Framework for using natural water system as a basis for optimum urban growth

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Abstract

Water is a finite resource. Finding enough water can be a formidable task as one has to balance strategies for increasing water supply against delicate balancing of the local ecosystem. Urbanization leads to the growth and development of city, utilizing more land and disrupting working of natural Ecosystem, in turn exerting stress on infrastructure. This is a very serious situation and planners along with administrators have to workout ways of arranging water availability of desired quantity and quality to the public.

The paper explores and stresses upon the importance of use of interdisciplinary knowledge of water availability, water usability and governance and integration of the same in the planning practices to ensure optimum sustainable urban growth which can be supported by available water system and possibility of extending usability of available water resources.

Key words: Water system, Carrying capacity, Urban, Crisis factor, Relieve factor, Local governance

Introduction

The kick off statement of The International Year of Water cooperation, given in Paris in Feb. 2013 , is very relevant in today's context " Water , water everywhere only if we share".

"Water is not just one subject among others, it is the central subject of international cooperation," said the Director-General of UNESCO. In 2010, the UN General Assembly recognized water as a human right and this must now be translated into reality. In a world where 300 water basins are shared between several countries, this can only be achieved through cooperation," Ms Bokova said. (UNESCO Feb. 13')

"The objective of this International Year is to raise awareness, both on the potential for increased cooperation, and on the challenges facing water management in light of the increase in demand for water access, allocation and services. It will also provide an opportunity to capitalize on the momentum created at the United Nations Conference on Sustainable Development (Rio+20), and to support the formulation of new objectives that will contribute towards developing water resources that are truly sustainable. (www.unwater.org)

Urban Water Conflicts

The issue of centralization *versus* decentralization of water utilities is also often discussed in the

context of institutional aspects of urban water management. These issues are intertwined and, thereby, a critical examination of socioeconomic and institutional aspects of urban water management in a holistic way is important for better understanding water conflicts in urban areas. (http://publishing.unesco.org).

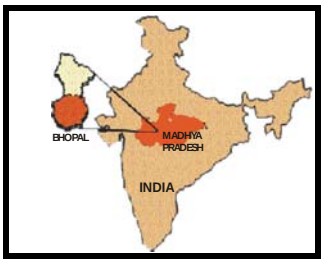
The concept of carrying capacity is rooted in demography, biology and applied ecology (Clarke, 2002). Few studies have been initiated by government of China, to determine the carrying capacity based on regional water resources in western china and north china plain (Xia and Zhu, 2002:, Zhu et al. 2009) . These studies mainly focused on the scale of social and economic development that can be substantially supported by a particular basin's or region's water resources without disturbing the ecosystem's normal operation (Zhang and Guo , 2006). Most of the metropolis and urban centres in Asia and other parts of the world are experiencing this situation of water infrastructure stress, resulting into not efficiently working of settlement fabric as well as effects livable conditions of settlements.

The National Commission on Water of 1999 has shown that overall water balances are precarious; that crisis situations already exist in a number of basins and that by 2050 India demands will exceed all available sources of supply. Already about 15% of all aquifers are in critical condition, a number which will grow to 60% in the next 25 years unless there is change. Currently more than 2,60,000 people are being added each day , this has become more concerning because of rise in life expectancy : 1900 it was 30 years , 1950 it was 46 years, 2002 it was 66 years (G.Joshi , March 2011)

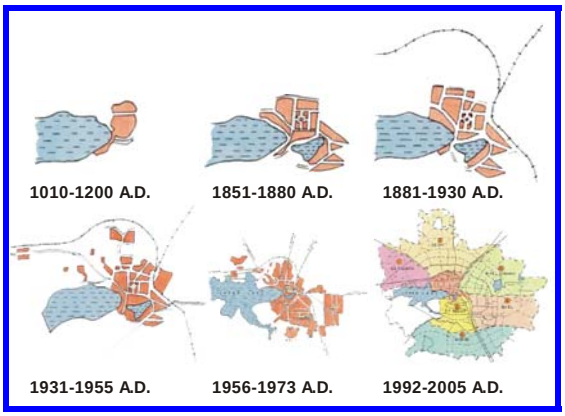
As in whole world In India, also, Increase of number of urban centres and urban population is at very high rate. For the first time since independence, the absolute increase in population is more in urban areas than in rural areas. Level of urbanization increased from 27.81% in 2001 census to 31.16% in 2011 census. The proportion of rural population declined from 2.19% to 68.84 % (Census of India, 2011) Overstressing of basic amenities one of it mainly is water availability is leading to concern of working of urban settlements. Using of integrated preventive measures like limiting growth of urban settlements with physical planning interventions and good governance and supporting measures like developing counter magnets and following regional balance approach could be a very authentic measure to help settlements work efficiently and optimally.

