Wetland study in Guangdong Province using remote sensing technology

KE DONG & JIANG TAO
Center of Water Resources and Environment Research, Sun Yat-Sen University, Guangzhou 510275, China

Abstract Wetland is a unique ecosystem, rich in biodiversity. It is not only a valuable land resource, it also protects rare animals and plants, therefore it is of high economic value and scientific significance. This paper studies the present situation and development trends of wetland in Guangdong Province, China, with remote sensing technology. The total wetland area of Guangdong Province is 1,864,101 ha. The type, distribution, environment and use of wetland in Guangdong Province was investigated and wetland resource and environment were assessed in coastal areas. The strategies and counter-measures for wetland use and protection are recommended for decision making.

Key words protection; remote sensing; resource and environment; wetland

INTRODUCTION

The wetland ecosystem is rich in biodiversity and is unique on the Earth. It is not only a valuable land resource, but also has a function in environmental protection, including protection of rare species (The Ministry of Forestry PRC, 1997), therefore it is of high economic value and scientific significance.

The coastal zone of Guangdong Province is closely connected with Nanhai Island and has abundant multi-type wetland resources. Compared with other provinces in coastal areas, it is characterized by tropical and subtropical wetland habitats. With rapid economic growth and urbanization the wetland resource has been overdeveloped and the environment has deteriorated. Animals living in the wetland have also been affected to a certain extent. As requested by the National Forestry Bureau, a programme on protection of wetland resources and environment of Guangdong Province was formulated for planning, development and management of wetland resources on a scientific basis via comprehensive investigation to study and identify the type, areal distribution and use of wetland, in which the study of wild animals is one of the important components. The expected results will contribute to the National Wetland Action Plan, which will also serve the development planning organized by Ramsar Pact Coordination Bureau (National Ocean Bureau, 1996).

This paper studied the present situation and development trends of wetland resources in Guangdong Province with remote sensing technology for a total area of 1,864,101 ha. The type, distribution, use and ecological environment of wetland were investigated and assessed, strategies and counter measures for protection and development of the wetland resources were recommended to the administration for decision-making.
REMOTE SENSING TECHNIQUE SCHEME

The wetland investigation is based on the latest Landsat imagery, mainly interpreted by an interpretation key in combination with field investigation and related information, including all previous studies. The wetland classification system was then identified and used with image processing and primary interpretation and the establishment of visual interpretation. A detailed interpretation was made and the images with different classes were delineated and revised after the field investigation for selected pilot plots. Finally the 1:250 000 scale remote sensing interpretation map was completed using the computer (Chen, 1995). The area of wetland for different classes was measured, i.e. the major and ordinary map with the scale of 1 000 000 and relevant tables of Guangdong Province were drawn up, which led to the completion of mapping for a natural protection area for wetland, as well as a protection map of waterfowl distribution (see Fig. 1).

Fig. 1 The framework of remote sensing technology scheme of wetland.
ASSESSMENT OF PRESENT WETLAND RESOURCES AND ENVIRONMENT

Based on the investigation, the type and distribution of wetland resources and the present eco-environment of Guangdong Province were assessed.

(a) Guangdong is rich in wetland resources of various types, especially in coastal and offshore areas. After investigation 12 types of wetland were found in Guangdong Province and a coastal freshwater lake was located in Hong Kong. It is evident that there is multi-type wetland in Guangdong, not only the mulberry pond with beautiful water scenery in the south delta area, but also diversified clumpy mangrove. It covers a large number of estuaries, beaches, and continuously distributed coral reef. Compared with other provinces in coastal areas, wetland in Guangdong has more characteristics typical of tropical and subtropical habitats.

(b) Based on investigations the wetland distribution in Guangdong and the total wetland area of the Province reaches 1,864,101 ha. Of this area, the wetland in coastal and offshore areas predominates and totals 1,081,988 ha, i.e. 58% of the total. The neighbourhood of rivers, with an area of 608,523 ha, accounts for 32.6% of the total. Wetland lake (reservoir) shore areas cover 140,971 ha, wetland around small ponds covers 31,595 ha and swamp accounts for 1000 ha. It is clear that Guangdong is a province characterized by an oceanic nature. It is one of the few provinces in coastal areas of China with vast wetland distribution.

