STUDY OF THE STORAGE POTENTIAL OF SMALL LAKES AND ITS UTILISATION USING REMOTE SENSING AND GIS

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ABSTRACT

The present study deals with the small lakes in Kumudvathi River left bank sub watershed, Gawribidanur Taluk, Kolar district. The farmers who have taken up lake activity were only considered and their land holdings, crops grown, and their details were collected. The farm areas, number of small lakes and other soil details were obtained from satellite data. To find the area under each soil type, the parcel map was imposed upon the soil map. From the attributes table the area under each soil type in the individual farms were obtained. Once the storage potential of small lakes is estimated, the irrigable area for various crops is calculated. The crops were chosen based on the soil suitability, soil-water requirement and the crops currently grown in the study area. The irrigable areas for various crops are calculated based on the delta values estimated.

INTRODUCTION

The growing water demand to meet urban and industrial needs has raised serious concerns as to the future of irrigated agriculture in many parts of the world (Food and Agriculture Organization, 2000). Regional planning tools must be capable of simulating the physical processes (soil-plant-water relationship) adequately for estimation of crop water demand and efficient utilization of the irrigation water. Most of the regional planning approaches use gross estimation procedures for water demand (Droogers and Bastiaanssen, 2002) by ignoring soil-water storage or by using average values for soil water storage or crop evapotranspiration. The crop water requirement estimation procedure of the FAO of the United Nations (Doorenbos and Pruitt, 1977) has been widely used across the world. But researchers tend to use average values for effective rainfall and other weather conditions necessary for estimating crop water requirement due to data or computing limitations (Santhi and Pundarikanthan, 2000). Simulation models can be used as analytical tools for estimating water demand and the impact of water management measures in irrigation systems and at the regional scale, and such models can significantly enhance the ability of planners, practitioners, and researchers to investigate management alternatives. The Command Area Decision Support Model (Prajamwong et al., 1997) was developed to estimate aggregate crop water requirements and study various lake water management options in irrigated command areas with multiple fields. The user can input only six soil types and six cropping patterns, and the model allows a maximum of 54 fields for simulation for computational reasons. . For a canal irrigation system in western Turkey, Droogers and Bastiaanssen (2002) used a surface energy balance land algorithm (SEBAL) to estimate actual ET for two days in a crop season with Landsat thematic mapper images. They also used a hydrologic model, called Soil-Water-Atmosphere-Plant (SWAP) (Van Dam et al., 1997) to simulate ET for the same area assuming a certain distribution of soil properties, planting dates, and irrigation practices. Spatial distribution of ET for the two Landsat days for cotton and grapes were used to validate the model-estimated ET by adjusting planting dates and irrigation practices. These optimized input data were used in the model to estimate the water balance and assess irrigation performance during an irrigation season in1998. The Droogers and Bastiaanssen (2002) study was performed for a single-year irrigation season (although it could be extended for many years), with a focus on irrigation water delivery performance. The limitation is that using remote sensing data for spatial distribution validation on a regular basis is expensive.

STUDY AREA

The proposed area chosen for study is Kumudvathi River left bank sub watershed, Gawribidanur Taluk, Kolar district (Fig.1).

