APPLYING GEOINFORMATICS IN LANDUSE PLANNING AND ENVIRONMENTAL MANAGEMENT FOR THE WETLAND – CASE STUDY OF CANGIO – HOCHIMINH CITY – SOUTH VIETNAM

Huynh Thi Minh Hang and Nguyen Hoang Anh
Institute for Environment and Resources, Vietnam National University - HCM City (VNU-HCMC)
142-To Hien Thanh Street, District 10, HochiMinh City, Vietnam
(*) E-mail: minhhang@hcmier.edu.vn

Abstract

As the estuary of DongNai – Saigon rivers system, Cangio is the wetland and the poorest district of Hochiminh City. Its mangrove forest and ecosystem have been recovered after Vietnam War and now are threatened by the economics projects for the area.

Geoinformatics has been used in monitoring the changes in geo- environment of the area as well as in planning for regional environmental management. The paper presents some achievements of the application as the followings

- Using geoinformatics in monitoring the changes of soil features
- Using geoinformatics in monitoring the changes of erosion and sedimentation.
- Using geoinformatics in site planning for residential and infrastructure development

The preliminary results prove that geoinformatics will be not only an effective tool of research on the complicated topographical areas, but also a useful tool for landuse planning.

Keywords: Data composing, data processing, geoinformatics, GIS, remote sensing, vegetation indicator

Introduction

The application of Geoinformatics, including GIS and Remote sensing data, in compose with ground data, for environmental monitoring and landuse planning has been increasing in some recent years. According to its convenient, Geoinformatics has become a suitable research tool for such complicated topographical area as the wetland.

Located on the estuary of Dong Nai – Saigon River system, the studied area is about 50 km far in the south of the Central of Ho Chi Minh City (figure 1).

The ground is divided by a complicated network of flows. Nearly 25 percent of the area is covered by surface water. Because of the topography, most part of the area are inundated by tide regime so it is very hard to carry out the ground survey. The mangrove forest was destroyed severely during Vietnam War by US bombing and defoliant. Recently, due to the great effort of Vietnamese Government and International Organizations, the project of mangrove-replanting to restore the mangrove ecosystem has got a lot of achievements: CanGio mangrove forest has been nominated by UNESCO the first Biosphere Zone of the World. As the result, mangrove forest is now covering more than 38750ha (Hong, 2000). As its nature, mangrove forest is very sensible with the change of the ground environment, especially the soil quality.

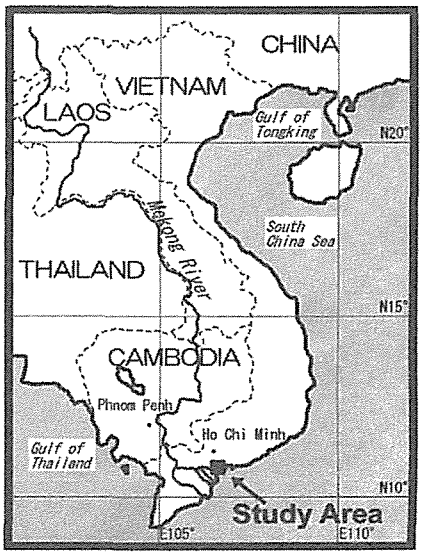


Fig.1 Location map of study area [

For raising up the economy situation of the area, some economics projects for the area have been discussed and in operating. These projects will drive to the conflict between economical benefits and demands of

environment conservation. It is necessary to find out the way to assess the interaction between economics development and environmental conservation from which the decision makers can set up a suitable plan of integrate management for the area.

The 2 years research on *"Integrate management for the estuarine of DongNai river system",* from 2001 to 2003, has been granted by VNU-HCMC. Belongs to this research, geoinformatics is used in different scale for different target objects.

Based upon the different objectives, the procedure of data processing varies lightly, but generally the role of the partner tool of Geoinfomatics can be summarised, as follows:

GIS

Map/info is used to combine the geographical data (both of digital images and numerical data), and to build up the derived products which can be updated easily.
The basic layers of the composing procedures will change in different researches. They will be presented in the following examples.
GIS is also a tool of data management.

