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Irrigational planning and water management in Chickballapur district

CP Shashikala[1], Y Rajaram[2]
[1] Research Scholar, Department of management, Tumkur University, Tumkur**,** Karnataka, India
[2] Research Guide RIMS, Bengaluru, Karnataka, India

Abstract
Water covers about three-fourth of the earth's surface and nearly 97.3 percent earth's water is in oceans and sea, Fresh water constitutes only very small fraction of 2.7 percent and this little portion of fresh water is effectively available for consumption. Water is essential natural resource for life and it is likely to become critically scarce in future. Demand for water is increasing rapidly with increase in population.
Judicious management of water resource is critical policy issue across the continents. The need for action in this direction is growing day by day as countries and communities across the globe are experiencing water stress.
Sustainable development requires wise policies and effective strategies that conserve, protect, manage fresh water to meet needs of human and other creatures.
This paper focus on water requirement, water demand and water availability in chikkaballapur district. The paper ultimately aims at recommending solution to the water problem.

Keywords: water, water demand, water availability

Introduction
Chikkaballapura district has the distinction of being the only district with two Highest Civilian Award "Bharath Ratna" in the Country. The district is proud to be home of Shri Sir M Viswesvaraya, the greatest ever engineer of this country and Dr. C N R Rao, a Scientist and Academician of International fame. Nandi Hills brings the name "Hill Station of the Plains" to the district, and the places of historical and mythological importance put this district in an important place with District administration oversees 6 Taluks, namely Chikkaballapura, Bagepalli, Chintamani, Gowribidanur, Gudibande and Shidlaghatta, Bagepalli Taluk is the largest and Gudibande is smallest of the taluks. There are 1515 villages in the district. The geographical area of the districtis is 4,04,561 hectares

Water Deficit District
Five seasonal rivers take birth in the district but it's a "No Rain No River" deal. There is no inflow from other areas. The average rainfall of 722 mm on 4.04 lakh hectares of land yields of 2.92 BCM of water and after all losses –Water available for use is 1.79 BCM (including Ground Water) Normal Water demand from various segments in the district is 1.40 BCM Any deficit in rainfall by 50 mm causes a shortfall of 0.17 BCM. In the past 15 years there has been cumulative deficit of 383 mm or the district is running on a deficit of 1.302 BCM already the normal ground water reserve of district is 0.28 BCM With annual recharge of 0.37 BCM, but drawing of 0.45 BCM, the ground water is getting overexploited. Presently ground water is at a depth of 1000 ft below the ground.

Domestic water availability
With a Population of 12.55 lakhs, the domestic water needs are estimated at 0.071 BCM. (135 LCPD). The Population is estimated to reach 13.64 lakh by 2020, the water demand is estimated to reach 0.092 BCM (at160LCPD). Livestock Water demand is at 0.02 BCM and Industrial Water demand is around 0.002 BCM. With a total usable water availability of 1.79 BCM there is adequate water for domestic, livestock and Industrial use. Efficient management is key to this segment.

Overview of Water Resources of Chikkaballapur district:
The only water resource for the district is rain water with around 722 mm of rainfall, the district receives a total of 2.92 BCM of water. Around 17.5% of this water is lost in immediate evaporation. Around 12.5% of balance water recharges ground water. After Evaporation transpiration losses in Forest, Trees and vegetation and Pasture lands, the available balance for use Thus a volume of 1.10 BCM is in surface flow and is available for crops and around 0.65 BCM of water from ground water, together around 1.79 BCM of water is available for use. There are three small reservoirs that are used for drinking water supply and there are around 1981 tanks and 733 open dug wells. They are not used in irrigation, although they charge ground water through percolation. These tanks are generally used by communities for daily utility purposes.

Objective
The present study is to analyze how water demand and water available in Chikkaballapur district is balanced which is rarely possible.

Statement of the Problem
In Chikkaballapur district there is shortage of water and also the water is contaminated and over exploitation of underground. There is urgent need to look for alternative sources of potable water in places where water quality has deteriorated sharply, community based water quality monitoring guidelines should be encouraged, people should be encouraged to look at effective methods of providing

water sources.

Ground water is over drafting leading to diminished agriculture yield and pollutants of water resources harming biodiversity. Further regional conflicts over scarce water resources sometime resulting is warfare. Drought dramatizer the underlying tenuous balance of safe water supply but it is imprudent action of humans that have rendered human population vulnerable to the devastation of major drought.

Water situations has occurred because of lack of proper rights, government regulations and subsidies in water sector, causing prices to be too low and consumption too high. The main research question is to find out whether the role of different agencies in management of water is effective are not.

This study will focus on water demand and water available and water management in Chickballapur District.

