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Assessment of Fresh Water Resource Availability in Coastal North Carolina

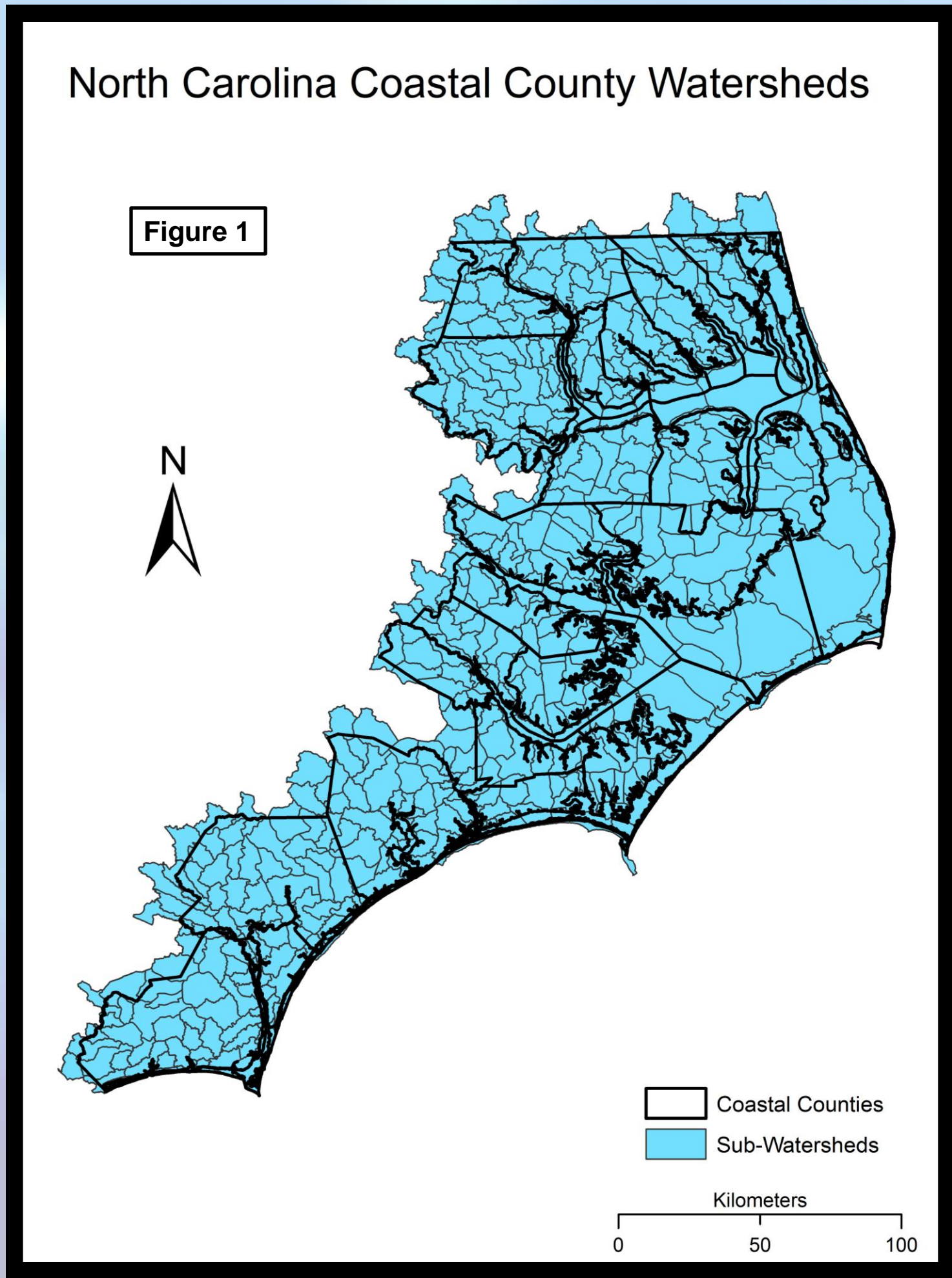
Abstract

Coastal North Carolina, a region which has historically been viewed as water rich, is beginning to see the need for adaptive water resources management. Recent droughts and a ballooning population in the region have raised awareness of the potential stress and scarcity that the future will bring. This project addresses the potential water resource issues and drivers in the region. Thorough analysis of surface water and ground water availability at the 12 digit USGS HUC scale indicates trouble ahead. Many watersheds are transitioning towards water stress and even scarcity as a result of climate change and more prominently population growth. The result of this analysis is a recommendation for a more encompassing management strategy, one that incorporates demand management as well as supply management. It is imperative to shift management practices in order to sustain future generations in the region.

Introduction

Fresh water resources in Coastal North Carolina (Figure 1) are being threatened by climate change, population growth and contamination. These conditions raise the following questions:

- How would a changing climate influence the availability of water in coastal North Carolina?
- Based on historical groundwater levels and climate data, can predictions be made for future water levels?
- What role do anthropogenic influences play in water resource availability in coastal North Carolina?
- Can current local water management practices handle the potential shortages in the future?
- What management strategies should be incorporated?



Methods

Surface Water Analysis

- A water balance model based on the USGS Thornthwaite model.
- Falkenmark water stress indicators to tie the population to water availability.

Ground Water Analysis: Barco et al. (2010)

- Time series / trend analysis
 - Compare climatological and hydrological data
- Correlation analysis
 - Identify correlated wells
- Spectral analysis
 - Decipher physical connections between ground and surface water
- State / Local Water Supply Plans Analysis
 - Review current and projected values of demand and supply
 - Projections available to 2060
- Address Uncertainty Surrounding Climate Models
 - Incorporate multiple climate projections
 - Range of possibilities based on best available data
 - Utilize information gap analysis
 - To provide the most robust option, given uncertainty.

Preliminary Results/State of Resource

- Initial case study shows trend towards increased surface water stress (Figure 2).
- Groundwater has been withdrawn in large quantities.
 - Leading to cones of depression
 - Central Coastal Plain Capacity Use Area (CCPCUA)
 - Mandates staged reduction in ground water withdrawals
- Review of select local water supply plans indicate demand surpassing supply by 2060 (Table 1).

