

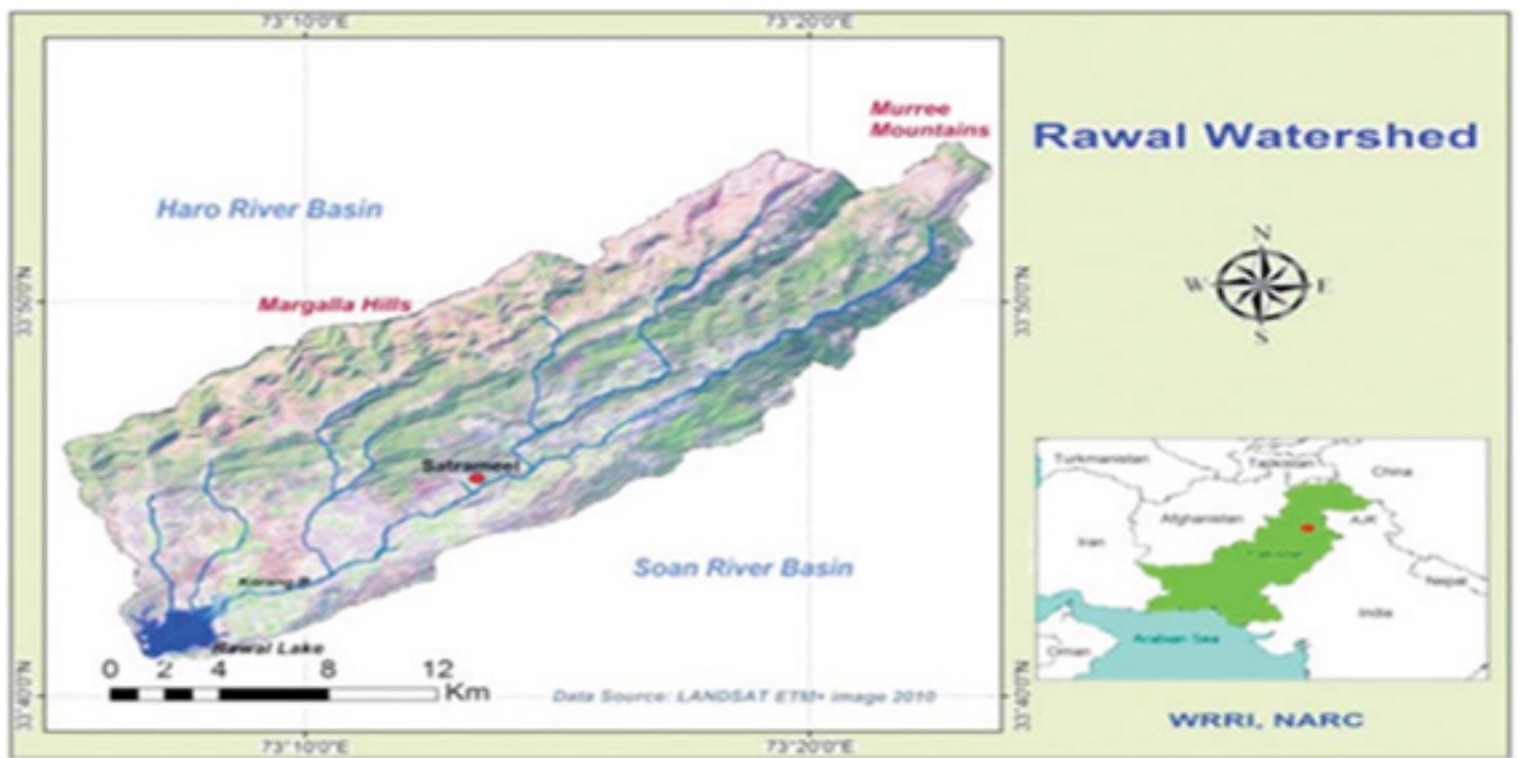
Hazards to environmental health of Rawal watershed due to rapid urbanization and deforestation

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Figure 1: Location map of the study area



(Source: Saeed et al., 2011)

Introduction

The Rawal Dam Lake is an artificial reservoir that provides for the water needs of Rawalpindi and Islamabad. It was constructed in 1960. The area around the lake has been planted with flowering trees and laid out with gardens, picnic spots, and secluded paths. The terraced garden and the lake are used for picnics, fishing and boating. The highest point in the garden offers a panoramic view of the lake, Murree hills, Rawalpindi and Islamabad. It is a good place for bird watching, as the majority of birds of Islamabad are found here. Boating, sailing, water skating and diving facilities have been organized by private clubs.

Importance of Rawal lake

Rawal watershed is Rawalpindi's main source of water supply (Figure 1). It generates almost 33,995 hectares feet of water in an average rainfall/year and 83 million liters/day to fulfill drinking and other household needs (IUCN, 2005). It also provides water for irrigation to the downstream areas.