Remote sensing data

Table 1: Satellite images in use

Image	Resolution (m)	Date	Source
LANDSAT MSS	80	April 2, 1987	Department of Informatics & Remote Sensing
LANDSAT TM	30	March 6, 1989	ERSDAC
MESSR	50	Jan 7, 1992	Department of Informatics & Remote Sensing
JERS-1	15	November 16, 1994	ERSDAC
JERS-1	15	January 16, 1997	ERSDAC
SPOT	20	Feb 26, 1997	Department of Informatics & Remote Sensing
LANDSAT ETM	30	January 2, 2001	ERSDAC
LANDSAT ETM	30	September 6, 2001	Department of Informatics & Remote Sensing
ASTER	30	August 8, 2002	ERSDAC

From these satellite images the tendency and the rate of bank erosion are defined, the different portions in vegetation cover are determined and the change of landuse is pointed out.

Modeling: the first version of the current model of the flows in Cangio has been built up as a tool for study on bank erosion and sediments aggregation.

Site survey

As the important part of the Geoinformatics tool, site survey were carried out for the followings purposes:

- Building up the polygones for satellite data interpretation.
- Checking the data gathered from satellite images and the information derived from surface water modelling.
- Adjusting the derived information
- Sampling (soil and water) and ground monitoring.

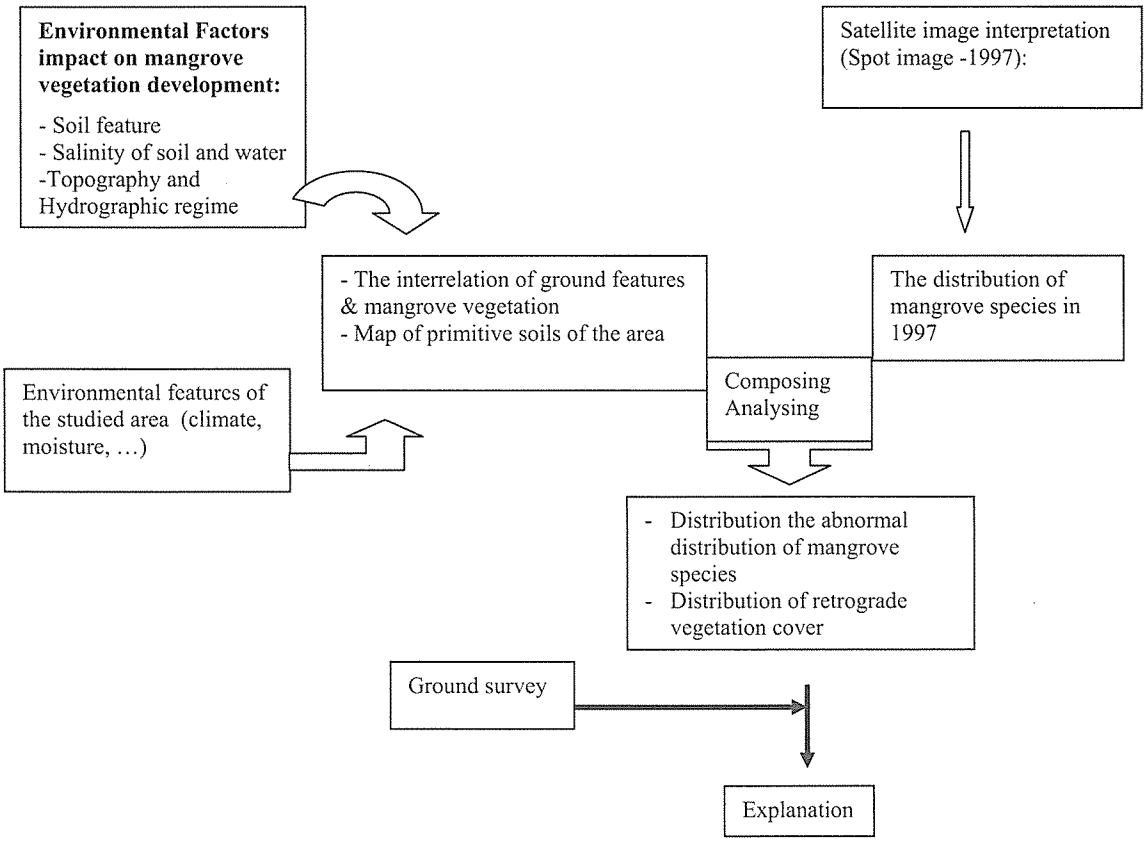
Monitoring the change of soil features by using vegetation indicator

