## 3-6 Groundwater R the '99-'00 rainy season echarge

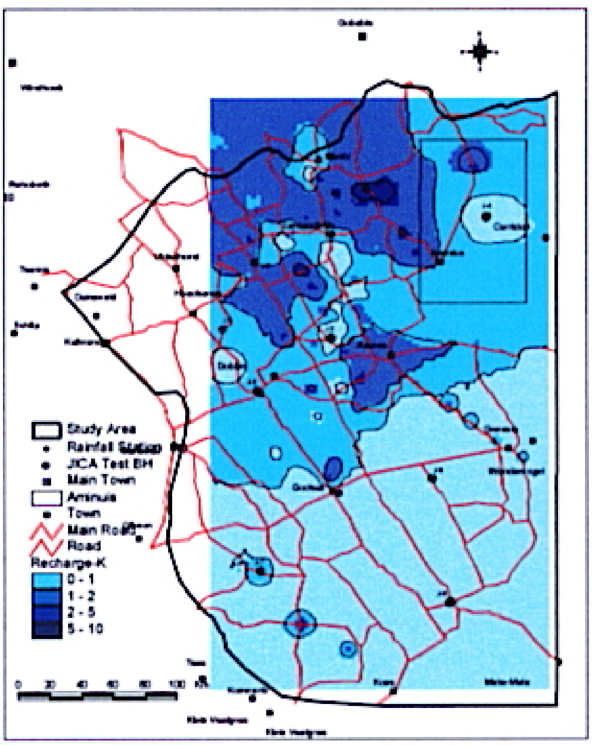
In this study, it was regarded that groundwater recharge was attributed to rainfall into Kalahari Aquifer directly and the Auob Aquifer was recharged indirectly through the Kalahari Aquifer. The water of the Nossob Aquifer seems to be regarded almost entirely as fossil water.

### (1) Recharge Volume in Ordinary Year

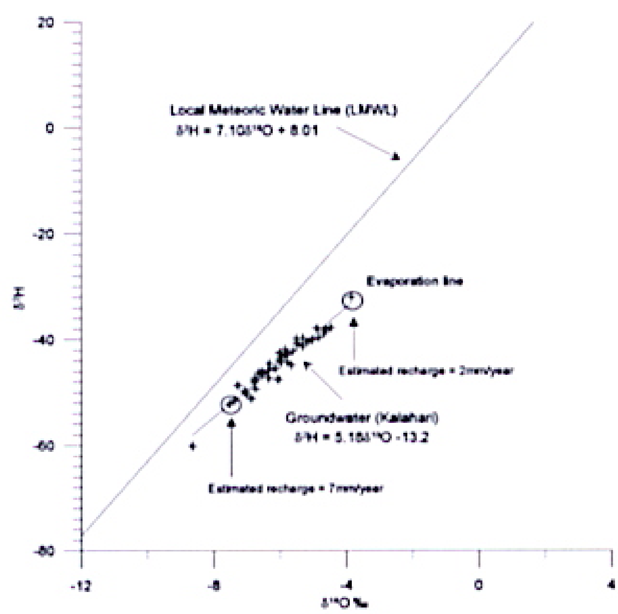
Recharge volume into the Kalahari Aquifer was estimated by Chloride Mass Balance Method as shown in Fig.3-10. The distribution of recharge into the northwestern half and southeastern half of the basin is subdivided by the 1 mm/year contour line of recharge. The total recharge volume is 0.105 billion $m^3$ /year. It is also equivalent to approximately 0.4% of the total rainfall within the catchment area. Fig.3-11, which presents the estimated recharge by stable isotopes, supports the above-mentioned recharge.

### (2) Recharge Volume in '99-'00 Rainy Season

Recharge during the '99-'00 rainy season, which has a probability of one in 50 years was considerably higher. Suppose an average recovery of water level within the whole study area is 50cm, the recharge volume can be calculated as 1.3 billion $m^3$/year during the '99-'00 rainy season. This is approximately 15 times as much as an ordinary year.




< Fig.3-10 Estimated Recharge into Kalahari Aquifer by CMBM >




< Fig. 3-11 Estimated Recharge by Stable Isotopes >

3-7 Macro Water Balance

The macro water balance in the study area is illustrated in Fig. 3-12 and Fig. 3-13. The macro water balance is analyzed on two cases, namely, an ordinary year and the '99 – '00 rainy season, moreover each case is subdivided into underground and ground for the sake of convenience.