Biodiversity of Rawal lake:

The reservoir is of considerable importance for wintering waterfowl, especially *Anas platyrhynchos*. Resident mammals include the common fox, pangolin, porcupine, jungle cat, jackal, wild bear and yellow-throated marten. Reptiles include Indian Cobra and Russell's Viper. There are 15 fish species belonging to 11 genera in Rawal Lake. The fish species in Rawal lake and its tributaries include: Doula (*Channa channa*), Rahu (*Labeorohita*), Thaila (*Catla catla*), Mori (*Cirrhinus mrigala*), Carp fish (*Cyprinus carpio*) and Talapia (*Tilapia mossambica*).

Hazards to environmental health of Rawal watershed:

Certain natural and anthropogenic factors are contributing to the rapidly declining health of this watershed, as well as spatial and temporal land use shift being observed in it (Aftab, 2010). These changes undergone by the watershed have not only altered the environmental conditions significantly but also have considerable impacts on several socio-economic factors. The connected environmental changes are resulting in accelerated land degradation, deforestation, and landslides (Saeed et al, 2011).

These changes ultimately influence the livelihood of the inhabitants of the area. The rate of deposition of untreated household and municipal waste into the streams increases as the number of settlements in and around the watersheds' area increase, because these streams ultimately end up in the catchment area. As the watershed supplies water to over a dozen small and large communities, all of these are likely to be affected by the dumping of waste. Along with municipal waste, spoils of road construction are also dumped along the water channels in many areas (IUCN, 2005; Butt, 2013).

The activities like illegal and intensive cuttings for high market value (timber) and household use (fuel wood), forest disease and ineffective forest management etc. are accelerating

the deforestation rate in the watershed area. This leads to the reduction of water holding capacity of the soil (thus promoting erosion), destruction of aquatic habitat and a reduction of water quality. The removal of a forest cover from steep slopes further leads to dramatically increased frequency of land sliding and surface runoff (Ashraf, 2013).

The number of farmlands and pasturelands in the watershed area has increased over a period of time due to easy accessibility of water leading to extensive cattle grazing and fuel wood cutting. These activities have deformed the plants to bushes. The watershed is further facing toxic pollution due to excessive use of pesticides and herbicides in agriculture. Furthermore the agricultural pollutants such as sediments, pesticides and fertilizers residue, grease, oils, bacteria and solvents that are carried to the water via runoff result in elevated levels of suspended solids, phosphorus and nitrogen, heavy metals and synthetic organic chemicals (bio-accumulative and toxic in nature) in the receiving waters. Studies conducted on water quality of Rawal lake/watershed reveal elevated levels of faecal coliforms and other contaminants leading to degradation of public health in the surrounding areas (Ghumman, 2010).

Many recreational pursuits e.g. Lake view point, Chatter and Valley parks etc. and housing schemes have been developed in the watershed. The construction of roads, pavements and other structures reduce the infiltration area that ultimately affects the recharging of the aquifer of the twin cities. Due to increasing sedimentation generated from natural and anthropogenic factors in the catchment area of the watershed, the storage capacity of the Lake is reduced almost 34 percent since it was developed in 1960 (which was 47,230 acre-ft) (Ashraf, 2013).

Conclusion

Recent landuse/land cover changes have brought substantial impacts on sedimentation, water flows and threat to eco-hydrology of the watershed area. The rapid and unplanned urban development has increased the demand for land for development purposes. Additionally intensive agricultural practices are contributing significantly to soil erosion, toxic pollution and consequently forest and water resources are coming under enormous pressure. The rise in global warming accompanied with high variability in precipitation further projects extreme changes in water balance and ultimately deterioration of the land quality. This increase in agriculture and built-up areas in the valleys has reduced the recharge source of ground water and increased sedimentation has led to reduced storage capacity.

How to address this situation :

1. Groundwater recharge source needs to be protected through controlling unplanned growth of urbanization as it is essential to regulate the urban development properly.
2. Affordable substitute-fuels should be made available for household use.
3. A community based extensive reforestation program should be undertaken to improve the fragile eco-system of the region

4. An integrated adaptation strategy at national and regional levels needs to be developed to cope with future implications of hydrological changes through focusing on key policy areas.

5. Campaigns should be initiated for improvement of adaptive capacities of the communities at risk.

6. Existing knowledge and data gaps need to be filled by systematic observations and enhanced capacities for research since these will be fundamental for developing climate change adaptation and mitigation programs for the watershed in future.

7. The poor water quality of Rawal Lake can be effectively rectified by appropriate implementation of environmental legislation, efficient lake environmental supervision and development of community based watershed management programs.

8. In the northwest corner of Rawal Lake establishment of a strict nature reserve could provide disturbance-free areas for waterfowl (Butt, 2013). It will also provide an ideal opportunity for the development of a nature reserve and conservation education centre with sophisticated facilities for the general public (DES,2011).

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