STATUS OF WATERBODIES IN CENTRAL WESTERN GHATS

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ABSTRACT

India has a wealth of water bodies that support diverse and unique habitats with other basic ecosystem functions. These provide numerous ecological goods and services but are under tremendous stress due to rapid urbanization, industrialization and agricultural intensification, manifested by the shrinkage in their area that emphasizes it's important to map and monitor the extent and number of water bodies. Temporal mapping and monitoring the water bodies can be accomplished by online virtual earth databases such as Google earth and Bhuvan. Since Satellite data has repetitive coverage of the earth surface it becomes an essential input in monitoring the wetlands. The Google earth provides information of surrounding landscape, which can be used to map various resources. The purpose of the study is to carry out the temporal analysis of wetlands (changes during the period (1973-2013)) in Chikmagalur, Hassan, Uttara Kannada and Shimoga district using Google earth. The result revealed that waterbodies were lost in last 4 decades. Hassan lost more than 3000 water bodies, while Uttara Kannada, Chikmagalur and Shimoga lost less than 1000 water bodies.

INTRODUCTION

Wetlands are ecotones or transitional land between terrestrial and aquatic eco-systems (Mitch and Gosselink, 1986). Wetlands are the conspicuous and play an important role in ecosystem, which helps in maintaining the ecological balance, serving the needs of the society by recycling nutrients, recharging ground water, maintain stream flow etc., (Ramachandra and Kumar, 2008). Water bodies are an intrinsic part of wetland ecosystem. It supports society directly or indirectly by providing various needs such as for domestic, agricultural, industrial, food, recreation, and aesthetics (Barbier et al., 1994). They store the water for longer periods and their capacity during heavy rainfall to retain the excess flood water and are the primary source of recharging ground water aquifers (Bullock and Acreman 2003).

In order to save and maintain these ecosystems, Ramsar convention on wetlands (1971) was the first intergovernmental treaty came into force in 1971. The aim of the Ramsar mission is "conservation, wise use of all wetlands and international cooperation which achieves sustainable development throughout the world". The Ramsar Convention defines the wetlands as 'Area of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salty including areas of marine water, the depth of which at low tide does not exceed 6 meters.

Wetlands functions as the downstream receivers of water and waste from natural and human sources. They stabilize water supplies, which helps in ameliorating floods and drought. They have been found to cleanse polluted waters, protect shorelines, and recharge groundwater aquifers. Thus the wetlands are well-known as "Kidney of the landscape". Further wetlands are also called as "ecological supermarkets" because of the extensive food chain and rich biodiversity that they support. They play major roles in the landscapes by providing unique breeding home for a wide variety of flora and fauna. Apart from these they also act as important carbon sinks and climate stabilizers on the global scale because they mitigate the greenhouse gases in the atmosphere (Mitch and Gosselink, 1986, Pandey et al., 1997, Kraiem H 2002).

In many countries throughout world, the urban wetlands are under immense pressure due to the pollution (discharge of domestic and industrial effluents), dumping of waste, unplanned urban development, intensified human activity, lack of proper legislation, lack of management structure, hydrological alterations (water withdrawal and inflow changes), overexploitation of their natural resources and lack of awareness about the importance of the wetlands (Mitsch and Gosselink 1993; Prusty 2008; Ramachandra and Uttam 2008). In Karnataka, about 35% wetlands are threatened due to sedimentation, 43% (encroachment) and 22% due to the rampant growth of exotic weeds (Ramachandra and Sreekantha 2006; Kumari and Lal 2008). It is necessary to conserve the valuable resource (Daily 1997). The protection of the wetland ecosystem is essential for the local biota. Progressing wetland degradation is caused by disturbances and pressures, such as population, agricultural intensification, plantation and unplanned urban development, large scale industrialization, water intensive lifestyles (Reschke and Hüttich 2014). These are the chief factors which lead to degradation of water bodies includes urbanization, water pollution due to sewage, nutrient rich run-off from agriculture etc., among many other sources. To prevent further loss of wetlands, conservation of the existing wetland ecosystems for biodiversity is necessary, thus it is important to inventory and monitor the status of wetlands. Temporal mapping of wetland is important for the understanding the functions and monitoring their response to natural variability and anthropogenic activities.

