

The temporal–spatial assessment of water scarcity with the Water Poverty Index: a study in the middle basin of the Heihe River, northwest China

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ABSTRACT

This paper details an application of the Water Poverty Index (WPI) to evaluate the state of water resources in an inland river basin using a case study of the Heihe River Basin (HRB) located in northwest China. The WPI includes five components (resources, access, capacity, use, and environment) and has 13 indicators; each indicator is assigned an equal weighting. The selected set of components and indicators was used to discuss the spatial and temporal variation of the water scarcity situation in the middle of the HRB for a 10-year assessment period. The results show that the water scarcity situation of the HRB is generally evolving in a positive way from 2001 to 2010. However, the WPI varied widely (from 24.6 to 66.5) at a spatial scale. The water situation was best maintained in Jiayuguan City, and it was most severe in Jiuquan City. These variations suggest that different cities require different policy intervention to improve the overall water situation. Overall, the WPI appears to be a reasonable approach to examine the water scarcity situation and help decision makers to better devise local policy.

Key words | Heihe River Basin, temporal–spatial, Water Poverty Index, water scarcity

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INTRODUCTION

There are several ways to define water scarcity. According to UN Water (UN-Water 2007), water scarcity is defined as the point at which the aggregate impact of all users impinges on the supply or quality of water under prevailing institutional arrangements to the extent that the demand by all sectors, including the environment, cannot be satisfied fully. Water scarcity is a global threat to sustainable development and political stability, resulting in the availability of clean, affordable, reliable, and sustainable water as a central issue to national sustainable development objectives. Recently, global climate change has resulted in a negative effect on water availability and the health of freshwater ecosystems in many regions (Kundzewicz *et al.* 2008), especially arid and ecologically fragile regions where water scarcities have become increasingly serious.

Monitoring and assessing water scarcity is therefore an issue. However, due to the complexity of the concept of

water scarcity itself, no consolidated approach or standard is available. Water scarcity can be measured in different ways: i.e. the ‘Falkenmark’ Water Stress Index, Criticality Ratio, Water Poverty Index (WPI) and so on. Different measurements capture different aspects of the pressures on water resources. The ‘Falkenmark’ Water Stress Index focuses on two factors: population and total freshwater resources in a region, measuring scarcity as the average per capita water availability per year (Falkenmark & Widstrand 1989). The Criticality Ratio measures water scarcity as the proportion of annual water withdrawal relative to the total annual available water resources (Alcamo *et al.* 1997; Perveen & James 2011). By contrast, the WPI is a new and holistic tool, which can effectively measure a population’s relationship with available water resources, including multiple indicators designed to reflect the role of human well-being and infrastructure in water availability.