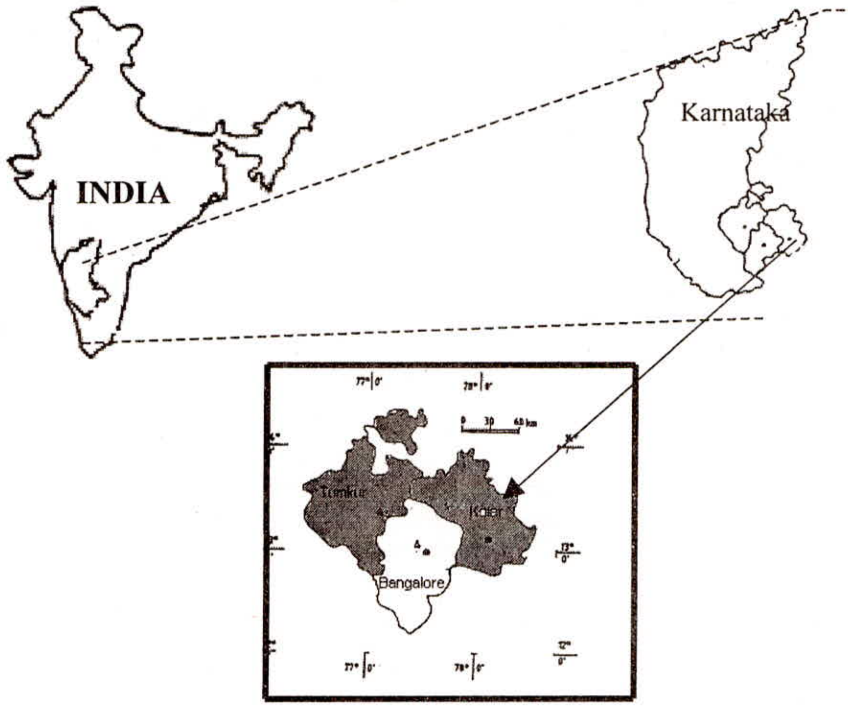

Fig.1: Location map of the study areas

The Kumudavati River left bank sub-watershed is located at 50 kms from Bangalore. This sub-watershed comes in the geographical area of Gawribidanur Taluk of Kolar district covering the SOI toposheet 57G/6. This sub-watershed is situated between 13°35′20″ to 13°39′55″ North latitude and 77°21′30″ to 77°26′35″ East longitude and covers a geographical area of 56.11 sq.

kms. This sub-watershed is found in the region 4 and Pennar river basin. The area has undulating to very gently sloping uplands and nearly level valley. The entire area has good number of tanks fairly well distributed all over the sub-watershed. The Kumudavathi River flows touching eastern side border of the watershed in the north south direction.

METHODOLOGY

The methodology adopted for the present study started with Sub watershed boundaries demarcated on SOI toposheet (1:50,000 scale), collected from the respective District Watershed Development Department offices. To exploit the dual resolution of spectral resolution of LISS III and spatial resolution of PAN sensor, PAN =LISS III merged products in PAN resolution can be used. Tnese products are supplied in 1:25000 (7 ½' x 7 ½' map sheet based product) and 1:12500 (floating geocoded product with area coverage of 5' x 5') scales as FCC products. The following features were studied on training sites:

Water bodies	:	Consists of tanks and streams
Agricultural land I	:	Consists of Kharif crop land
Agricultural land II	:	Consists of Kharif+Rabi crop lands
Water harvesting structures	:	Consists of farm ponds

Land use /land cover map

The land use / land cover map is one of the most important factor which gives infor ation about the cropping pattern, settlements, fallow lands water bodies like tanks streams etc. In the present study, land cover map is preferred from LISS III + PAN Geo coded products. Table 1 provides the detailed land use / land cover units along with area coverage. The land use/ Land cover map prepared for the study is presented in Fig..2. Land use map of the Kumudvathi

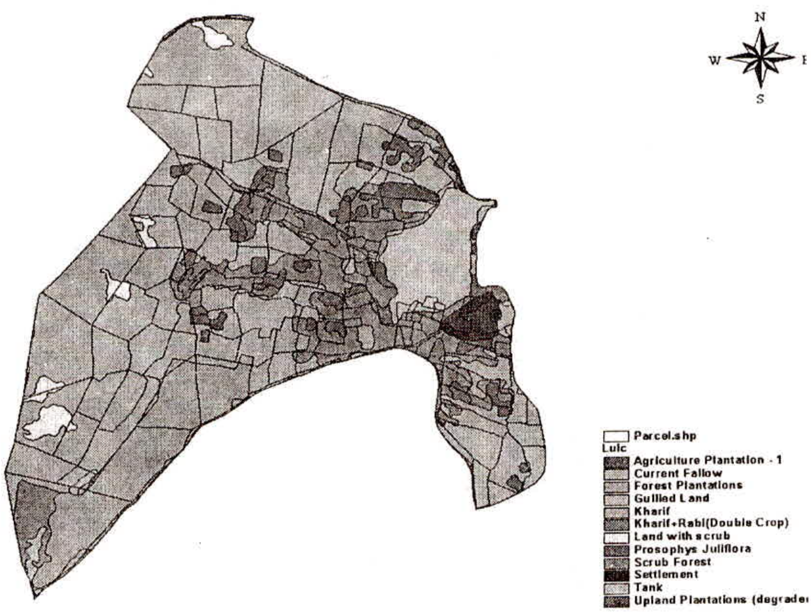

Fig.2. Land Use Land Cover Map of Kolar

River Left Bank Sub Watershed, Kolar shows major area under Kharif crop. All along the valley region and adjoining uplands have numerous patches of banana plantations, coconut plantations along with the sugarcane, Hybrid Jowar and floriculture crops. In ridgeline of the watershed, eucalyptus plantations can be observed. Waste lands in the sub-watershed include large patches of gullied land and scrub lands. This sub-watershed consists of river Kumudavathi and some of the large tanks and small canals as water bodies.

