CHAPTER 9

SUMMARY
The Amner river basin occupies the western part of the Chhattisgarh basin in Rajnandgaon district of Madhya Pradesh. The area lies between 21°15' and 21°45' north latitudes and 80°20' and 81°45' east longitudes covering an area of 1658 sq km approximately. Khairagarh and Chhuhiakhadan, are the principal towns in the study area.

Amner river, forms the principal drainage and consists of eight main tributaries, namely, Kulhi nala, Lumti nala, Kukrapat nala, Muska nala, Pipariya nala, Moti nala (A), Kulhuri nala and Moti nala (B). The pattern of annual precipitation (1050.00 mm) and the temperature variation (from 9.5° to 45.0°C), suggests that the study area falls in tropical morphogenetic region.

The Dongargarh Supergroup consisting of Nandgaon and Khairagarh Groups, occupy the western portion of the study area while the Chhattisgarh Supergroup comprising of Chandarpur and Raipur Groups of sedimentary rocks are exposed in the central and eastern portion of the basin.

Geomorphologically, the Amner river basin comprises of six distinct units namely, structural hills, denudational hills, igneous pediplain, sedimentary pediplain, valley fills and lateritic uplands. The drainage pattern varies from pinnate and radial in the western uplands to dendritic in the central and eastern region of the basin. The Amner river and its tributaries
follow Horton's first and second drainage law of stream number and stream length, respectively. Based on the basin circularity ratio, basin elongation, form factor and lemniscate values, the pear shape of the basin has been confirmed. The bifurcation ratio ranging between 2 and 5 has revealed that there is no effect of lithology on the development of drainage network of the basin. The basin has coarse drainage density with six distinct slope categories.

On the basis of systematic monitoring of 169 dugwells, covering the entire basin, for pre and postmonsoon seasons, five major hydrolithounits have been demarcated which are andesite, Chilpi Group, rhyolite, limestone and sandstone. The groundwater level contour maps indicate that the general groundwater flow direction is towards the Amner river i.e. the axis of the basin, and which further moves eastwards to the Shivnath river. The groundwater fluctuation maps have revealed that the limestone forms the major hydrolithounit of the study area. These studies have led to demarcate groundwater holes around Khairagarh and Paiti regions which suggests the effluent nature of groundwater. Similarly, the groundwater around Udaipur - Sonpuri - Acholi and Salebharri - Madrakuhi - Saloni areas form active recharge zones in the basin.

The pump test results revealed that dugwells in limestone has comparatively higher specific capacity than the dugwells in rhyolite. This variation is attributed due to shearing in rhyolite. It is also fund that the relation between specific capacity values and the area of cross-section of the dugwell has
a direct relation. But at places, due to presence of clay patches or shale in limestone this relation is found to be reversed. A positive correlation is observed between the specific capacity and water level of dugwells in rhyolite and limestone which is an indirect evidence of extent of weathering on permeability. The transmissivity values, determined by Jacob timedrawdown method at five boreholes in the limestone region, show a large variation, from 31.19 lpm/m to 59.04 lpm/m, which indicates the anisotropic nature of the aquifer. The correlation of yield and depth of borewells has shown that the borewells pierced upto 46-60 m depth range in sedimentary pediplain and 31-45 m and 46-60 m depth range in igneous pediplain are more productive. The yield data analysis of 355 dugwells has brought out that 82.80 % borewells in sedimentary pediplain and 55.17% of borewells in igneous pediplain have poor yield, as the borewells have either not or have pierced beyond the suitable depth range.

The groundwater exploration studies based on geological and remote sensing methods have indicated that the groundwater potential of the structural and denudational hills is poor, and that of the igneous and sedimentary pediplain varies from moderate to good. The valley fills has good to excellent groundwater potential, whereas the lateritic upland is suitable to cater the domestic needs only. The electrical resistivity soundings have revealed that three layers are present in the limestone region, namely, top soil, weathered zone in middle, and limestone at the bottom, with an average thickness of 2.5 m, 20.52 m and 60 m respectively.
The concentration of major and trace elements in groundwater samples shows that, these are well within the prescribed safe limits of drinking water standards of World Health Organisation and Public Health Engineering of Government of India. The groundwater, on the basis of total dissolved solids and hardness, has been classified as freshwater and hard to very hard water respectively. The Pipers Trilinear Diagram plots show the predominance of calcium as cation and carbonate and bicarbonate as anion in the groundwater. Thus, the groundwater in general, has been designated as calcium bicarbonate carbonate water. The sodium adsorption ratio (SAR) and conductance values have clearly revealed that the groundwater of the basin under study is suitable for agriculture purposes without any treatment.

The component of hydrological cycle i.e. monsoon recharge, non-monsoon recharge and potential recharge which are calculated to be 14470.91 ham, 2369.52 ham, and 3740.70 ham respectively. Total annual recharge, which is the sum total of net monsoon recharge, non-monsoon recharge, and potential recharge, is calculated to be 17572 ham approximately. It is found that 70% of total annual recharge is available for development, which for Amner river basin is 12300 ham. The net annual groundwater draft comes out to be 2339 ham through various water harvesting structures like dugwells, mhots, energised dugwells and tubewells. Thus the groundwater balance is 9761 ham, which is available for future exploitation.
The groundwater prospects, as determined from the detailed hydrogeological studies of the Amner river basin, have revealed that the structural hills possess poor groundwater potential whereas, the intermontane valleys have moderate potential and are suitable for shallow depth large diameter dugwells. However, the foothills are favorable for shallow to moderately deep, large diameter dugwells. The igneous pediplain comprising of andesite and rhyolite hydrolithounits is capable of providing water both through dugwells and borewells and there is enough scope for groundwater development for domestic and irrigation purposes. The limestone, principal hydrolithounit of the sedimentary pediplain, forms the major aquifer of the investigated basin with moderate to good groundwater potential. The karst structures namely, sinkhole, swallowhole and doline should be preserved and maintained as artificial recharge sites. In contrast to this, the area occupied by laterite / shale provides little scope for groundwater development whereas, the valley fills within the sedimentary pediplain possess excellent groundwater prospects, which is currently underutilised. This can effectively be tapped by putting a series of pumps in the valley fill deposits.

Various water conservation and diversion structures constructed throughout the basin act as suitable sites for artificial recharge of groundwater, as well as, provide water for irrigation purposes. More such structures can be constructed at suitable sites which may prove their utility in the upliftment of socioeconomic status of the people in the Amner river basin.