Temporal mapping and monitoring the Wetlands can be accomplished by online virtual earth databases such as Google earth and Bhuvan. Since Satellite data has repetitive coverage of the earth surface it becomes an essential input in monitoring the wetlands. Google earth provides information of surrounding landscape, which can be used to map various resources. The purpose of the study is to carry out the temporal analysis of wetlands (changes during the period (1973-2013)) in Chikmagalur, Hassan, Shimoga and Uttara Kannada district(s).

STUDY AREA

Study area comprises of 4 major districts of central western ghats of Karnataka, namely Chikmagalur, Shimoga, Hassan and Uttara Kannada as shown in Figure 1.

Chikmagalur district is located in the south-western part of Karnataka. Chikmagalur district is situated in the heart of the Western Ghats region. The large area of this district is malnad i.e., a largely forested hilly region of heavy rainfall. It is situated at the 12º 54'42" and 13º 53' 53" North latitude and 75º 04' 46" and 76º 21' 50" East longitude. The district is bounded by the Tumkur district on the east, south by the Hassan district, west by the Udupi, on the north-east by the Chitradurga and on the north by Shimoga district. Chikmagalur district enjoys a cool climate throughout the year and pleasant retreat during hot months (March to May). December month is the coldest with mean minimum temperature of 13.1°C. The hottest month is March with a mean maximum temperature of 36°C. The average annual rainfall in the district is 1772 mm. Kadur Taluk receives the lowest rainfall of 620 mm while Sringeri taluk receives the highest rainfall in the district of about 3773 mm. The district has largest portion of water i.e., 86% falls under Krishna basin while the Cauvery basin covers 8.4 percent. The main rivers are Tunga and Bhadra. The other river which originate in the district are Hemavati, Yagachi, Veda, Avati, Netravati etc. there are also several minor streams in the district, but are not of much importance.

Shimoga district of Karnataka state is situated in the heart of the Western Ghats region, which is one of the 'hot-spots of biodiversity' in India. Shimoga district is situated between 13°27' and 14°39' N latitude and between 74°37' and 75°52' E longitude in about the mid-south western part of the Karnataka State. The district receives an average annual rainfall of 2869 mm (Annual rainfall report, Govt. of Karnataka). The important rivers that flow through the Shimoga district are the Tunga, Bhadra, Tungabhadra, Sharavati, Kumudvati and Varada.

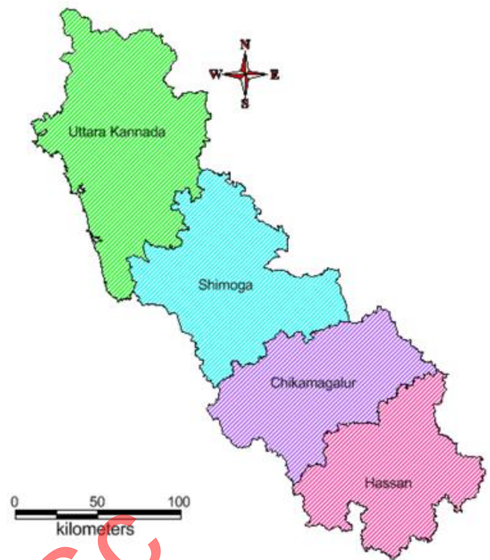

Figure 1. Uttara Kannada, Shimoga, Chikmagalur and Hassen districts, Karnataka State, India

Uttara Kannada district is located in the north – western part of Karnataka state, in India. It lies between 13º 10´ N to 15º23´ N latitude and 74º4´ E to 75º 3´ E longitude. The district cover an area of 10,291 km^2 which is sub-divided into 11 taluks. Topographically, the district has 3 distinct zones coastal zone, ridge (Ghats) zone and elevated flat eastern zone. The district is known for its dense forest cover.

