

# EVALUATING SOCIAL SERVICE VALUE OF WETLANDS IN BEIJING BASED ON REMOTE SENSING AND GIS

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Wetlands can provide environment and social services, such as flood control, gas regulation, climate regulation and biomass production. But at the same time they are ecologically sensitive and adaptive systems (Turner, 2000), which need to be properly used and protected. Ecosystem services are presumed not to be pursuing any conscious goals, and are largely outside the market (Costanza, 1997). Therefore, they do not have a 'value system' (Farber, 2002), and are too often ignored or undervalued. Reasonably assessing value of wetland services is important for decision making on development and protection of wetland, and raise the public awareness of the importance of wetlands value. Currently putting a price tag on wetlands services seems to be a practical way to achieve these.

Beijing is the capital of China with the total area of 16, 808 km<sup>2</sup>, ranging from 39° 38' N to 41° 05' N, 115° 24' E to 117° 39' E. In 60s the area of wetlands is about 120, 000 hectares, while the area was only 50, 000 hectares in 1998. In the last 50 years, the reduce area of wetlands have reach up to 862 km<sup>2</sup>. One of the main reasons is the poor understanding of the general public and decision makers on wetland services. To change this situation, we combined remote sensing and GIS technologies to evaluate the social services value of wetlands in Beijing. The social indicators include water supply, recreational opportunity and raw material supply.

There are multiple data including remote sensed image, social data and wetlands reconnaissance survey data. The image was TM obtained on May 28, 2007 with 30× 30m resolution. Social data covering amount of tourists and their consumption including accommodation and tickets, as well as prices of agricultural and industrial water supply, were collected. Survey data including the distribution, area and main plant species of wetlands were supplied by Beijing Municipal Bureau of Landscape and Forestry.

Normalized difference vegetation index (NDVI) and water boundary were derived from TM image. The data were go-referenced and processed by using ENVI. According to the different level of calculated NDVI, 16 plant sampling sites were determined to get the biomass weight. Since reed is the major economic plant in Beijing, mainly distributed in Yeyahu wetland, Hanshiqiao wetland and Mentougou wetland, these samplings were collected from Yehahu wetland. There was a significant relationship between image-based NDVI and measured biomass. This regression model was used to estimate biomass of every pixel covered by plants.

Wetlands economic value of social services was calculated by two methods. Market exchange-based values method was utilized to calculate the economic value of water supply and raw material supply. Travel cost method (TCM) was used to estimate the benefits of outdoor recreational opportunity for individuals.

The total social services value is about 6 billion Yuan. Since a necessary step toward better understanding wetland services is to map their spatial patterns (Sutton and Costanza, 2002), ArcGIS 9.2 was applied to map the distribution of wetlands' social services (Fig. 1).

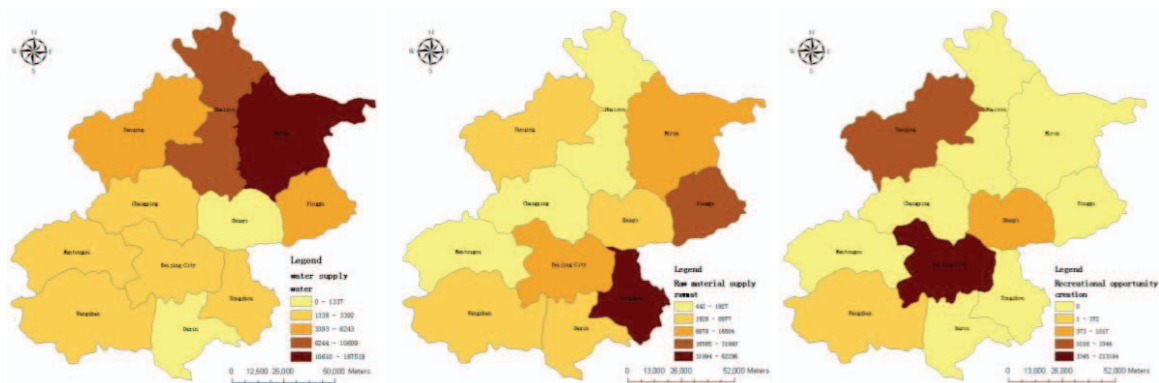


Fig. 1 Distribution of water supply value, raw material value and recreational opportunity value

**Water supply value:** The economic value of water supply is predominant in Miyun country. The main reason is that Miyun reservoir, the drink water resource, locates in the region. The value in North area is higher than that of south area, because that the flow direction is from north to south, and reservoir is generally built in the upstream.

**Raw material supply value:** Tongzhou county has a high economic value of raw material supply. The main reason is the increasing intensity of human activities, such as many ponds have been converted into breeding commercially valuable fish species. There is a decline tendency of raw material supply value from east region to west one. The main reason is that the rice field, lotus-roots fields and fish ponds are distributed in the east, the plain area. The distribution of this value has no significant correlation with NDVI. There are two reasons: one is that the market price of plant per ton is much lower than that of fish, and this economic value determined by largely decided by fish economic value. The other is that the area of plants owing economic value is small, distributed in Yeyahu wetland, Hanshiqian wetland and Mentougou wetland.

**Recreational opportunity value:** The economic value of recreational opportunity is dominant in the city area because there are many famous parks in this area, such as Summer Palace, Yiheyuan and Yuyuantan. At the same time, another important reason lies in the huge population quantity of 20.527 million of Beijing (Beijing Year Book, 2008).

## Reference

- Robert Costanza, Ralph d'Arge, Rudolf de Groot, Stephen Farber, Monica Grasso, et al., The value of the world's ecosystem services and natural capital, *Nature*, 1997, vol.387, 253-260
- Paul C. Sutton, Robert Costanza, Global estimates of market and non-market values derived from nighttime satellite imagery, land cover, and ecosystem service valuation, *Ecological Economics*, 2002, vol.41, pp.509-527

R. Kerry Turner, Jeroen C.J.M. van den Bergh, Tore Soderqvist, et al, Ecological-economic analysis of wetlands: scientific integration for management and policy, *Ecological Economics*, 2000, vol.35,pp.7-23

Stephen C. Farber, Robert Costanza, Matthew A. Wilson, Economic and ecological concepts for valuing ecosystem services, *Ecological Economics*, 2002,375-392

Paul C. Sutton, Robert Costanza, Global estimates of market and non-market values derived from nighttime satellite imagery, land cover, and ecosystem service valuation, *Ecological Economics*, 2002, vol.41,pp.509-527