

ANALYZING THE IMPACT OF  
ECOLOGICAL RESTORATION PROJECTS IN DRYLANDS:  
A CASE STUDY ON VEGETATION RESPONSES AND PEOPLE'S PERCEPTIONS  
IN LOWER REACHES OF HEIHE RIVER BASIN, CHINA

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ABSTRACT

Desertification is a severe environmental problem all over the world. It was defined as land degradation in drylands and has affected nearly 170 countries as of the latest study in 2011. China is one of the most extensively affected countries. The lower reaches of the Heihe River basin in northwestern China where the Ejina Oasis is located is considered as one such area experiencing the severest desertification in China. The ecological environment in the region severely deteriorated in the last century, and this has led to an increase in sandstorm problem in Eastern Asia.

To restore the degraded ecological environment, a series of ecological restoration projects were initiated in the Heihe River basin beginning in the late 1990s. Short-term and Comprehensive Management Plan of Heihe River basin (SCMPH) implemented in 2001 is the largest such project. The recovery of terminal lakes, elevation of groundwater level, and restoration of vegetation in the Ejina Oasis were reported by many researchers during the 2000s, and these ecological changes were referred as the outcomes of SCMPH. However, previous research contains two main deficiencies. Firstly, most researchers have developed

their conclusions about vegetation impact of SCMPH from single year remote sensing data, or incomplete field observations. This lack of comprehensive analysis of vegetation changes may very well lead to misinterpretation of the project's impact. Secondly, most of the previous research tend to focus only on monotonous ecological impact of SCMPH, the local people's interests were excluded. Neglecting the interests of local people can result in conflicts between ecological restoration and local people, and often leads to compromising environmental achievements of the ecological restoration projects.

For filling these gaps and providing insights on the comprehensive impacts of SCMPH, this research aims to 1) analyze the comprehensive impact of SCMPH on vegetation from multi-scales, and 2) examine local people's perspectives of SCMPH in the lower reaches of the Heihe River basin. In this study, multi-temporal remote sensing analysis and sample plot survey were conducted to quantify the response of vegetation to the implementation of SCMPH. Normalized Difference Vegetation Index (NDVI) values between 2001 and 2012 were calculated to ascertain change in vegetation coverage. Eco-physiological features (height, DBH, crown size) of every vegetation species in 2003 and 2013 in a determined riparian 20 m × 350 m plot were analyzed to determine local vegetation responses to the project. In addition, a semi-structured questionnaire survey was conducted for examining the local people's perspectives of the project outcomes. Descriptive statistics and Pearson's chi-square were used to analyze the results of the survey and the relationships between personal attributes of the respondents and their answers. The relationships between

people's perceptions and actual ecological changes derived from NDVI changes were analyzed spatially.

The main findings of the research are as follows. Firstly, SCMPH resulted in vegetation increase. Vegetation in approximately 775 km<sup>2</sup> in the lower reaches region and 272 km<sup>2</sup> in the Ejina Oasis experienced an obvious increase in last decade. Those areas were mostly distributed alongside the Heihe River, with spatial differences inside. Secondly, vegetation species were mostly growing in 0-300 m away from the river in a sample plot, and vegetation biomass increased in 2003-2013. Different response patterns were found for three dominant vegetation species in the Ejina Oasis: *Achnatherum splendens* increased most in the past 10 years from 2003 to 2013, followed by *Populus euphratica*. *Tamarix ramosissima* experienced the fewest changes. Thirdly, more than half of the respondents of our questionnaire survey perceived an increase in river discharge, lake area, and vegetation coverage in the lower reaches of the Heihe River basin. Increases in precipitation and humidity in the Ejina Oasis were only perceived by 15.0% and 19.7% of the respondents during the past decade. What is more, we discovered that people who perceive vegetation change negatively contrary to actual changes mostly cluster in the Ejina Oasis.

The results and discussions above indicate that SCMPH led to a vegetation increase in the Ejina Oasis area to a certain level; however, the vegetation recovery was not remarkable as an outcome of SCMPH. The increases in agricultural fields, large-scale afforestation practices, and livestock number control policy have significant influence on

vegetation increase in the Ejina Oasis. On the other hand, results from the questionnaire survey lead to a hypothesis that a part of people's interest was marginalized in the implementation process of SCMPH. At the same time, most local people recognize vegetation increase as the consequences of SCMPH. We also found that respondents' occupations and awareness of the project can significantly affect their perceptions to SCMPH outcomes. In conclusion, the author suggests: (1) researchers, resource managers, and decision makers must commit to taking an integrated view in evaluating and implementing ecological restoration projects and policies for achieving long-term benefits; and (2) relationship between ecological recovery and local people's interests need to be carefully balanced. Further research involving the viewpoints of local people on the impact of SCMPH is urgently needed and highly recommended.

*Key words:* ecological restoration project, vegetation responses, local perceptions, environmental change