Water Requirement or Demand

The district has two segments of demand. A perennial domestic, livestock and Industrial sector demand and a seasonal agricultural cropping demand. In addition the floating population demand as well as services sector demand, especially the huge number of offices, trade centers, community centers etc. These demands need to be estimated and matched with supply side augmenting resources wherever necessary. This chapter addresses the issue of estimating the demand for water in different sectors. While estimating a prominence is given to improve quality of life with a higher provision for domestic and livestock segment.

Table 1: Water Demand Consolidated in BCM (Billion Cubic Meters) in Chikkaballapur district

Sector	Present Demand	Future demand	Increase in demand
Domestic	0.0711	0.0916	0.0205
Crop	1.3033	1.6291	0.3258
Livestock	0.0168	0.0193	0.0025
Industry	0.0033	0.0039	0.0007
Power	-	-	-
Total	1,3945	1,7440	0.3495

Domestic Water Demand:

The present population of the district is 12.55 lakh numbers and the decadal growth was at 9.33% for 2001-2011 period. The Census data has forecast population growth.

As per the Bureau of Indian Standards, a minimum water supply of 135 litre. Per capita per day (lpcd) should be provided for domestic consumption in cities with full flushing systems. However, in an attempt to improve quality of life, the present estimation intends to provide 160 litres of water per day per person irrespective of Rural or urban nature of it. The need includes every aspect of daily life, including cleaning the houses. As seen from the above table: the domestic water demand is estimated at 0.09163 BCM for the year 2020. Major source of water for domestic use is borewells, both private and the ones owned by the local bodies. A system is in place to provide good drinking water by establishing water purification systems in the villages and urban bodies. There are six ULB's i.e., Chikkaballapura, Chintamani, Shidlaghatta, Gowribidanur, Bagepalli and Gudibande. These urban bodies are using following sources of water currently. The district has on an average a cropped area (Gross Sown area) of 2.20 lakh hectares including horticulture crops. The Average potential Evapo-transpiration of the district in the rainy season is around 1168 mm. This works out to an average of 3.2 mm per day. Given that seasonal crops are in the field for a maximum of 120 days, the average Evapo transpiration for field crops is around 384 mm, rounded off to 400 mm. Further the district has an area of 1,94013 under seasonal crops under rainfed conditions and an area of around 29,256 hectares under perennial crops. Taking 400mm as average PET for seasonal crops and the annual PET of 1168 mm for perennial crops.

Livestock water demand

The total cattle population of the district is around 24.73 lakhs. Major part of it is in poultry birds with a population of 16.48 lakhs. The water needs of large animals like Cows, Plough cattle, Buffaloes are estimated at a water demand of 150 litres per day. This is again an increased provision to ensure that sufficient water is provisioned for the animals and their progenies. 64Poultry birds have been provided water at 1 litre per bird, which includes water required for all purposes including hygiene. Small ruminants have been provisioned at 15 litres for pigs and goats and 10 litre for sheep.

The total water needs of livestock is estimated at 0.0166 BCM and future demand is taken with a 15% growth for 2020 and the future demand is estimated at 0.0191 BCM. The demand by taluks for each taluks is estimated as follows: 4.4 Industrial Water Demand There are good number of industries in the district and industrialization is picking up, as part of industrial policies to generate more employment in this dry district. There are 3 notified industrial areas in the district that are monitored by the KIADB. These are at Chikkaballapura town, Gowribidanur Phase-1 and Phase-2 are located in Gowribidanur Taluk. With an intention to promote industrial growth the taluks have been classified in 3 industrial zones. Gudibande and Bagepalli are in Zone-1, Chintamani and Chikkaballapura in Zone-2 and Gowribidanur and Shidlaghatta in Zone-3. Considering the fact that the industrial units are small, the industrial water demand is estimated including services sector needs at 2 million Gallons per day by 2020, as against current demand of around 6 lakh litres per day. Accordingly, the industrial water demand is estimated at 0.0033 BCM at present and 0.0039 BCM by 2020, providing a 20% increase in demand. It is taken in to account that the industrial growth is fairly slow in the district.

Power Generation Units -Water Demand There are no hydel power generation units in the district and accordingly the demand is considered as nil. As per the estimated demand, the district requires around 2.5454 BCM of water in 2020 and increase of 0.2198 BCM.

Water Availability

Status of Water Availability

Since there is no permanent surface irrigation, the district mainly depends upon the Ground water for Drinking, Agriculture and other purpose. Thus a lot of pressure is created on use of rain water and the Ground water. With rains getting scarcer the use of Ground water is increasing day by day, resulting in decrease in the ground water level of the District. Geohydrology of the District: Geo-morpalogicaly the area of the District is an undulating terrain having sub dedritic type of drainage pattern. Maximum elevation is noticed at Nandi hills with a height of 4851 feet with a

maximum inclination towards north western portion. Chikkaballapura district forms typical Granite and Gneissic rocks of Archean age. Lateritic capping is observed on the southern and south east peripheral edge of the district.