Methodology

The proposal of using vegetation indicator in monitoring the change of soil features is built on the sensitivity of mangrove forest vegetation to the ground environment.
From satellite images, especially those have a wide spatial and spectral resolution, vegetation cover can be identified in detail. Therefore, if there is a *"key"* of the interrelation between vegetation species and the soil features, the change in ground environment can be interpreted from the abnormal changes of vegetation cover.

Data accumulation and processing:

Figure 2: The procedure of data composing



Results and discussion

On the figure of the distribution of abnormal vegetation cover (fig. 3) there are two types of abnormal vegetation covers, they are:

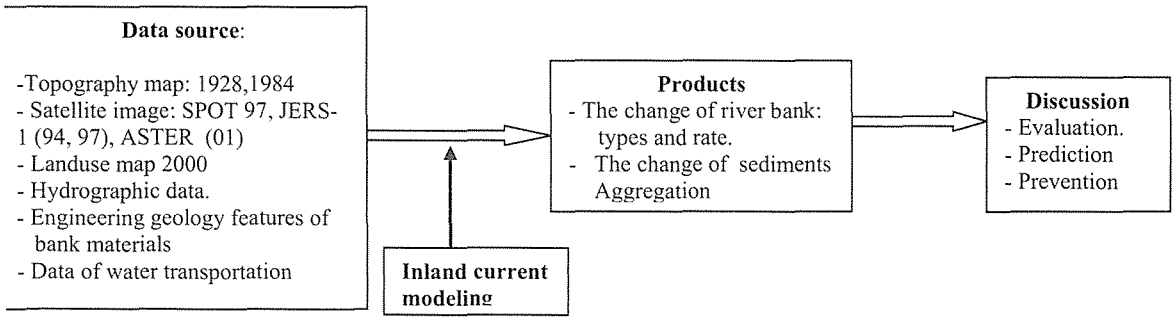
- *The abnormal distribution of vegetation:* They are defined along Soairap river, Dua river and at DongHoa hamlet. They are planted Rhizophora on the ground higher than 1 meters. As they were planted at wrong places, rhizophora have grown slowly.
- *The Retrograde vegetation cover*: It is defined on the left bank of Longtau river, in the village of BinhKhanh, AnThoiDong TamThonhiep and LyNhon. Commonly they are on the ground of Haplic Salic Fluvisols. There are two types of retrograde vegetation covers, they are:
+ Deserted salt fields: The salt field was abandoned because they were set on the land that is unfavorable for salt field.
+ Low land affected strongly by defoliant during Vietnam War

The result proves that vegetation indicator can be used as an effective tool in monitoring the environment change in the wetlands as Cangio area. Beside the ground database, the application of vegetation indicator will depend on the satellite images resolution. ASTER image and JERS /OPT image that have a wide spatial and spectral resolution should be the most suitable ones for the purpose.

