ABSTRACT

By far the residential land occupies the largest share of land use in the urban areas of India. Urban development adds impervious surfaces comprising building roof-tops, sidewalks, paved areas and roads and therefore increases surface runoff. In India, it is the monsoon rain falling on the land surface that contributes to the formation of surface runoff. Failure to manage this excessive storm water may cause flooding, loss of property, water pollution and even water shortage during dry periods. Moreover, with the rise in urban water demand, there is a constant drop in the groundwater level, which often leads to a competition in search for alternative water resources. Research findings demonstrate that conventional system of urban water and waste water management with its sectorised approach and centralized "end-of-pipe" treatment work out to be expensive and ineffective over a long run for all such urban areas.

Against this background, a re-orientation in research is needed. "Water Resource Management" rather than "Water Resource Development" should become the watchword for the future. Such a reversal is more pertinent as water, a scarce resource, is becoming scarcer in this 21st Century. Hence, urban catchment planning and development has to be more water sensitive in years to come. Thus urban layout could be planned and implemented in a way so as to minimise negative effects on one hand and derive opportunities for improved water resource management on the other. This calls for focused research to find out the relationship between rainfall pattern, water use and urban layout pattern while balancing water demand with water availability for urban areas in India.

Typical Urban water cycle in Indian towns is driven by water inputs in the form of rainfall and water supply and outputs as stormwater and wastewater. Any change in the level of imperviousness disturbs the local water balance. As is practiced now, hydrology is generally analysed by the hydrologists considering only the inputs of water cycle, while drainage engineers are mainly concerned with the discharge of waste water and the overland flow resulting from storms. Where urban environment is concerned, it is important to develop and apply methodology that optimizes water cycle management at the plot allotment scale for a given climate and land cover scenarios. Thus "Water Sensitive Urban Development" is a relatively new approach that addresses a series of simple control measures such as land cover control, rainwater retention control, conveyance control of storm water through infiltration and finally discharge controls through proper drainage systems for a sustainable catchment development right from residential cluster level.

Till very recently researches in urban watershed remained at a budding stage in India, with a traditional engineering approach of developing complex models requiring a host of data on hydro-meteorology, geology, hydrology, and pedology. In most of the small urban areas in India, the required data either do not exist or are not available to the desired extent. Even if the data are available, the problem remains with regard to in-house expertise to run complex models and software tools. In such a situation, a change in approach from a reactive to a pro-active one is necessary. Thus there is a need for developing a model that supports decision making at the planning stage.

To achieve this task, a methodology has been developed for studying the water use patterns in the domestic sector vis-à-vis rainfall characteristics and land cover parameters which affect mostly the surface runoff in small catchments. Further, simulated annual runoffs were found out over six typical plotted residential clusters within the Medinipur Town of West Bengal using mathematical tools and techniques. Then causal linkages between urban land-cover parameters and hydrological responses were established through multivariate linear regression equations. Results showed a strong co-relation between increase in urban development and rise in per capita water requirement as well as increase in annual surface runoff. Later on, sensitivity analysis had also been carried out on various developmental options for imperviousness control, reliability of rainwater tanks for substitution of non-potable water requirement and performance of roadside drains in mitigating extreme cloudburst scenario. Based on the above investigations, some environmental targets and standards to promote sustainable development had been proposed. The methodology thus derived could provide a package of an optimum water resource management solution at residential cluster level. Similar solution may be obtained for any other urban area through replication of the technique.

Key words: - *Urban Water Cycle, Urban Surface Runoff, Centralised end-of-pipe treatment, Urban Catchment Planning, Water Sensitive Urban Development, Land Cover Parameters, Rain Tank Reliability, Roadside Drainage Performance.*