(1) Ordinary Year

- Underground
  Recharge is only 0.4% (0.105 billion $m^3$/year) of the total precipitation (22.1 billion $m^3$/year). Withdrawal is only 0.1% (0.015 billion $m^3$/y) of the precipitation in the study area or 14.3% of the total recharge. On the other hand, transpiration is almost two times of recharge and a shortage of water balance, which results in a deficit of 0.13 billion $m^3$/year. Therefore, the deficit results in an annual lowering of the water level year by year.

- Ground
  River discharge is 0.042 billion $m^3$/year or 0.2% of rainfall and 0.4% of rainfall percolates into underground. Yet more than 99% of it disappears by evaporation due to the high evaporation potential of 3,000mm/year in the study area suggests that it sounds quite possible.

(2) 1/50 Heavy Rainy Year ('99-'00 rainy season)

The possibility of the heavy rain that happened during '99-'00 rainy season is one in fifty years. The heavy rain altered the groundwater balance of the basin dramatically. The recharge resulted in a rise of the rest water level. On the assumption that transpiration, withdrawal and groundwater flow are the same as an ordinary year, calculations resulted in the following for the macro water balance.

- Underground

  Recharge is 3% (1.55 billion $m^3$/year) of the total precipitation (51.3 billion $m^3$/year).

- Ground

  The heavy rain brought about river discharge at Gochas 4.7 times as much as the ordinary year and recharged into underground approximately 15 times as much as the ordinary year. Nevertheless 96.6% of precipitation or 2.3 times as much as the ordinary year was evaporated.