Monitoring erosion and sedimentation

Data composing: The study on the change of erosion and sedimentation was addressed on the waterway of Longtau- Tacdinhcau and on DongTranh river.
Longtau- Tacdinhcau is the important waterway of the South Vietnam. After 1984, water transportation has been increasing at high speed with heavy loaded ships. As the consequence of the fact, bank erosion has happened strongly along this waterway; some hamlets must be moved. Therefore, the identification on the rate of erosion and the boundary of eroded bank has attracted a lot of attention. Beside bank erosion, sediment deposition along the channel of rivers, especially of the waterway, can cause accidents for fluvial transportation, so it is necessary to point them out for dredging.
At the mouth of DongTranh River, sediment aggregation and erosion are caused by the interaction of sea currents and inland current coming from Soairap River. In this river sedimentation plays the main role. Where the sediment flat is rich of medium grain particles, it can be exploited for site developing.

Figure 4: Procedure of composing and analysing data



- Erosion and sedimentation of the area are complicated and both of them have been affected by natural process and human activities.
- Along the main waterway, LongTau – TacDinhCau, erosion types include overwash, scour, and avalanch. The rate of erosion varies from 1 - 4 m/year.
+ 1984 – 1997: Transportation activities increased strongly in the area, so the changes of waterline were caused mainly by human actions. Generally, waterline changes in this period did not obey the nature: aggradation on protrudent banks and scour on sunken banks
+ 1997 – 2001: Erosions got more and more stronger because of vigorous development of the waterway, especially in the Tac Dinh Cau–Dua River; besides, some erosion places are stable
- On Dong Tranh river, sedimentation and erosion that are directed by inland and tide currents are defined through the distribution of vegetation cover.

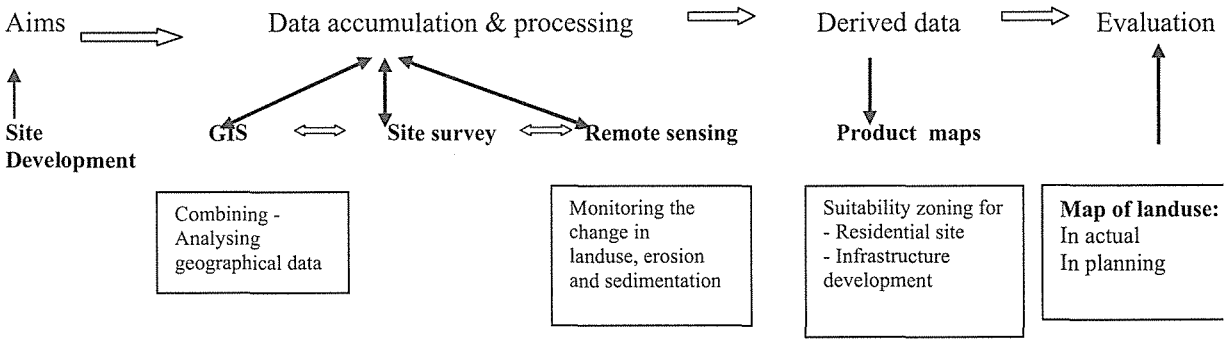
+ Sedimentation plays a predominant role. Avicennia alba that is stable in newly formed mudflat forms an area of 300-400m in width and 3-4 km in length [2].
+ Erosion is caused by the current. Beside the erosion cause by tide flow, the erosion that are closed to the drain mouth near shrimp ponds is caused by the shrimp ponds'operation [2]