Table.1: Current land-use/ land-cover and area statistics of Kumudavathi River left bank sub-watershed, Gawribidanur Taluk, Kolar district

LULC CLASS	AREA IN HECTARES	% OF TOTAL AREA
Current Fallow	13.29	0.24
Forest Blank	4.63	0.08
Forest Plantations	520.62	9.28
Gullied Land	53.27	0.95
Kharif	3009.79	53.63
Kharif + Rabi (Double Crop)	712.50	12.70
Land with scrub	70.76	1.26
Plantation	156.68	2.79
Plantations	319.64	5.70
Prosophys Juliflora	49.03	0.87
Quarry	0.69	0.01
Scrub Forest	360.19	6.42
Tank	265.46	4.73
Upland Plantations	39.93	0.71
Village	35.51	0.63
TOTAL	5611.98	100.00

The Kumudvathi River Left Bank Sub Watershed, Kolar is divided into 12 physiographic units, and the soil series identified and mapped are 12 with surface soil phases. These soils were classified as Inceptisols, Alfisols, and Entisols. The details of this soil series is shown in the Fig. 3&4.

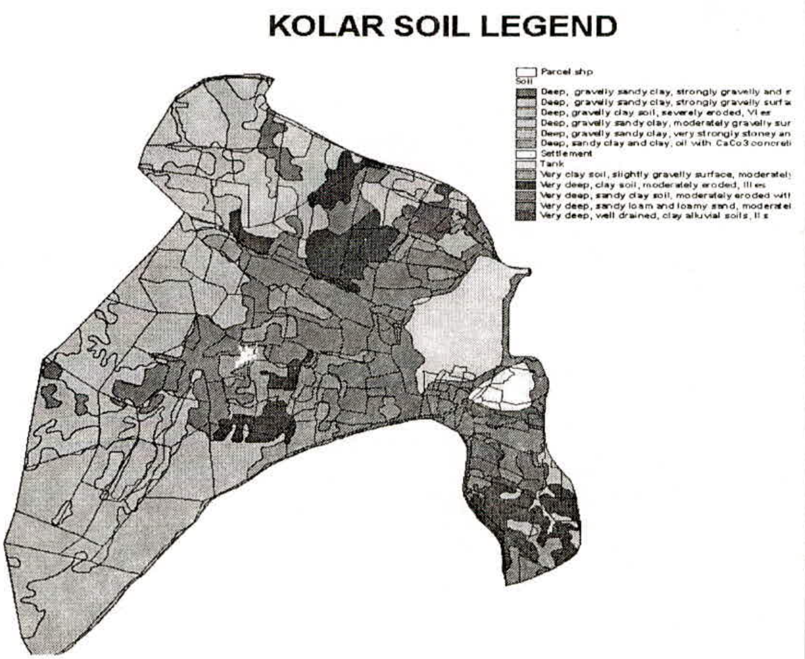

Fig.3: Soil Series of Kolar

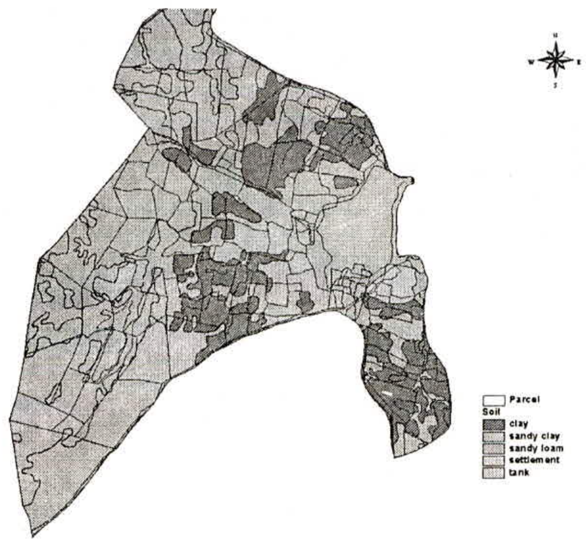

Fig.4: Soil Map of Kolar

SMALL LAKES UTILIZATION

Potential of a small lakes is the total amount of water a lakes can hold. This water is available for irrigation. Runoff from the surrounding catchments area gets collected in small lakes. Precipitation is the primary resource of irrigation water. Once the storage potential of small lakes is estimated, the irrigable area for various crops is calculated. The crops were chosen based on the soil suitability, soil-water requirement and the crops currently grown in the study area. The irrigable areas for various crops are calculated based on the delta values. The growth period (Base period) of the chosen crops, their minimum, maximum and average water requirements for the entire growth period is given in the Table 2.

Table 2:Water Requirements of crops

Crop	Growing period in days	Water Required for entire Growth period in mm			Delta(Δ) in mm
		Min	Max	Average	
Cabbage	120	300	500	400	500
Maize	120	500	800	650	800
Peanut	150	500	700	600	700
Paddy	180	1500	2000	1750	2000
Millet	150	450	650	550	650
Sugarcane to	600	1500	2000	1750	2000
Tomato	90	400	800	600	800
Ragi	180	600	800	700	800
Chilli	150	400	600	500	600
Jowar	150	450	650	550	650
Sunflower	150	600	1000	800	1000

