Water Erosion Control Using the Fetch Calculator. Applications for Constructed Wetlands Full-Scale Design and Natural Wetlands Restoration. A Control Case-Study for Dianchi Lake (Kunming, P.R.China).

Maria Conceicao Fidalgo Matos, C., Yang, J.X., Chen, X.Y.
Address:
GEF Dianchi Project, Kunming Institute of Zoology, The Chinese Academy of Sciences, 32 Jiaochang Donglu, Yunnan 650223, P.R. China,
Email: maria@mail.kiz.ac.cn, yangjx@mail.kiz.ac.cn, chenxj@mail.kiz.ac.cn,

ABSTRACT
There are many attempts to control diffuse pollution in lake Dianchi (Kunming, China) both restoring the natural wetlands or designing new Constructed Wetlands (CWs). Natural wetlands and constructed wetlands plantings are generally made for the purpose of shore protection, habitat development or dredged materials stabilization. A survey was carried out on both historic and modern planting processes and data were collected in 900 Km² of Dianchi lake water area. The relative stability of plantings is compared with physical indicators such as fetch and climate parameters, wind and storm orientation and intensity, the shore configuration and shore slope, sediments particle size, offshore and lake depths. Fetch, shore configuration and particle size of sediments were found important parameters related to wetlands plantation stability. A software to calculate the most suitable new wetlands sites has been developed, based on the related fetch.

Keywords: Constructed wetlands design, Dianchi Lake, Erosion, Fetch, Natural wetlands restoration, Planting, Wave Climate severity, Wind Climate severity

INTRODUCTION

Background

Shoreline characteristics are wave climate indicators. There are many physical and biological variables which must be acknowledged when attempting to describe the impact of waves on Dianchi lake (Kunming) wetlands stability. First, the frequency and magnitude of severe wave conditions will be largely influenced by local climatological patterns, the width (fetch), and water depth. Second, the impact these waves have on the shore will depend on the tidal stage or water level coincident with these waves, as well as such factors as offshore contours, foreshore slope, and shore configuration. Third, the ability of the wetlands in withstanding wave stress will depend on its growth stage, density, vigour, and overall width.

The shore characteristics are related with erosion and planting success.

Fetch is an important parameter in estimating wave height. The height of a wave formed by a constant wind blowing over water of a constant depth is directly related to fetch length. This relationship is not linear. For example, a constant wind blowing 50 km per hour over a constant water depth of 6 meters will generate a 15-centimeter wave over a fetch of about 150 meters, a 30-centimeter wave in 2,125 meters, and a 60-centimeter wave in 4,575 meters. As fetch length increases, it has incrementally less influence on wave height.

In the recent years there has been increased necessity of the establishment or rehabilitation and restoration of natural wetlands along the Dianchi Lake, capturing sediment, creating grazing lands and speeding reclamation activities.

METHODS

Generalities about Shoreline Vegetation

Planting are generally made for the purpose of:
• shore protection
• dredge material stabilization
• habitat development

Relative Stability of Planting

The relative stability of plantings must be compared with erosion and the physical indicators of:

Wave climate severity
• fetch
• shore slope
• offshore depth
• shore configuration

Sediment grain size

Orientation with respect to prevailing and storm winds

Proximity to boat traffic

In Dianchi Lake it is found to be strongly related with the planting stability:
• Fetch
• Shore configuration
• Sediment grain size were found to be related to planting stability

Using these parameters, a system can be developed for evaluating potential WETLAND development sites.

Characterization of the Shore and Wave Climate Indicators

The shore characteristics are related with erosion and planting success.
The shore characteristics are:
• Sediment grain size
• Swash zone
• Mean tide
• Fetch (meters)
• Longes
• Average

Calculating the Energy Along the Shoreline

In order to obtain an accurate energy calculator of the shore it is necessary to follow the next steps:
1. Print out the map of the lakeshore site
2. Figure out the correct meters-per-centimeter value using the map scale and the ruler
3. Mark your shoreline site on the lake map
4. Draw the longest unobstructed straight line originating from a specific site across the water to any other point on the shore; this is the fetch at this specific site.

Figure 1. Dianchi lake shoreline and relative fetches.
Figure 4. Kunming rainfall (mm) during 15 years, between 1990 and 2004.

Figure 5. Line draw of different types of wetland plants.
Figure 6. Nitrogen cycle.
Figure 7.3 Line-Drawings of *Myriophyllum aquaticum*. (University of Florida, USA, http://plants.ifas.ufl.edu/myrspi2.jpg)

Figure 8. Line Drawing of *Potamogeton illioensis*. (University of Florida, USA, http://plants.ifas.ufl.edu/potill2.jpg).
Figure 9. Line Drawing of Water Yacinth (*Eichhornia crassipes*). (University of Florida, USA).