Site_ID	Name	Supply (NC DENR)					Demand (NC DENR)					Demand (Population Projected)				
		2020	2030	2040	2050	2060	2020	2030	2040	2050	2060	2020	2030	2040	2050	2060
04-65-999	Lower Cape Fear WSA	106	156	156	156	156	22.99	66.15	76.15	101.15	125.15	21.10	26.99	34.51	42.01	43.99
04-65-000	CPFLA Wilim	69.752	81.613	81.613	81.613	81.613	29.595	17.658	20.192	23.308	26.459	31.822				
04-65-015	Carolina Beach	2.012	2.012	2.012	2.012	2.012	1.045	0.566	0.813	-	-	1.21				
04-65-025	Kure Beach	0.637	0.637	0.637	0.637	0.637	0.365	0.342	0.354	0.366	0.379	0.379	0.38	0.40	0.41	0.43
04-65-199	The Cape	2.938	3.136	3.136	3.136	3.136	1.009	1.037	1.039	1.039	1.039	1.07	1.10	1.10	1.10	1.10
04-65-020	Wrightsville Beach	1.429	1.429	1.429	1.429	1.429	0.901	1.008	1.066	1.068	1.068	0.91	0.91	0.91	0.91	0.91
04-10-130	Bald Head Island Utilities	0.443	0.443	0.443	0.443	0.443	0.206	0.125	0.147	0.168	0.19	0.211	0.42	0.53	0.64	0.75
04-10-045	Brunswick County	32.875	32.875	32.875	32.875	32.875	13.968	24.125	26.096	27.977	30.216	36.892	17.99	20.88	24.23	28.12
04-10-010	Brunswick Regional WSD	1	1.94	1.91	1.96	1.99	1.66	2.833	2.777	3.865	4.415	2604.18	2.03	2.36	2.74	3.17
04-10-055	Clewett Beach	0.145	0.145	0.145	0.145	0.145	0.145	0.561	0.561	0.561	0.561	3.162	0.15	0.15	0.15	0.15
04-10-060	Holden Beach	53.15	1.15	1.15	1.15	1.15	0.786	0.58	0.61	0	0	1.11	1.48	1.75	1.75	1.75
04-10-065	Nawassa	0.072	0.072	0.072	0.072	0.072	0.072	151.793	162.81	179.948	198.31	216.672	0.15	0.23	0.30	0.38
04-10-045	Northwest	0.21	0.21	0.21	0.21	0.21	0.186	-0.973	-1.009	1.057	1554.67	-1.116	0.13	0.15	0.17	0.20
04-10-010	Southport	1	1	1	1	1	0.426	1.159	1.39	1.7	1.86	2.07	0.45	0.46	0.49	0.54
04-10-020	Town of Oak Island	2.5	2.5	2.5	2.5	2.5	0.884	1.467	1.558	1.678	1.824	2.038	1.69	1.80	1.91	2.02
04-71-020	Topsail Beach	0.63	0.63	0.63	0.63	0.63	0.166	0.189	0.189	0.189	0.189	0.189	0.17	0.17	0.17	0.17
04-31-040	Falcon	1.44	1.44	1.44	1.44	1.44	0.473	0.578	0.609	0.629	0.669	-	0.40	0.42	0.43	0.44
04-31-015	Warsaw	0.468	0.421	0.421	0.421	0.421	0.36	0.72	0.809	-	-	-	0.49	0.57	-	-
03-82-045	Actonville	0.05	0.05	0.05	0.05	0.05	0.027	0.038	-0.003	-0.003	-0.003	-0.003	0.04	0.04	0.04	0.04
03-43-010	Dunn	12	12	12	12	12	3.415	4.977	4.998	5.019	5.04	5.061	3.42	3.49	3.53	3.56
04-24-035	Rigelwood	1	1	1	1	1	0.2	0.199	0.199	0.199	0.199	0.191	0.20	0.20	0.20	0.20
03-09-060	Bladen Co WD (East)	0.35	0.35	0.35	0.35	0.35	0.175	0.195	0.196	0.198	0.199	0.199	0.18	0.20	0.21	0.22
03-09-055	Bladen Co WD (West)	0.872	0.872	0.872	0.872	0.872	0.394	0.253	0.255	0.258	0.26	0.262	0.42	0.43	0.46	0.49
03-09-025	Dublin	0.05	0.05	0.05	0.05	0.05	0.007	0.061	0.064	0.067	0.07	0.074	0.05	0.05	0.05	0.05
03-09-050	East Arcadia	0.289	0.289	0.289	0.289	0.289	0.095	0.565	0.569	0.571	0.574	0.578	0.13	0.14	0.14	0.15
03-09-030	White Lake	0.95	0.95	0.95	0.95	0.95	0.25	0.33	0.33	0.334	0.335	0.335	0.32	0.32	0.32	0.33

Table 1

Conclusion

Based on initial case studies and current conditions in Coastal North Carolina, the future looks bleak. As a result of increased population and climate change water quality is likely to be degraded while stress increases in the future. Figure 2, which represents a portion of the study area, indicate potential areas of stress and scarcity in the future. Based on the initial analysis of local water supply plans (Table 1), management plans need to enact measures to increase supply and limit use through conservation.

Moving Forward

- Expand analysis to entire Coastal NC region (Figure 1).
- Incorporate ground water analysis.
- Apply information gap analysis to asses the uncertainty in the climate projections.

Final Product

The final product of this research will be a comprehensive analysis of the fresh water resource in Coastal North Carolina. This product will outline how climate change and population growth will factor into the overall water resource health of the region. Based on these results, an all-encompassing management plan will be presented to effectively plan for the future conditions. It is likely that the norm of managing for demand will not be sufficient in the wake of climate change and excessive population growth. Therefore, management for supply as well as demand will be incorporated into the plan. Conservation can be highly effective in combating water stress and it is the cheaper to implement.

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