Considering the soil efficiencies, the area irrigable is modified(Table3). The efficiencies of clay, sandy clay, and loam are 80%, 65% and 70% respectively.

Table 3: Irrigable area under different soil conditions in Kolar

Small lakes volume in Cu.m	Crop	Clay		Sandy clay		Loam	
		Sq m	Acres	Sq m	Acres	Sq m	Acres
675	Cabbage	1080	0.2716	8775	0.2207	945	0.2376
	Maize	675	0.1667	548.44	0.1355	590.625	0.1459
	Peanut	771.44	0.1905	626.795	0.1548	675.01	0.1667
	Potato	771.44	0.1905	626.795	0.1548	675.01	0.1667
	Paddy	270	0.0667	219.375	0.0542	236.25	0.0584
	Millet	830.80	0.2052	675	0.1667	726.95	0.1795
	Sugarcane	216	0.054	175.5	0.0433	189	0.0467
	Tomato	675	0.1667	548.44	0.1355	590.625	0.1459
	Ragi	675	0.1667	548.44	0.1355	590.625	0.1459
	Chilli	900	0.2223	731.25	0.1806	787.5	0.1945
	Jowar	830.8	0.2053	675	0.1667	726.95	0.1795
	Sunflower	540	0.1334	438.75	0.1084	472.5	0.1167
1323	Cabbage	2116.80	0.5229	1719.90	0.4248	1852.20	0.4575
	Maize	1323	0.3268	1074.94	0.2655	1157.62	0.2859
	Peanut	1512	0.3734	1228.50	0.3034	1323	0.3267
	Potato	1512	0.3734	1228.50	0.3034	1323	0.3267
	Paddy	529.20	0.1307	429.97	0.1062	463.05	0.1144
	Millet	1628.32	0.4022	1323.01	0.3267	1424.78	0.3519
	Sugarcane	423.36	0.1046	343.98	0.0849	370.44	0.0915
	Tomato	1323	0.3268	1074.94	0.2655	1157.62	02859
	Ragi	1323	0.3268	1074.94	0.2655	1157.62	0.2859
	Chilli	1764	0.4357	1433.25	0.3540	1543.5	0.3812
	Jowar	1628.32	0.4022	1323.01	0.3267	1424.78	0.3519
	Sunflower	1058.40	0.2614	859.95	0.2124	926.1	02287

The farmers who have taken up small lakes activity were only considered and their land holdings, crops grown, and their details were collected. The farm areas, number of lakes and other soil details were obtained from satellite data. To find the area under each soil type, the parcel map was imposed upon the soil map. From the attributes table the area under each soil type in the individual farms were obtained.

CONCLUSIONS

The small lake technologies can be used every fruit fully in all watershed areas. This is a very good low cost supplement to check dams. The cost storing in the head of check dams is substantially higher compared to these small lakes.

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