Hassan District located in the south-western part of Karnataka in India. The district, noted for its architecture and sculpture at Belur, Halebeed and Shravanabelagola. It has 8 taluks encompassing an area of 6845 km^2 lying between 12°13´ and 13°33´ N latitudes and 75°33´ and 76º38´ E longitude with an average rainfall about 1031 mm. District may be divided into three regions, southern malnad, semi-malnad and southern maidan.

DATA AND METHOD

Survey of India (SOI) toposheets of 1:50000 scales were used to generate base layers of district boundary, taluk boundaries, road network, drainage network, mapping of water bodies, etc. SOI toposheets were geo-referencing to latitude-longitude coordinate system, and digitized to map water bodies of 1973. Further, Google earth is used to digitize water bodies of 2013.

RESULT AND DISCUSSION

Chikamagalur district water bodies cover about 2% of total geographic area in 2013. Bhadra reservoir and Jambadahalli reservoir are the major irrigation projects. Devanakere and Dodahadlukere are the prominent water bodies. Table 1 shows the status of water bodies during 1973 and 2013 in the Chickmagalur district. The analysis revealed that there were 1583 water bodies (17932.74 ha) in 1973 dropped down to 1015 (14400.834 ha) in 2013. About 568 water bodies disappeared in 4 decades. Graphical representation of changes in water bodies during last 4 decades is given in Figure 2 and tabulated in table 1. Spatial comparison of location of water bodies is as shown in Figure 3. Ayyanakere was the largest water body with an area of 180.17 ha in 1973 which decreased to 108.02 ha in 2013. Another largest water body Madagadakere decreases its spatial extent from 124.71 ha in 1973 to 72.58 hectares in 2013. The analysis of water bodies in Uttara Kannada revealed that there were 1468 water bodies (3185.77 ha) in 1973 dropped down to 618 (1465.21 ha) in 2013. About 850 water bodies were lost in 4 decades. Figure 4 and graphical representation of changes in water bodies during last 4 decades. Spatial distribution is as given in Figure 5 and tabulated in table 2. The analysis of Hassan district revealed that there were 4067 water bodies (18930.14 ha) in 1973 dropped down to 1042 (3645.93 ha) in 2013. About 3025 water bodies disappeared in 4 decades and graphical representation of changes in water bodies during last 4 decades in Hassan is given in Figure 6 and tabulated in table 3. Spatial distribution of water bodies is as shown in Figure 7.

Table 1: Status of Water Bodies in Chikmagalur district

Area (hectare)	Number of water bodies		Area covered in Hectares		% of Geographical area covered	
	1973	2013	1973`	2013	1973	2013
< 2	1160	763	854.509	431.913	0.119	0.060
2 to 5	194	114	594.225	357.064	0.083	0.050
5 to 10	89	58	607.228	404.335	0.084	0.056
10 to 50	113	60	2457.288	1188.422	0.341	0.165
50 to 100	14	11	1018.064	743.972	0.141	0.103
> 100	13	9	12401.426	11275.129	1.722	1.566
Total	1583	1015	17932.74	14400.834	2.49	2.00