The granites exposed in the form of bold hills extending north-south in the western portion of Chikkaballapura are course to medium grained with grey colour. These rocks are subjected to physical and chemical weathering give rise to sandy soil. This soil is very useful in Ground water recharge. A small patch of laterite is exposed at Shidlaghatta taluk, Laterite capping is observed at 3-4mts above the surface, they act as good aquifers. About 15 years back the Ground water was available within the depth of 80 to 90 mtrs, due to over exploitation of Ground water and recharge only through rains have created depletion.In Chikkaballapura district, there are 51 observation wells, whichis monitored every month the water levels of the area. A comparison of the water levels from 2011 to 2015 indicates that the average water level of the district is 31.43 mtrs, below ground level. In 2011 the average water level was 22.47 mtrs, and in 2015 it is 42.96 mtrs and thus a decline of 20.26 mtrs is noticed. This decline in water table is due to over exploitation of Ground water and absence of major recharge water bodies in the district. If major surface water projects are implemented in the district, there is lot of scope for ground water recharge. Based on the Utilization of ground water 5 taluks of Chikkaballapura district have been classified as over exploited as per the ground water estimation 2011.

Table 2: Present stage of ground water utilization in chikkaballapur district

Name of the taluk	Stage of utilization
Chikkaballapura	145%
Gudibande	165%
Shidlaghatta	143%
Chintamani	168%
Gowribidanur	190%
Bagepalli	91%

Water use Efficiency

It is 12 Litres of Water demand per Rupee of GDP in the District. Paddy Crop takes up to 2758 litres per Kilogram, Maize consumes 2500 litres and Ragi consumes 1700 litres per Kilogram of produce. Animal Husbandry on the other hand appears to consume less water, especially since Maize, a major ingredient and fodder out of same crop is used. So the challenge here is to reduce water used per kilogram, by increasing yields or reduce consumption of water.

The Calculations of Water Availability in the district is based on following assumptions

- Rainfall is normal at 722 mm per annum, on a geographical area of 4.04 lakh hectares.
- For every deficit of 50mm district loses 0.20 BCM of water
- Immediate evaporation loss of 17.5% and Ground water recharge at 12.5% of rainfall and as per Water Technology Center for Cauvery Command Area Report 2016.
- Crop demand is based on Area, Production and Productivity data for the year 2012-13. (des.kar.nic)
- Domestic Water demand is taken at 160 litres per Capita per day, as an approach for better quality of life
- Transpiration loss from lake surface is taken at 600 mm
- Industrial and Services Sector Water demand is taken at 2 million gallons per day.

Water resource management

To summarize the district is fairly a plain terrain, with an average of 722 mm rainfall spanning over 43 days, a typical semi-arid climate in eastern dry agro climatic zone or Zone-5. The district has a total of 4,04,501 hectares of which 1,54533 hectares are cultivated in kharif, 5800 hectares in Rabi and 2217 hectares in summer. Around 44,201 hectares are under protective irrigation (which includes around 28,631 hectares of Horticulture crops (Fruits and Vegetables) and balance 15,570 hectares under Sericulture). The district principally a rainfed agriculture scene, quite typical of Semi-Arid Zone. Although the district received 722mm of rainfall, almost equal to that of Mysore District, the spread of rainfall makes a lot of difference. Major part of rainfall is received between July and October months, restricting cropping season to only one.

Rainfall Deficits and Impacts

Let us see how deficit rainfall impacts the demand widens gap in water availability Present Demand 1.3945 BCM
Demand for 2020 1.744 BCM

Table 3:

Rainfall	Available BCM
722	1.749
672	1.5825
622	1.4156
572	1.2488
522	1.0890

As may be seen with every 50 mm shortfall, available water reduces by 0.1665 BCM and straight away puts district in a precarious situation. Ground water goes in to serious depletion from 0.6495 BCM at 722 mm rainfall to 0.5988 BC at 622 mm presently the overall deficit is 1.27 BCM. Yet the farmers here are quite industrious and work hard to gives a good productivity in almost every crop they grow, matching State and National averages indicating high levels of farming skills and a control over technology.

In a rain fed farming agriculture economy, the district presents a agri-GDP of Rs.2507 Crores which includes income from Animal Husbandry, Forestry and Fishery. The per hectare Agri-GDP is at Rs. 1, 19, 120/- and a per capita agricultural income per rural person of Rs. 25,610/- (agriculture income per rural head). The economy and life here is dependent on rainfall, which yields surface water for tanks and open wells (mostly used for domestic use of population and livestockneeds).Agriculture is supported by ground water to a large extent and it supports irrigated farming perennially for around 44,201 hectares including vegetables and Sericulture in main. Ground water stands over exploited at present.

