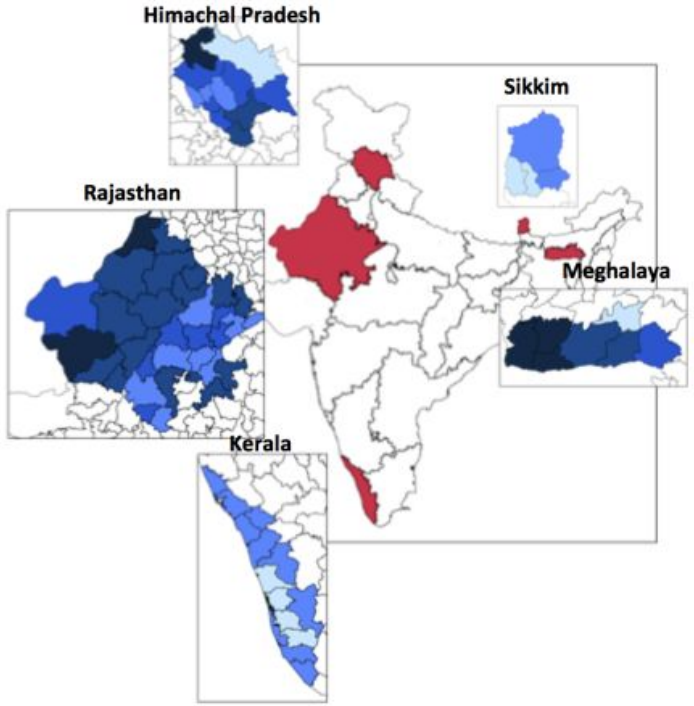




Himachal Pradesh, Rajasthan, Sikkim, Meghalaya and Kerala = top 5 most optimal states

Same method was used for district-level analysis.





South Garo Hills, Chamba, Barmer, East Garo Hills and West Garo Hills = top 5 most optimal districts

Preliminary results from the semester.

- Top optimal state also has 3 of the top 5 optimal districts!
- Local partner in Meghalaya?

http://www.miscw.com/meghalaya-bid-2022-national-games-4850.html

Research can only take us so far - we need on the ground communication!

Future work will be local communication.

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Refine optimization code so that it can be transferred to Python.

Look out for qualitative data for India such as governance set-up, political conflicts at state-level and district-level.

Look out for more potential local partners in India based on their technical feasibility

Find out data on water turbidity at local level.

Future teams should get down to the village-level analysis in the optimal districts.

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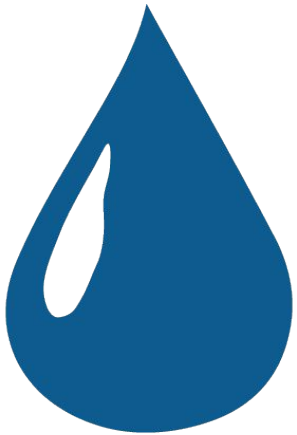
Questions and Recommendations



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Appendix Slides

Analyzing the optimal states.

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ST_NAME	Dependent	Poverty_ra	Annual_Rain	HDI_1	%rural pop	localpartner	%rural/india
Meghalaya	31.94	12.53	2354	0.573	0.80	0	0.002845
Sikkim	14.25	9.85	1427.8	0.573	0.75	0	0.000548
Rajasthan	8.40	16.05	180.1	0.434	0.75	1	0.061791
Himachal Pradesh	1.62	8.48	417.5	0.652	0.90	0	0.007410
Kerala	4.15	9.14	1647.4	0.79	0.61	0	0.020962

This shows the breakdown of characteristics that determine the optimality of these states. “Dependent”=percent population dependent on surface water.

Analyzing the optimal districts.

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DI_NAME	Dependent	Poverty_ra	Annual_Rain	HDI_1	%rural pop
South Garo Hills	0.59	45.33	2459.80	0.48	0.90
Chamba	0.11	54.15	1117.50	0.42	92.50
Barmer	0.13	45.30	243.40	0.58	90.00
East Garo Hills	0.44	55.94	2554.40	0.40	0.84
West Garo Hills	0.30	53.71	2459.80	0.57	0.88

This shows the breakdown of characteristics that determine the optimality of these districts. “Dependent”=percent population dependent on surface water.