At present, India can store only relatively small quantities of its rainfall of about 30 days of rainfall, compared to 900 days in major river basins in arid areas of developed countries (India's Water Economy, 2005).The National Commission on Water, India (1999), has shown that overall water balances are unstable; and that number of basins are already facing crisis situation as regards availability of water and that by 2050 India demands will exceed all available sources of supply.

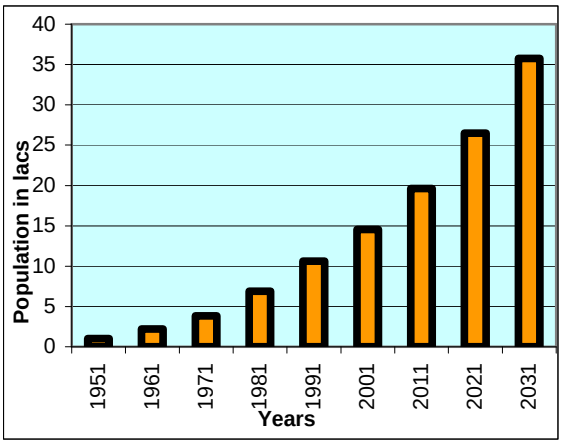
Urbanization has led to all impervious surfaces that do not allow the water to percolate in to the ground and also lead to huge quantity of storm water to flow and go to waste. If this water is saved and treated it can cater to half the demand of the city. If this water is directed to the ground it can increase the water table and give plenty of water in the summer season. The other important factor is that lack of environmental considerations in city planning and construction has led to blocking of natural drainage system of the cities. For **SCENARIO ANALYSIS** case of capital city of Bhopal (M.P.), India has been taken. Bhopal is fast developing capital city with very high urban sprawl rate.



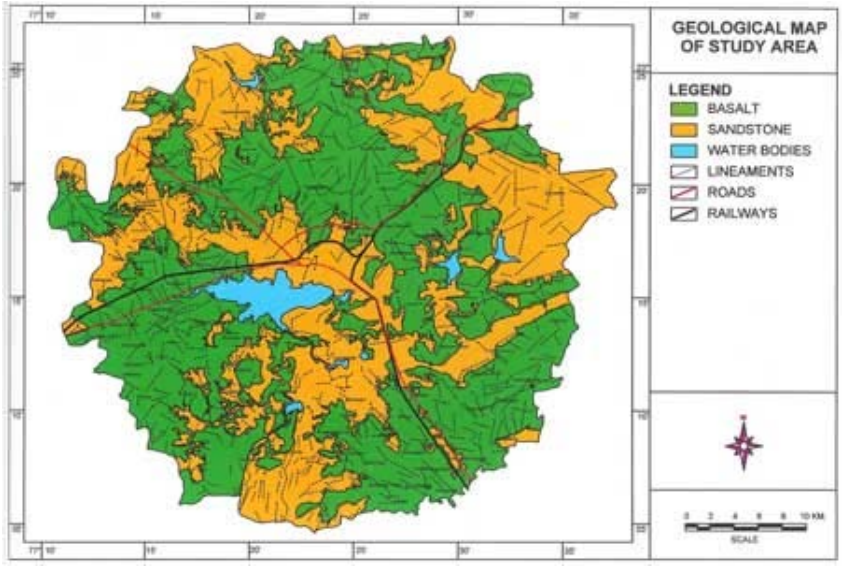
Location map of Bhopal



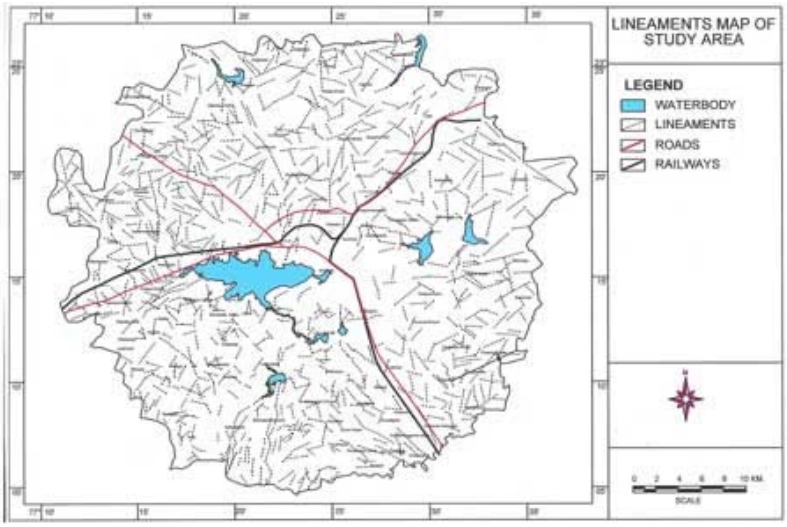
Chronological development of Bhopal



Population characteristics of Bhopal (Census 2001)



Geological map of Bhopal



Lineaments map of Bhopal

Present Status of Water Availability (Bhopal)

The identified study area for Bhopal has 18 major water bodies. These water bodies are being put to different uses such as water supply, irrigation, washing, recreation and fisheries etc.The water supply to Bhopal city is mainly from surface water from Upper Lake.Facing water scarcity people have drilled their own tube wells to meet the domestic water requirements of the ever-increasing population of the Bhopal city.