Geoinformatics in site planning for RESIDENTIAL and infrastructure development

Data accumulation and processing

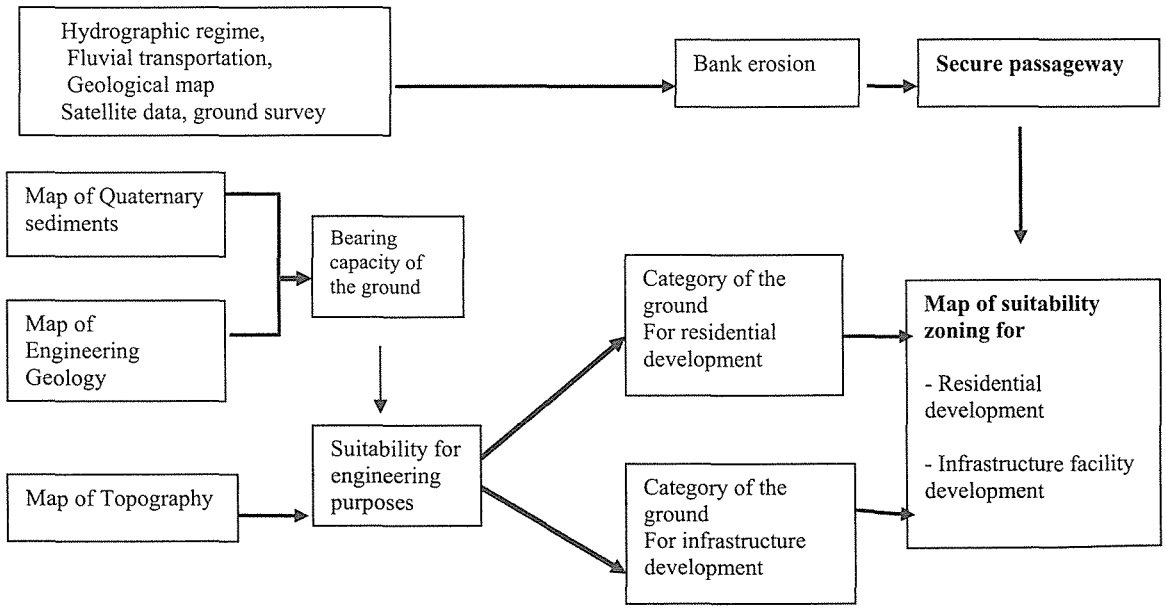
Data collection and processing are set upon the requirements of site development for building residential and infrastructure facilities that are placed in the following range
- The stability of the ground.
- The evaluation of the ground
- The homogeneity of the ground materials
- The location of the area threatened by natural hazards.
- Landuse in actual and in plan

Figure 5: Procedure of data processing



The ability of site developing for residential and infrastructure facility is investigated by composing the selected data.

Figure 6: Procedure of data composing



The derived data and the product maps

Bearing capacity, inundation regime, and the homogeneity of the ground materials are the important factors for site development. They are considered as variations of which the suitability of the ground for site development is considered as a function of these variations. From the function, the map of suitability zoning for residential site development (figure 7) and the map of suitability zoning for infrastructure development are formed as the product maps.

In comparison with the map of landuse in plan, some information can be pointed out as follows:

- The recent inhabitant areas distribute upon the most suitable and suitable grounds of the product map (figure 7), but some of them are threatened by erosion.

- There are enough lands for residential purpose, but the most important thing to be concerned in planning is that the municipal waste management, for both solid and fluid waste.

- Some of infrastructure facilities in plan for 2005 can not be acceptable because they are in wrong places and they will waste lot of money.

In planning for site development along Dua River - Tacdinhcau it is necessary to pay attention on the secure passageway to avoid the risk of bank erosion.

- The deposits of sandy sediments that are defined in Soairap rivers can be exploited for site developing.

Conclusion

The result proves that satellite data with the contribution of GIS will be the effective and economical tools not only in monitoring the geo-environment change but also in planning development projects in the wetland as the studied area.

For the success of the results the standpoint of the procedure of data collection and composing play the most important role. In setting the standpoint, the requirement of "users" for each product must be the priority.

The interaction between human activity and natural process can be identified by the help of geoinformatics.

As a unit of geoinformatics it is necessary to have more research on surface water modelling, both inland and nearshore currents.