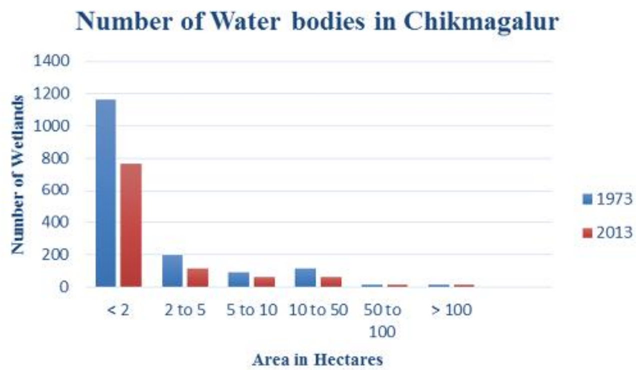

Figure 2: Number of water bodies in Chikmagalur district

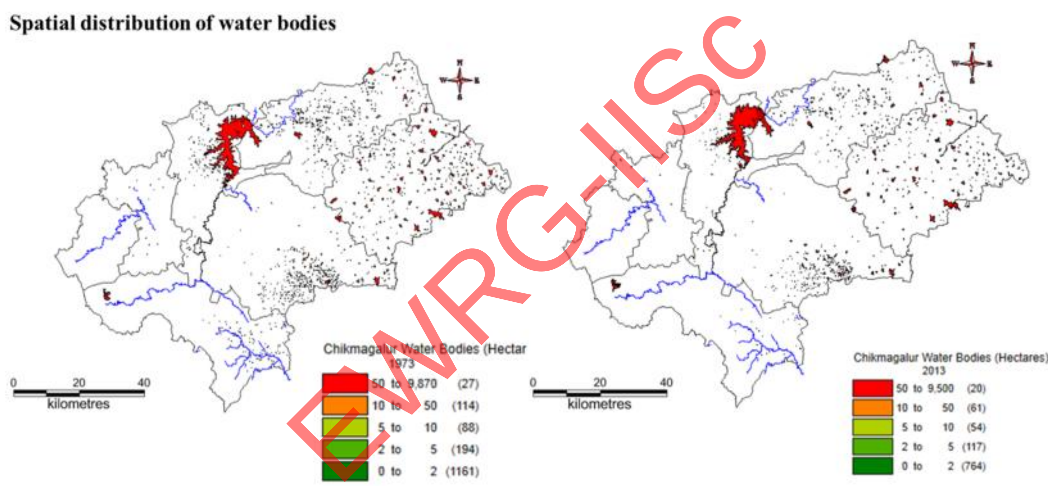

Figure 3: Spatial distribution waterbodies in Chikmagalur (Area in hectares and number of water bodies)

Table 2: Status of Water Bodies in Uttara Kannada district

Area (hectare)	Number of Water Bodies		Area covered in Hectares		% of Geographical area	
	1973	2013	1973	2013	1973	2013
< 2	1049	489	884.16	360.38	0.086	0.035
2 to 5	247	87	665.41	268.33	0.064	0.026
5 to 10	89	23	327.68	155.23	0.032	0.015
10 to 50	64	14	516.06	248.83	0.05	0.024
50 to 100	16	2	349.07	94.55	0.034	0.009
> 100	3	3	443.39	337.89	0.043	0.033
Total	1468	618	3185.77	1465.21	0.309	0.142