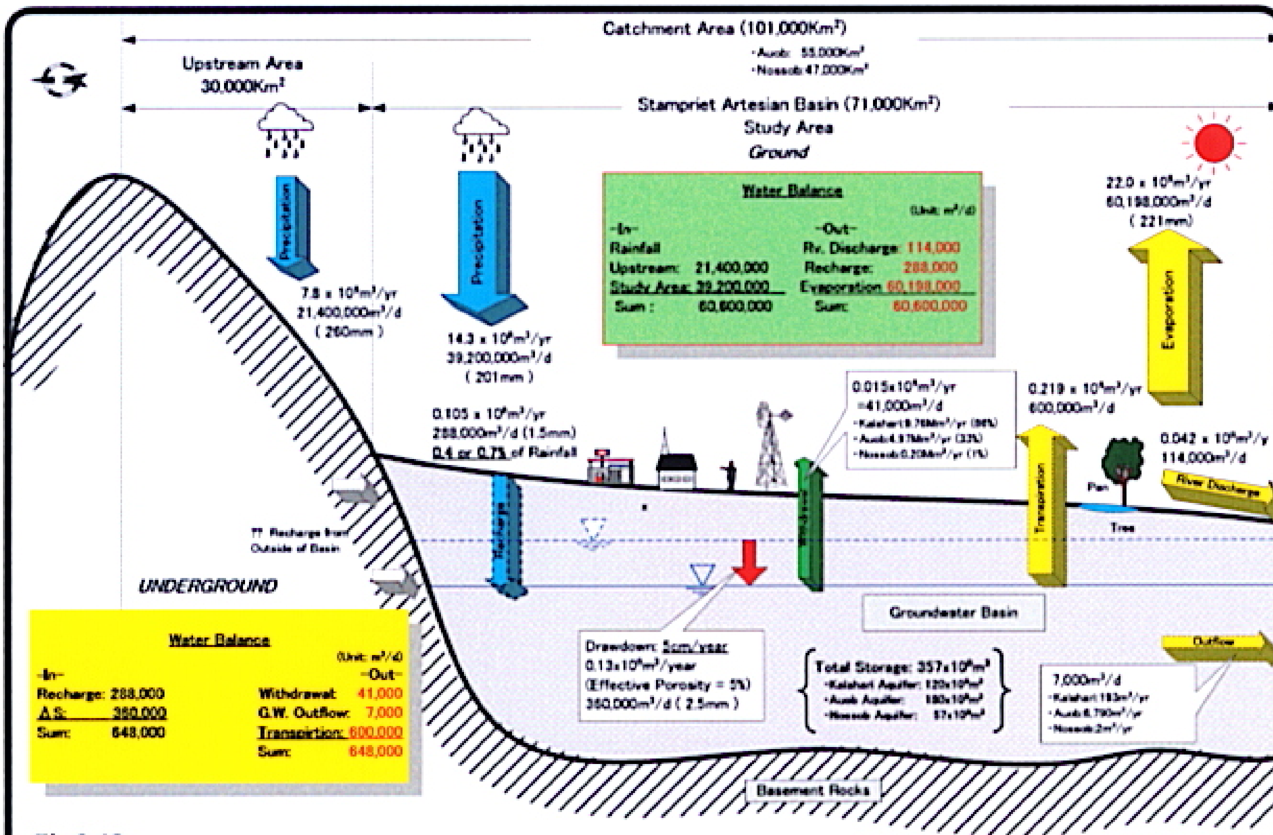



Fig.3-12 Macro Water Balance of Southeast Kalahari (Stampriet) Artesian Basin in Ordinary Year

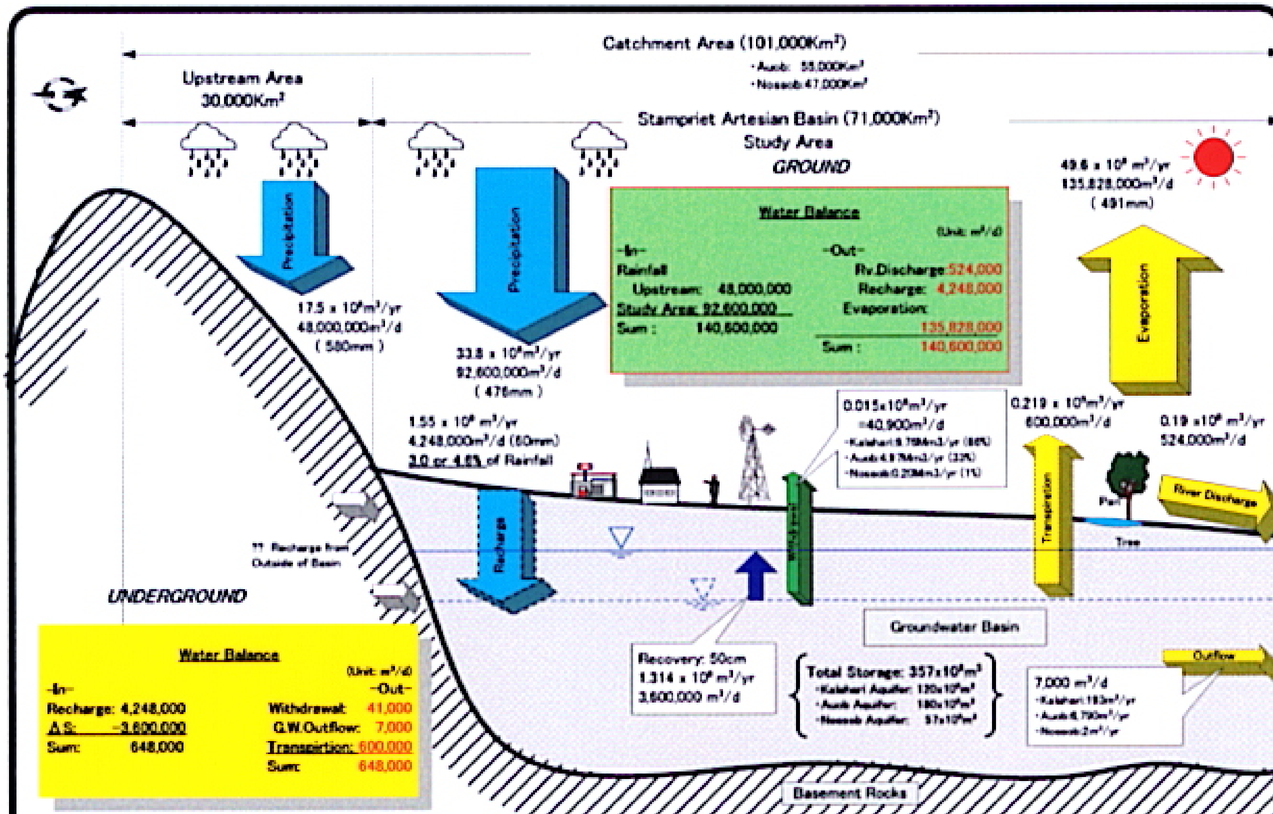



Fig.3-13

Macro Water Balance of Southeast Kalahari (Stampriet) Artesian Basin in '99-'00 Rainy Season