The “city of lakes” is no exception to water crisis. In organized sector of the city Bhopal Municipal Corporation supplies 60 MGD of water, which is sufficient for entire city @ 160 lpcd. Still about 40% of the population is dependent on ground water, due to poor management.

Future demand of water (Bhopal)

The water supply schemes in Bhopal have been developed in different phases depending on the projected requirement from time to time. The three land mark decisions for augmenting the supply were:
1970's - Increase in upper lake capacity (local)
1980's - Kolar water scheme ---32K.M. away from Bhopal
2005 - Narmada river water scheme---67.3K.M. away from Bhopal (partially executed)

The future water demand projection depending on the population growth rates indicates that water demand in year 2031 for Bhopal city would be increased to118 MGD. The present identified schemes would not be able to meet such high demand (Table 1) **(condition of draught arises not only due to deficit rains, but also due to bad or no planning interventions)** thus there is a need to look for alternative options such as:

1 **Water Resources**
   a) Development of possible resources within the area.

b) Ground water recharge
c) Conservation of existing water bodies
d) Arrange for additional water (naturally on basis of geology or geo-hydrology or by following technical measures like water harvesting etc.)

2 **Governance**

a) Proper Water management (controls as per dynamic population projection , considering migration , birth rate and mortality rate)
b) Define and hold growth (type , extent and share of different land uses)

3. **Planning Interventions**

a) Strategic balance of land use and magnet effect for in – migration
b) Counter magnet and Satellite town development (More resources will be added , pressure density will be reduced)
c) Regional planning concepts of distribution of resources and balanced development to be followed

The projected demand for water in the city till the year 2031 has been given in table 1:

Table 1: Projected demand for water in Bhopal City

Year	Population In lacs	Demand in MGD
2011	19.62	65.0
2021	26.49	87.5
2031	35.77	118

Some facts about Ground water resources availability, utilization and stage of development of water resources (Bhopal):

Monsoon season

Recharge from rainfall 27627 ham, recharge from other sources 1768 ham

Non monsoon season

Recharge from rainfall 0, recharge from other sources 5051 ham, total 34446 ham

Natural drainage during non monsoon period 1722 ham, net ground water availability 32724 ham

Annual ground water draft

Irrigation 24326, domestic and industrial water supply 2289 ham, total 26614 ham
Allocation for domestic and industrial water uses upto next 25 yrs (2033), 3146 ham
Net ground water availability for future irrigation use 5253 ham

Stage of ground water development (%) = total annual ground water draft / net ground water availability x 100 = 81 % (Report : Dynamic ground water resources of M.P. , 2009 , deptt. of state ground water survey and central ground water board north central region , Feb. 2012)

Findings and results

Water resources have become the victim of intensive urbanization. The high nitrate concentration is evident due to disposal of untreated sewage through open and unlined drains / Nallas and indiscriminately dumping of solid wastes without considering Hydro geological situations.

The water level has gone down to 150 meters below ground level.

In fact we should store at least 90%, if not the full amount of water which nature give us. To fulfill the ever-increasing demand of water it is necessary to collect the water in water bodies and recharging the ground water sources. The main factors responsible for ground water resource development assessments are geology, geomorphology, lineaments and hydrology.

In addition to population pressure there are other indirect pressures on water resources (different IPCC reports) .This is the reason why we are seriously concerned with the possible impacts of climate change. The few possible relevant impacts of climate change are mentioned below:

a) Water stress and reduction in the availability of fresh water due to potential decline in rainfall.
b) Adverse impact on natural ecosystems, such as wetlands, mangroves, grasslands and mountain ecosystems.
c) Adverse impact of sea-level rise.

Institutional set up and governance

Objective of Institution and governance should be **"Water Democracy "**rather than **"Eco Terrorism".**

It is worth mentioning here that to achieve ambitious goals of the millennium declaration, the governance should have to improve and be more dynamic , interactive , process focused and last but not the least, output oriented. The need at the local level is to lead the process of needs assessment. Global partners can assist by analyzing local policies and priorities. The results of the analysis can then be used to design, preventive, mitigating, adaptive and curative measures.