(c) The coastal and delta area of Guangdong Province were developed in the form of polder building in the 1950s and 1960s, and large scale fishery development, urbanization and other land uses in the 1990s. Presently there are 186,200 ha of land along the coastal line located in low lying delta areas, which are characterized by: (i) large land extension, such as the sediment in Pearl River estuary extended by 9 km from the 1960s to 1990s, with a yearly average of 300 m, (ii) fertile land is created containing abundant organic substances and nutrition, and (iii) transitional zones of saltwater and freshwater, that are suitable for aquiculture. Furthermore, there are abundant mineral resources such as sand, precious metals and rare earth minerals. It is a big issue of common concern to protect the wetland eco-environment and reasonable use of wetland resources.

(d) Mangrove and coral reef wetland are not only wetland resources in tropical and subtropical areas in south China, they also have high ecological value. Scientists have called it the "tropical rain forest of the ocean". The mangrove, by resisting typhoons, is the guard of the bank. It provides a sound and sustainable environment for aquiculture such as fish, shrimp, crab etc., and is also the habitat of birds, especially migrants. It plays the role of cleaner of sea water and air, protecting the environment from pollution and beautifying the environment. At the same time it is a precious resource for tourism. Countries around the world attach great importance to it due to its multi-purpose economic and environmental benefits. The coral reef is one of the wetland resources with most economic and environmental benefits in the world. It is endowed with usable medicine resources and the development of underwater tourism resources is a promising prospect.

The investigation shows that mangrove wetland in Guangdong totals 214,000 ha at present, being 50% of that in the 1950s. However, it is still one of the largest in
the country. There are 25 species of mangrove in Guangdong Province (among them 11 are semi-mangrove), only next to HaiNan Island. Most species with wide distribution and large coverage were found in the west of Guangdong. While in the east, the mangrove was badly ruined, the remainder are scattered over less than 300 ha. This is due to large scale polder building and aquiculture activities. The situation is being improved, while understanding the huge social and ecological benefit of the mangrove. Government at different levels starts to strengthen the protection of mangrove and to build the protection area in a planned way.

The coral reef wetland of Guangdong Province totals 41,221 ha, most of which is distributed in Dongsha Island and only 1,221 ha are located in estuaries, i.e. Leizhou Peninsula, Dapeng Bay and Daya Bay. The coral reef eco-environment is facing the great threat of water pollution and other human activities.

(e) Water pollution is an important factor which has deteriorated the wetland eco-environment and has led to resource depletion and species reduction. In recent years Guangdong Provincial government has implemented a program on water cleaning which focuses on regulation of the polluting sources in lakes, reservoirs and rivers. However, it needs time (up to 20 years) to completely achieve the goal. It is suggested that the protection of various types of wetland, effective control of polluted water drainage, and prevention of the wetland eco-environment deterioration should be the highest priority.

(f) Wetland resources of Guangdong Province have a unique tropical and subtropical ecological scene of special tourism resources, which include the outstanding countryside views in the mulberry pond wetland in delta areas. It is highly recommended that the tourism industry is developed there so that tourists can enjoy the special view, understand the natural eco-system, and at the same time raise the awareness of the importance of environmental protection. The mangrove in Zhanjiang Leizhou Bay has the tropical forest view in the sea, so that it has a bright future for the development of “eco-tourism” in this region for the multi-purpose of bird watching, enjoying the tropical ocean scene, and popularizing the knowledge of eco-environmental benefit of mangrove. Besides, the beaches, underwater views, and island topography with tropical ocean scenery can be used for swimming, surfing, snorkelling and holiday resorts.

(g) Application of high-tech, i.e. remote sensing (RS), global position system (GPS) and geographic information system (GIS).

Different types of wetland information were collected based on TM imagery. Measurements of longitude and latitude of key selected wetland areas were used with on the spot GPS, GIS software was used for wetland mapping and the area of different wetland classes was obtainable with high accuracy. The information is easy to preserve and manage so that it can be used to lay a good foundation of wetland information system building for the future (Chen, 1990; Guan, 1990).

STRATEGIES AND MEASURES FOR WETLAND PROTECTION AND SUSTAINABLE UTILIZATION IN GUANGDONG

As discussed, the main threat to the wetland is due to over reclamation and environmental pollution. The blind reclamation of wetland without scientific guidance has led
to resource depletion. The environment pollution is mainly from water pollution due to poor management of polluted water causing eco-environment deterioration. The densely distributed cities and towns and the very large population in coastal areas of Guangdong Province, together with rapid industrial development, have resulted in a trend to make use of marine resources. It brings an issue of how to achieve the sustainable development as the use of resources in coastal areas deems desirable. So long as there is efficient management, and good coordination between protection and use, we can achieve benign and sustainable development for wetland eco-systems. In view of the above, it is suggested:

(a) Legislation and strengthening integrated management system for wetland resources. Wetland is the eco-system with the highest economic value and productivity in the world, it contains not only a useful land resource, but also rich bio-resources, water resources, mineral resources, aquiculture resources and tourism resources, etc. It can provide human beings with food, raw materials, land, energy and water, and also plays the role of protecting bio-diversity, environment improvement, flood control and drought relief, fighting against typhoons and the development of tourism. Integrated management of wetland resources has to be emphasized in order to strictly protect and reasonably utilize wetland resources, aiming at protecting the eco-system to ensure sustainable wetland development. So far legislation of wetland resource lags behind development. It is highly recommended that an expert team and institution are formed under the relevant ministries which are responsible for wetland development and protection to work out a plan to formulate rules and regulations of integrated wetland resources (water and land resources, living species, aquiculture and mineral resources) management, including policies and regulations for protection of wetland environments, especially the water environment. The protection of rare species requires special attention. The system should also include the regulations for development, verification and approval (Sun, 1998).

(b) Formulation of a plan for wetland protection and overall planning for wetland use to guide the local government with an overall view and to take into account long term interests and integrated benefit in development. The protection and development of wetland are two-sided. The purpose of protection lies in realization of a benign role for wetland eco-system so as to achieve sustainable development and to provide more resources for human beings. The development and use of wetland should be carried out on a scientific basis. It is useful to listen an old Chinese saying “feed the hen but don’t kill the hen for eggs”. On the basis of investigated wetland information regarding areal distribution, development and characteristics of the eco-system, an overall and realistic plan for wetland protection could be formulated and implemented, which will be able to lead to sustainable development of wetland—active protection and reasonable utilization.

(c) Establishment of wetland protection area for protection of major (key) wetland. In view of the current situation of wetland resource depletion and incomplete system of rules and regulations for wetland management, the urgent task ahead is to legally identify the protection area for those with bio-diversity, rare species and with typical eco-scenery. It is expected that the wetland eco-environment can be
restored in a short time period in these identified areas on the basis of well planned activities and management measures.

(d) Publicizing and promoting an education programme relevant to the function, benefits and protection of wetland. It is necessary to raise the awareness of the public and leading members at different levels on the importance of wetland protection and its reasonable utilization. The issue is closely related to the existence and development of human beings. It also relates to the long-term interests of everyone. The education programme would be able to promote the public to voluntarily take action for wetland protection.

(e) More fund raising and technology contribution to wetland research program. The wetland research programme includes: management, institutional and legal system building, dynamic monitoring of environment, function of wetland environment, and the impact of human activities on wetland, etc. Scientific management of wetland should be based on comprehensive studies, which would provide justification and verification for formulation of regulations, measures, and policies for better management. At present the economic development of Guangdong is along the line of development strategy in the 21st century. The process of urbanization and development of industry and agriculture will strongly promote the people’s desire on wetland reclamation, so that the study on wetland is of great importance and urgency. The following activities are of high priority:

(i) Establishment of wetland database and information system by using a sophisticated technique for management of the wetland in Guangdong Province. In order to establish a scientific and modernized wetland management system, sophisticated techniques should be applied for wetland monitoring and collection of background information. Database and relevant information systems for wetland include the status of the type, structure, quantity and quality, the historic evolution and dynamic changing environment. Background information includes climate, geology, topography, water system and land distribution, vegetation, rare animals, as well as eco-environment. As a large amount of information on wetland is available, the classification could be realized by computer, so that wetland information system could be established. The recent investigation completed the collection of wetland information. It is suggested that an increase of the input in the future should accomplish the wetland information system.

(ii) Monitoring the dynamic change of wetland resources and environment for the timely understanding of the development of the changing eco-environment. One remote sensing investigation can only provide information for a fixed time period, the information for the changing environment of wetland is obtainable by repeated investigation at a regular time interval. The conventional approach of investigation is time consuming and needs substantial funding support. It is recommended to use remote sensing techniques combination with field investigation for key areas. It is also necessary to investigate the changing environment of wetland by dynamic monitoring once or twice a year.

(iii) Implementation of pilot study on function, development and use of key wetland areas to guide the comprehensive study in the Province.

A number of key wetland areas with representative characteristics should be selected for in-depth study, which include the role of wetland on environmental
protection, flood control and drought relief, and the protection of bio-diversity. The sedimentation in wetland and its development trend is also an important subject that needs to be studied.

REFERENCES