Case Study Land Cover Change Groundwater Niger

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Land cover changes and impacts on groundwater in southwest Niger

Demographic changes have led to land cover change in an area of southwest Niger near the capital, Niamey. This has impacted on groundwater recharge and quality, and has implications for subsequent groundwater use, especially for irrigation.

Agriculture and land cover change in Niger

Agricultural land cover has increased across southern Niger since the 1950s. The effects of this have been investigated at a field site approximately 60 km to the east of Niamey, in the department of Kollo. Traditional agricultural activity in this zone comprised low intensity millet farming, as well as extensive cattle rearing, often by Fulani people. Much of the land cover change happened between 1950 and 1975, and has been ascribed to population growth: Niger's population growth rate in the 1950s was 1.5%, rising to 3% in the 1990s.

The first major change was clearance of Acacia and Combretum tree species on plateaus, attributed to an increased demand for fuel by local villagers. There was a 59% decrease in woody cover on plateaus from 1950 to 1992. However, the focus was on the removal of smaller shrubs and not larger trees, in part because of the positive influence that larger trees have on nutrient input to fields.

From the 1960s onwards, growing demand for grain cultivation by local people led to clearance of sandy slopes and more intensive cultivation of rainfed millet. Valley bottoms were also cleared from 1975, being planted with more thirsty crops such as cassava, groundnut and sorghum. These changes led to drastic reductions in slope canopy cover, with a total of 87% reduction by 1992.

Alongside this change in vegetation cover, this area saw a marked increase in the presence of sandy gullies and ponds, which form an internal surface water drainage network. Aerial photographs show a ~2.5 fold increase in drainage density between 1950 and 1992.

Contemporary land use in Niger: millet farming and cattle herding. Figure source: ICRISAT / M. Winslow

Local hydrogeology

The local aquifer is part of the Continental Terminal formation of Tertiary age, within the Iullemeden Basin, which outcrops over a large part of southwest Niger and neighbouring countries. The aquifer comprises loosely cemented clays, silts and sands, and is unconfined.

For more information on the hydrogeology of this aquifer, see the Hydrogeology of Niger page.

Impacts of land cover change on groundwater

The changes in land cover and surface water drainage patterns have led to an increase in groundwater recharge rates, and a corresponding rise in groundwater levels. Groundwater recharge has increased from 1 to 5 mm/year in the 1950s to more than 20 mm/year in the 1990s. Groundwater levels rose by an average of ~4m/year between 1963 and 2005.

The increase in recharge has in the past been attributed largely to a reduction in evapotranspiration from vegetation surfaces due to the changes in vegetation cover. The recent studies suggest that the increase in gullies and ponds and increased surface water drainage density is more likely to be the main driver of increased recharge. Surface runoff during rainfall events flows to sandy gullies and ponds, where it is temporarily stored – the internal nature of the surface water drainage network means that runoff doesn’t leave the catchment. The permeable sandy base of these gullies and ponds allows ready infiltration of this runoff to the sedimentary aquifer.

A connected change has been an increased concentration of nitrate in groundwater, which is seen preferentially close to the gullies and ponds. Nitrate values of over 50 mg/l have been recorded, exceeding the WHO recommended limit for drinking water. Isotopic concentrations in groundwater and in soil show that this is not due to pollution from sewage or agriculture: it is due to increased leaching of biologically fixed nitrate from the soil. The correlation of high nitrate with the presence of the ponds and gullies that are sources of recharge indicates that surface runoff is indeed the source of nitrate.

Groundwater for irrigation

This change in the local groundwater system has implications for human use of groundwater. Groundwater use in this area was initially relatively limited, largely for domestic use and livestock watering. However, since 2000, groundwater has been increasingly used for small scale vegetable irrigation, with onions, tomatoes and cabbage being important crops grown in small gardens. The increased recharge supports this increase in groundwater abstraction.

This irrigated vegetable cultivation mostly takes place in the dry season, using shallow wells dug by the irrigators themselves. Richer farmers can afford to line their wells with cement. There are a few deep drilled boreholes, more usually drilled by NGOs or the government, and these are used for drinking water. Water is generally extracted from shallow wells using buckets and from deeper wells using mechanical hand and foot pumps. Irrigators rely on water cans for application to crops.

Farms are small – on average just 0.127 ha – but there is a large variation in size. Women cultivate smaller plots than men, and are more likely to work in collective fenced gardens. Men tend to work on their own or family land. There is a range of tenure situations involving traditional usufruct.

Impact on livelihoods

Incomes from groundwater irrigated vegetable farming are low – only 5 to 15% of incomes from rainfed agriculture. The majority of farmers concentrate their labour on field cropping in the rainy season, leaving the gardens. Yet the opportunity cost of labour in the dry season is also low, not least because political instability in Cote d’Ivoire and northern Nigeria has disrupted traditional seasonal labour migration to those countries. This low cost of dry season labour is one reason that irrigated vegetable farming persists. Another is that, although irrigated vegetable farming does not necessarily substantially raise incomes, it does help maintain food security.

Vegetable cultivation is not constrained by a lack of water or land or tenure insecurity – land cover change continues and groundwater levels continue to rise. Rather, there is a capital constraint on farmers acquiring the inputs to expand their enterprises. These include fertilisers, pesticides and in particular fencing materials to protect their crops from grazing animals. One way that some people have overcome this constraint is by obtaining loans from NGOs that have drilled boreholes.

The future?

Indications are that groundwater levels will continue to rise in the area. This will be good for the future of irrigated agriculture, if capital constraints can be tackled. Abstracting groundwater for irrigation could also limit the extent of ponding, which would decrease the risk of ponds causing salinisation through evaporation, and acting as sites for malaria vectors. Wells situated in high nitrate zones can still be used for irrigation, although those for drinking water would need to be located away from zones of high nitrate concentration.

Sources

Favreau G, Cappelaere B, Massuel S, Leblanc M, Boucher M, Boulain N and Leduc C. 2009. Land clearing, climate variability, and water resources increase in semiarid southwest Niger: A review. Water Resources Research, 45 (7).

Favreau G, Leduc C, Seidel JL, Ousmane SD and Mariotti ANDRÉ. 2003. Land clearance and nitrate-rich groundwater in a Sahelian aquifer, Niger. International Association of Hydrological Sciences Publication (278) 163-167.

Leblanc MJ, Favreau G, Massuel S, Tweed SO, Loireau M and Cappelaere B. 2008. Land clearance and hydrological change in the Sahel: SW Niger. Global and Planetary Change, 61 (3), 135-150. doi: 10.1016/j.gloplacha.2007.08.011

Torou BM, Favreau G, Barbier B, Pavelic P, Illou M and Sidibé F. 2013. Constraints and opportunities for groundwater irrigation arising from hydrologic shifts in the Iullemmeden Basin, south-western Niger. Water international, 38 (4), 465-479. doi: 10.1080/02508060.2013.817042

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