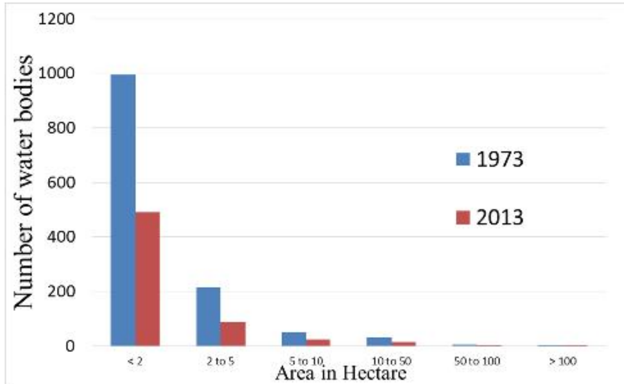

Figure 4: Number of wetlands in Uttara Kannada district

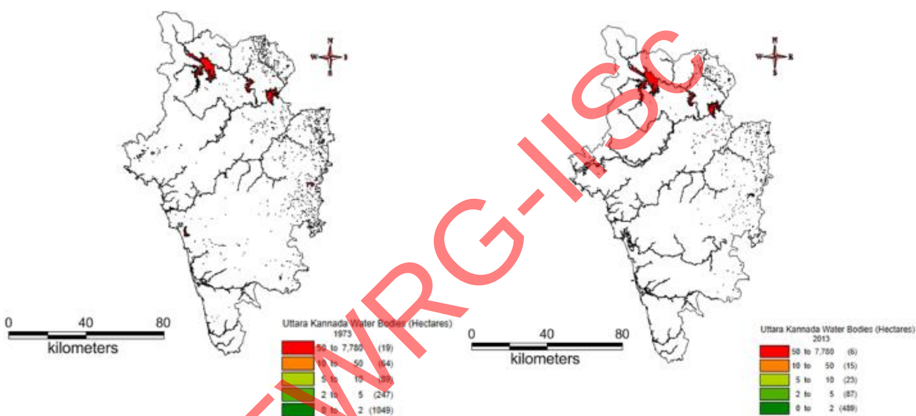

Figure 5: Spatial distribution of wetlands in Uttara Kannada (Area in hectares (no of water bodies))

Table 3: Status of Water Bodies in Hassan district

Area Hectares)	Number of water bodies		Area covered in Hectares		% of Geographical area	
	1973	2013	1973	2013	1973	2013
< 2	2753	760	2038.89	480.98	0.298	0.070
2 to 5	656	154	2040.07	481.48	0.298	0.070
5 to 10	295	53	2097.06	359.05	0.306	0.052
10 to 50	301	64	6292.63	1308.10	0.919	0.191
50 to 100	44	8	3171.15	549.18	0.463	0.080
> 100	18	3	3290.34	467.14	0.481	0.068
Total	4067	1042	18930.14	3645.93	2.77	0.53

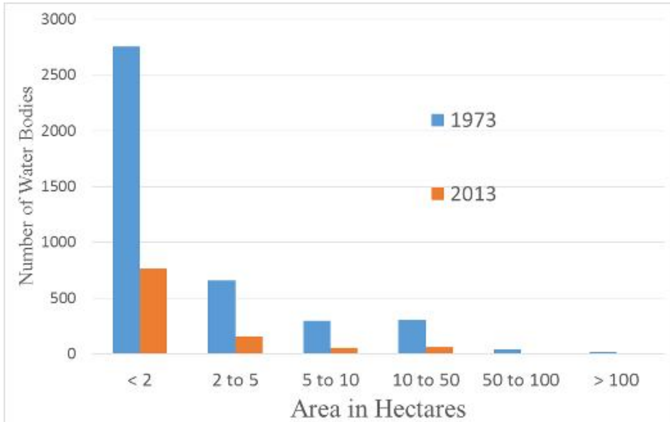

Figure 6: Number of Water Bodies in Hassan district

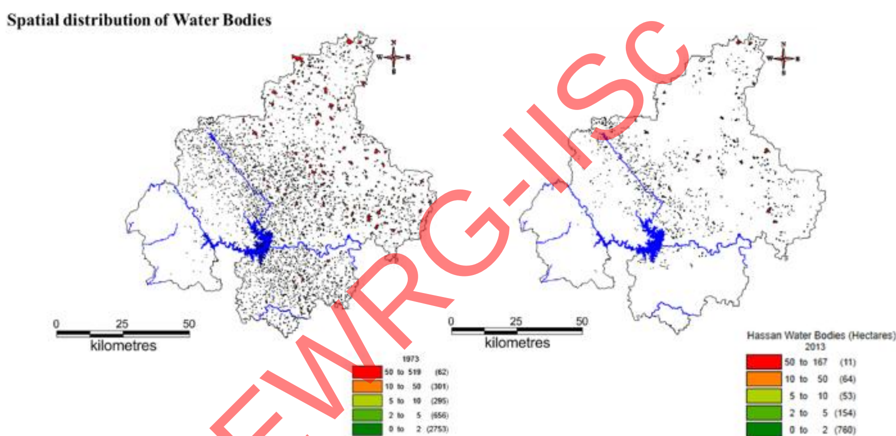

Figure 7: Spatial distribution of wetlands in Uttara Kannada (Area in hectares (no of water bodies))

