Moisture samples obtained from unsaturated-zone profiles in sands from northern Nigeria were used to obtain recharge estimates using the chloride (Cl) mass-balance method and to produce records of past recharge and climatic events. Recharge rates range from 14–49 mm/year, on the basis of unsaturated-zone Cl values and rainfall chemistry measured over eight years at three local stations. The unsaturated-zone results also provide a record of the changing recharge and climatic events of the past 80 years; this record compares quite well with modelling results using precipitation data from Maiduguri, especially for the late 20th-century period of drought. The best fit for the model is made, however, by using a lower mean rainfall Cl (0.65 mg/l) than that obtained from the mean of the field results (1.77 mg/l Cl). This result implies that the measured rainfall Cl probably overestimates the depositional flux of Cl, although the lower value is comparable to the minimum of the measured rainfall Cl values (0.6 mg/l Cl). Recharge estimates made using these lower Cl values range from 16–30 mm/year. The spatial variability was then determined using results from 360 regional shallow wells over 18,000 km2.

Using the revised rainfall estimate, the Cl balance indicates a value of 43 mm for the regional recharge, suggesting that either additional preferential flow is taking place over and above that from the vadose one, or that the regional recharge represents inputs from earlier wetter periods. These recharge estimates compare favourably with those from hydraulic modelling in the same area and suggest that the recharge rates are much higher than values previously published for this area. High nitrate (NO3) concentrations (NO3-N>Cl) preserved under aerobic conditions in the vadose zone reflect secondary enrichment from N-fixing vegetation, as occurs elsewhere in the Sahel.