

Save the Tiger! Save the Groundwater?

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The Global Tiger Initiative aims to double the amount of tigers in the wild in 2022 when compared to 2010. Nepal is among the countries that signed this initiative; an important habitat for the Nepali tigers is the zone at the foot of the Himalaya mountain range called the Terai. Some national parks are situated in the Terai, where several tens of tigers are still found. There are also important economic developments in the Terai: large irrigation plans are initiated for which water is taken out of the natural rivers that flow out of the Himalayas into the Ganges plain. This brings forward the question whether the grasslands along these rivers will be subject to change.

Here, it must be realised that these grasslands are important grazing lands for deer which is the most important prey for tigers. Current investigations suggest that the grasslands become overgrown by forests, which may be caused by lowering of the groundwater table and disappearance of regular flooding. Grass can grow in wet soils having a high groundwater table whereas forests regularly need deeper groundwater tables. Grass is also well capable to survive frequent flooding of the ground surface.

Bardia National Park in western Nepal is one of the most important parks in which tigers are found. A river diversion project has recently been initiated that will take out water from the Beri River, which is a major tributary of the Karnali River (being the western boundary of the park). The Karnali River itself is one of the major tributaries of the Ganges River and drains a large part of western Nepal. Water is taken out and transported via a tunnel to the Babai River, where a hydropower station will be constructed at the end of the tunnel before the water gets discharged into the Babai River immediately upstream of Bardia N.P. Somewhat more downstream where the Bardia River leaves the park, water will be taken out of the river for irrigation purposes. Comparably, water will be taken out of the Karnali River for irrigation of land immediately west of Bardia N.P. The irrigation canal starts at Chisapani at the border between the Terai and the Siwalik Hills, being the lowest, southernmost hill range of the Nepali Himalayas.

A series of research activities is foreseen to study the hydrology of the Bardia N.P. The outcome of these activities should provide insight into the water management needed to preserve Bardia N.P. for tigers and deer alike. Hence, the ultimate goal is to clarify whether water management is needed in the park and its surroundings in order to enable fruitful nature conservation. The activities proposed are split into two types: characterisation activities to understand the local hydrological situation and modelling activities to study the impact of measures using scenario analysis.

The following characterisation activities are proposed:

- Installation of groundwater wells for monitoring of groundwater levels in the park and adjacent areas with monitoring for at least one year;
- Sampling of groundwater and river water with isotope analysis of H₂O to trace infiltrated Karnali River water versus locally infiltrated rain water;
- Establishment of a detailed surface water map to indicate the drainage system with indication of perennial and ephemeral streams;
- Temporal trend analysis of the surface water discharge of the rivers present to characterise the seasonal fluctuations and their multi-annual variability;
- Hydrogeological characterisation of the subsurface using geophysical techniques such as vertical electrical sounding to indicate the local presence of permeable (sand, gravel) and impermeable layers (clay, loam);
- Groundwater pumping tests to measure the permeability and transmissivity of water bearing layers (so called aquifers);
- Characterisation of the surface (topography, land use changes, etc.) using digital elevation models and other remote sensing data;
- Hydromorphological characterisation of the river plains to enable surface water modelling
- Soil physical measurements of the top layer in order to characterise the water uptake conditions for the vegetation.

Results from these activities are used as input for the two modelling activities proposed:

- Construction of a 2-dimensional surface water model to model changes in river water level, extent of flooding, impact of gravel and sand extraction, etc. for the river plain of the Karnali River in order to evaluate the impact of anthropogenic activities and also natural variations in erosion, accumulation, discharge;
- Coupled groundwater/ surface water model to model the dynamics in interaction between surface water and groundwater (incl. infiltration and exfiltration, spatial and seasonal fluctuation in groundwater levels, etc.) also in order to evaluate the impact of anthropogenic activities and natural variations.

We like to suggest that these activities will be performed by Dutch students in cooperation with Nepali people and supported by Dutch scientific staff.