

NORTHERN CHINA'S THIRSTY FARMS AND CITIES: HOW CAN A SUSTAINABLE BALANCE BE ACHIEVED?

KEY TERMS

Drawdown:

Pumping groundwater causes the water level or water pressure to fall.

Cone of depression:

A zone of particularly intense groundwater pumping, in which water levels have declined in a funnel or cone shape, with the highest decline near the centre of greatest pumping.

Land Subsidence:

Groundwater in the pores between soil and rock grains helps support the weight of the overlying soil and rock. If pumping removes sufficient amounts of the water, the soil and rock grains squeeze closer together. This compaction of the soil can result in the land surface sinking.

The North China Plain Aquifer

The North China Plain (see location in Figure 1) is one of the most densely populated and agriculturally productive areas of the world. However, unlike many agricultural areas, the climate is dry, and the surface water is comparatively scarce – there is only around 400 m³ of available surface water per person in the area, where a volume of 1700 m³ per person or below is defined as a 'water shortage'.

How is this area also one of the major producers of grain crops for the world's most populous nation? The answer is groundwater. The North China Plain lies above a major aquifer, which is probably the world's most intensively exploited groundwater aquifer system.

Groundwater wells were drilled into the north China Plain aquifer beginning mostly in the 1960s. Pumping groundwater from these well allowed a huge expansion in the area and productivity of agriculture and allowed land to be cultivated on a two crop per-year basis; with summer maize and winter wheat crops rotating. Today there are over 2 million deep groundwater wells in the region.

Because of the high levels of groundwater extracted, groundwater levels (the height to which water will rise in a well) have been declining at rates of more than a meter per year since the 1980s. This has created a number of problems:

- 1) Increased pumping and drilling costs required to reach falling groundwater levels
- 2) De-pressurisation of the aquifer, causing land-subsidence
- 3) Contamination and mixing of saline water with high quality water;
- 4) De-watering of the aquifers, depleting the overall water resources

How can a sustainable balance be achieved?

Surface water in most of northern China is scarce, and the existing resources are either fully allocated, or not high enough in quality to use for irrigation as an alternative to groundwater. The massive South to North Water Transfer Project (a pipeline which will bring water from the wet south of China to the dry north) is planned to open in 2014; however there is still projected to be an overall water shortage in northern China, which will be met in the short term by groundwater pumping. Many people believe that the answer will be desalination plants. The major costs and energy requirements may prevent this being a feasible option on a scale to meet the projected water shortages in northern China.

Many agricultural scientists and water managers have also been encouraging increased water efficiency measures to reduce the pressure on the North China Plain aquifer. However, it may be that the imbalance between water supply and water demand (e.g. the over-exploitation of aquifers) will only be solved by changes in land-use. The consequence is a decrease in grain production (for example, abandoning the heavily irrigated winter wheat crop).



FIGURE 1 LOCATION OF THE NORTH CHINA PLAIN (IN GREEN), INCLUDING HUBEI PROVINCE (IN RED), WHERE INTENSIVE GROUNDWATER PUMPING OCCURS



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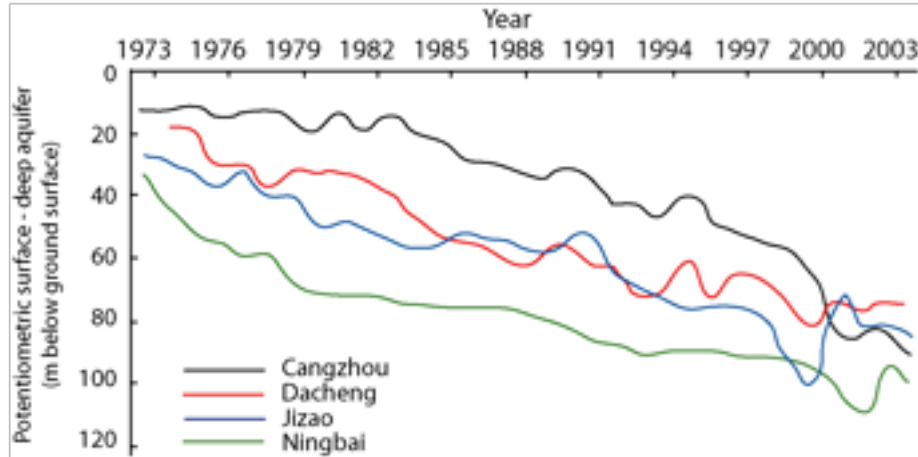


FIGURE 2 DECLINE IN AVERAGE GROUND WATER LEVELS WITHIN SOME MAJOR TOWNS/CITIES ON THE NORTH CHINA PLAIN.

Going further

If the population in the North China Plain is approximately 250 million people, what is the estimate of the total volume of surface water within the area? How much water do they need?

What types of contaminants and other water quality issues might be a problem in an area of intensive agriculture like the North China Plain?

Is it right to pump water from the “wet” south to the “dry” north? What are the issues that would have to be considered in making this decision? Chose a position and prepare how you would present that argument to others.

Links to Further reading:

‘China faces up to groundwater crisis’

Nature News:

<http://www.nature.com/news/2010/100713/full/466308a.html>

The South-North Water Transfer Project (on Wikipedia):

http://en.wikipedia.org/wiki/South_E_/80_93North_Water_Transfer_Project



Australian Government
National Water Commission



Teacher Earth Science Education Program