Rainfall Deficits and Impacts

The Following table shows how much deficit is being carried over by the district and the impact is on ground water which stands over exploited to the extent of 145%

Table 4

Year	AFA	NRF	-VE
2002	390	722	(332)
2003	540	722	(182)
2004	630	722	(92)
2005	900	722	178
2006	540	722	(182)
2007	810	722	88
2008	900	722	(178)
2009	600	722	(122)
2010	810	722	88
2011	680	722	(42)
2012	628	722	(94)
2013	619	722	(103)
2014	633	722	(89)
2015	1,048	722	326
Net Deficit			(383)

That translates to a shortfall of around 1.27 BCM short fall or loss of one year's Agricultural income of Rs. 2500Crores.
The district receives excess rainfall generally in the month of November and not in Cropping Period. Tanks have been desilted to store more water from November rains for ground water recharge.79 mainly dependent on rainfall, and it's a matter of concern for the administration. The earlier chapters also indicated that the rainfall yields a gross precipitation of 2.92 BCM of precipitation in the entire district. Out of this 17.5% is lost directly to evaporation without use, and around 12.5% goes in to ground water recharge. Net rain water available to use is around 38% of the said volume. Crops through PET consume around 53% of rain water and balance 17% is lost by way of runoff, surface flow etc.

Suggestion and Recommendation

- Catchment Area Management – Linking of water bodies/ restoring linkages and Catchment Area Management – Water Harvesting Trenches
- Identify high ground water recharge blocks and ensure 20%increase in ground water recharge ·
- Filling of tanks through re-used water from urban bodies and filling of water in to tanks from other rivers/ canals. A major part of the investment (50%) is being spent to pump –reuseable water from sewerage treatment plants in Nagavara Bangalore to 39 tanks in the district which is likely to enhance ground water recharge for borewells in the short term. Since this is a long term arrangement, the ground water augmentation will be permanent. The balance of the work proposed is likely to benefit almost 50% of the rainfed area in terms of provision of equipment for efficient use of water and attain more crop per drop. The watershed works proposed are likely to help in conservation of surface water in tanks and aid ground water recharge.
- To develop infrastructure to regenerate environment to facilitate higher rainfall
- To adopt equipment for efficient utilization of water
- Develop a re-use mechanism so that water availability is enhanced.
- Focus on quality of water
- Look for linking of resources wherever possible Long Term Measures

Watershed Development

- The activities of Farm Ponds, Trench cum Bunds, Nalabunds, Check dams, Gokatte, mini percolation tanks are expected to fill around 2% of rain water that would otherwise flow in to streams and help re-charge ground water as well as help in being temporary water storages for grazing animals and wild animals.
- On the other hand, Farm bunds, and borrow-pit bunds on individual farm fields, especially in fruit orchards of Mango and Sapota will prevent soil erosion and at the same time improve moisture availability to orchard increasing yields by 20%.
- The district administration believes Education, Engineering and Efficiency can drought proof drinking water and livestock water demand on one hand and ensure a sustainable agriculture within the precarious
- Promotion of scientific moisture conservation and run off control measures to

Improve ground water recharge so as to create opportunities for farmer to access recharged water through shallow tube/dug wells.

- Promoting efficient water conveyance and field application devices within the farm viz, underground piping system, Drip and Sprinklers, pivots, rain-guns and other application devices etc.
- Encouraging community irrigation through registered user groups/farmer producers' organisations/NGOs.
- Promotion of scientific moisture conservation and run off control measures to improve ground water recharge so as to create opportunities for farmer to access recharged water through shallow tube/dug wells;
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- Encouraging community irrigation through registered user groups/farmerproducers' organisations/NGOs.
- Farmer oriented activities like capacity building, training and exposure visits, demonstrations, farm schools, skill development in efficient water and crop management practices (crop alignment) including large scale awareness on more Farmer oriented activities like capacity building, training and exposure visits, demonstrations, farm schools, skill development in efficient water and crop management practices (crop alignment) including large scale awareness on more crops per drop of water through mass media campaign, exhibitions, field days, and extension activities through short animation films etc.
- Improvement in the soil moisture availability Reclamation of waste lands. Convergence of investments in irrigation at the field level.
- Enhance the physical access of water on the farm and expand cultivable area under assured irrigation (Har Khet Ko pani) Best use of water through appropriate technologies and practices. Improve on farm water use efficiency.
- Enhance the adoption of precision-irrigation and other water saving technologies (More crop per drop).
- Promote extension activities relating to water harvesting, water management and crop alignment for farmers and grass root level field functionaries.
- Explore the feasibility of reusing treated municipal waste water for peri-urban agriculture,
- Attract greater private investments in irrigation.

Conclusion

Thus we can conclude balance and protecting both water resources and ecology we have to do it by using strategies and technology and different factors that govern utilization of water resources in spite of increase in demand. Water resources management requires combined initiative and action of all.

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