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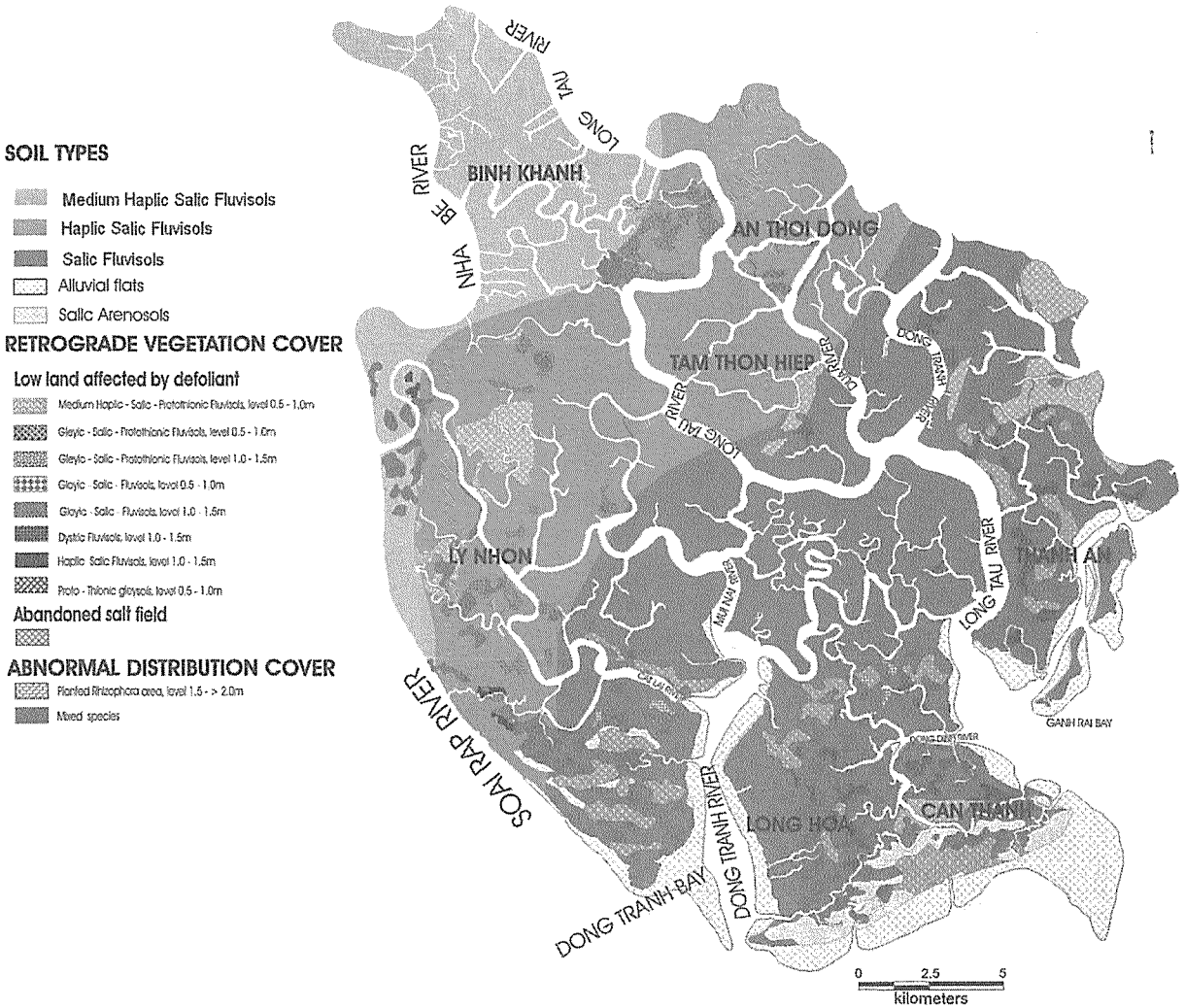
Figure 3

DISTRIBUTION OF ABNORMAL VEGETATION COVER



DISTRIBUTION OF SUITABLE SITE DEVELOPMENT FOR RESIDENTIAL PURPOSE

Figure 7

SITE ZONING FOR RESIDENTIAL DEVELOPMENT

PROTECTED MANGROVE FOREST

SUITABILITY GRADING

- Very suitable
- Suitable
- Rather suitable with limitation of loading capacity
- Unsuitable

BANK EROSION

- 2m - 3m/ year
- 3m - 5m/ year
- > 2m - 3m/ year
- 1m - 2m/ year
- Border
- Main road
- Safe limitted line