Governance plays very important role in handling grass root problems and situation. The importance or role of governance can be described through its three pillars:

a) Organizational Structure
b) Financial Mobilization
c) Legal Framework

The 74th Constitutional Amendment provides a broad structure for organizing urban governance with an accountable and decentralized system at local level and for strengthening the Urban Local Bodies (ULBs) in critical areas.

Functional Devolution (Implementation)

But can we **(stop natural population growth / in-migration to urban centres working as economic engines)** do without overstressing systems **(by increasing water availability / contain growth through population as well as functions)** over extracting groundwater resources or overusing surface water resources **? The answer is NO, then what is the solution?**

Solution can be in form of Plan Urban centers on basis of its carrying capacity (Availability of water as one of the main basis)

Following is conceptual framework for working-out population and carrying capacity (water resource) relationship:

Water availability (Wa)

1 **Rate of change (Rc-Rd)**

- **a) Reduction Rd**
  - a. Extraction from ground
  - b. Variation in rainfall / high temperature (climate variability)
- **b) Recharging Rc**
  - a. Runoff (related to rainfall, rate of built – up / vegetation)
  - b. Geological / Hydro geological character (water holding capacity / natural springs)

Note : In case **Rd > Rc** , then the system will collapse

2 **Water Demand / consumption Wc**

- **a) Land use (% breakup)**
- **b) Losses**

Note : In case **Wc > Wa** , then the system will collapse

Relation between Water Availability (Wa) and population to be served (Ps) is as follows:

Assuming that with **Wa ,** only **Pa** is the population served **(considering all stresses and minimum water provided to optimum population),** such that **Pa <Ps , then Ps – Pa is the CRISIS FACTOR (F) .** To handle this situation of crisis, following ways / concern for factors are possible (**RELIEVING FACTOR, R) :**

a) Then the amount of water which individual might have got as Wa / Pa , should be provided as Wa / Ps (which will be lesser), but in case this is not even minimum supply then ,

b) Over extraction from ground or additional surface water resources should be worked out, even if this is not possible , then,

c) Either population has to be controlled (planning of counter magnets, satellite towns) **or system will collapse due to overstressing or crisis**, this may lead to Environmental and Social failure and non working of system.

So, it is suggested that **Crisis Factor** should be considered at early planning stage.
Considering water availability, water consumption and character of settlement primarily in terms of **population growth rate, economic growth rate, social change index**, it can be hypothetically understood as follows:

Assuming **Ps** as combination of 75% of population served with average water supply, 20% population with minimum water supply and 5 % population with critical level of water supply .
There can be different permutation and combinations of different proportions depending upon basic chosen factors of **Population growth rate, Economic growth rate, Social change index.**

Relating **Wa , Ps and F , limits of growth of city in terms of Ps Or Pa** can be found**.**

Role of Law and Governance is very important and plays key role in proposed framework and working model.

Conclusion

Water resources are extremely sensitive and once degraded would take hundreds and even thousand of years to revive (many human generations). Urban planners will have to give priority to conserve, protect and plan economic use of water resources. Every planning should have the essence of being “Water Resource Friendly”.

As spatial planning decisions are taken for planned growth of settlements, similarly, water availability provisions and water stress plans should be prepared beforehand. Planning strategies should be worked out keeping water availability, population and settlement character as basis.

List of References

- Briscoe,John., Malik, R.P.S., 2006. India’s Water Economy, World Bank.
- Climate Change (2001).Contribution of the Working Group III to the Third Assessment report of the IPCC.
- Dynamic ground water resources of M.P.(2009) , A Report by department of state ground water survey and central ground water board north central region , Feb. 2012
- G.Joshi , (2011) water issues at focal point , Workshop on innovations for sustainable water management , Bhopal ,March 2011
- Nziramasanga N. (2004). Development Gateway Governance Expert Perspective: "Global" and "Local" in Environmental Governance and Climate Change mitigation: a View From Africa, www.developmentgateway.org,
- Parivesh, online Journal of the Central Pollution Control Board (CPCB), India , (2006)
- Rajeev Gandhi National Drinking Water Mission, India Sanitation Portal (http://indiasanitationportal.org)
- Sharma, D., Bharat.A. , Gupta. S, (2005) Urbanization vis a vis water an element of concern: A case of major Urban area of Tehsil Huzur, Bhopal block (M.P.), India, Orlando USA (poster)
- Zhang. Y. et al, : Evaluating Beijing’s human carrying capacity from the perspective of water resource constraints, journal of environmental sciences, 2010 , 22 (8) , 1297 – 1304 , www.sciencedirect.com