Table 4: Status of Water Bodies in Shimoga district

Area (Hectares)	Number of Water Bodies		Area Hectares	
	1973	2013	1973	2013
< 2	2928	2266	2488.25	1873.16
2 to 5	830	653	2616.52	2088.32
5 to 10	338	305	2365.15	2135.02
10 to 50	164	155	3118.17	2968.37
50 to 100	12	12	709.31	709.31
> 100	7	7	29330.50	30220.19
Total	4279	3398	40627.91	39994.36

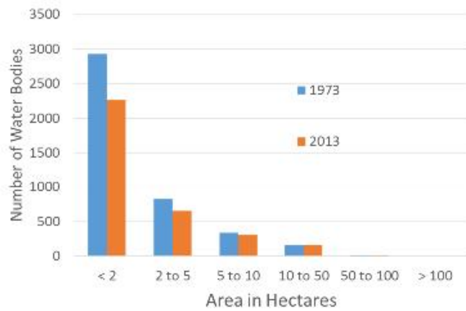

Figure 8: Number of Water Bodies in Shimoga district

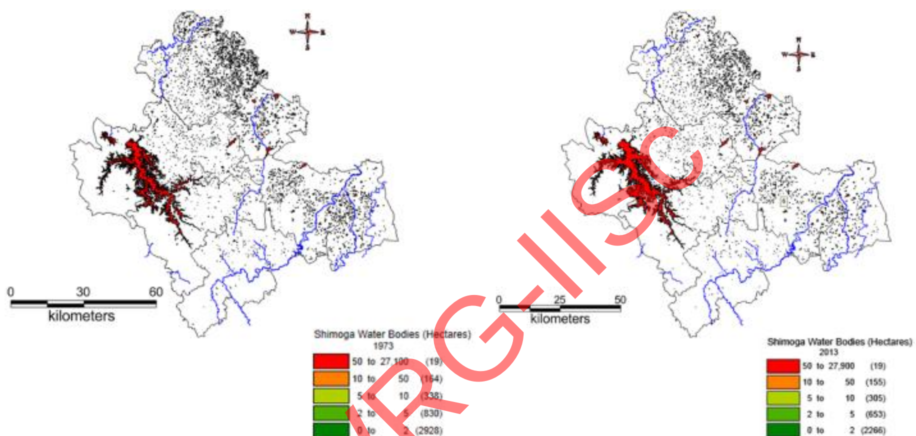

Figure 9: Spatial Distribution of Water Bodies in Shimoga District

Temporal analysis of water bodies in Shimoga district revealed the district had rich distribution of water bodies totaling about 4279 bodies in 1973, which were lost in past four decades and now the total water bodies have reached to about 3398 in 2013 (as also described by Ramachandra et al., 2013). About 3025 wetlands disappeared in 4 decades. The graphical representation of changes in water bodies during last 4 decades in Shimoga is given in Figure 8 and tabulated in table 4. The spatial distribution of water bodies in Shimoga district is as shown in Figure 9.

CONCLUSION

Loss of water bodies has led to decrease in various important contributions for these regions such as ground water storage capacity, wetland area, flora and fauna diversity as seen from many studies in the regions. Water bodies being converted to agricultural fields farm lands and so on has led to decrease in water storage capacity in the region and water availability for entire region annually. Chikmagalur has lost almost 568 water bodies, while Shimoga lost 3024 water bodies in past 4 decades. Hassan lost 3025 in last 4 decades while Uttara Kannada also decreased by 850 water bodies in past 4 decades. The increased public awareness to protect wetlands would help in conserving these wetlands which can be better done using and developing wetland database and understanding temporal changes in wetland dynamics. Also it may be necessary to promote and strengthen legislation, policies of the government in protecting kidneys of the landscape and important necessity of both flora and fauna.

ACKNOWLEDGEMENT

We are grateful to (i) NRDMS division, the Ministry of Science and Technology, Government of India, (ii) The Ministry of Environment and Forests, Forest department, Government of India and (iii) Indian Institute of Science for the financial and infrastructure support.

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