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**Human impacts on coastal ecosystem: Case study of mangroves along the coastline
of Binh Thuan Province, Southeast of Vietnam**

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HUMAN IMPACTS ON COASTAL ECOSYSTEM:

CASE STUDY OF MANGROVES ALONG THE COAST LINE OF BINH THUAN PROVINCE, VIETNAM

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CONTENT

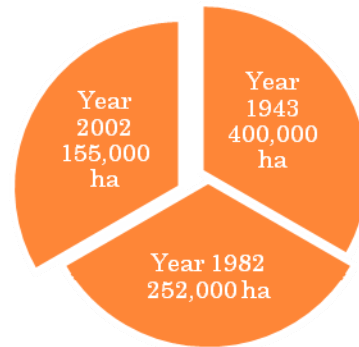
- Introduction
- Mangrove forests in Vietnam
- Human Impacts on mangrove forests in Vietnam:
Example from mangrove forests along the coastline of Binh Thuan province, Southern Center of Vietnam

INTRODUCTION

- Mangrove forest **MF** is one of our most important and widespread coastal ecosystem. Along the coastline there are fringes of mangroves. They are classified as the most vulnerable eco-system in coastal ecosystems (IPCC, 1995).
- Mangrove forest already has been pressured by human activities such as
 - ✓ Human settlement,
 - ✓ Aquaculture,
 - ✓ Mining and Tourism.

MANGROVE FOREST IN VIETNAM

Distribution:

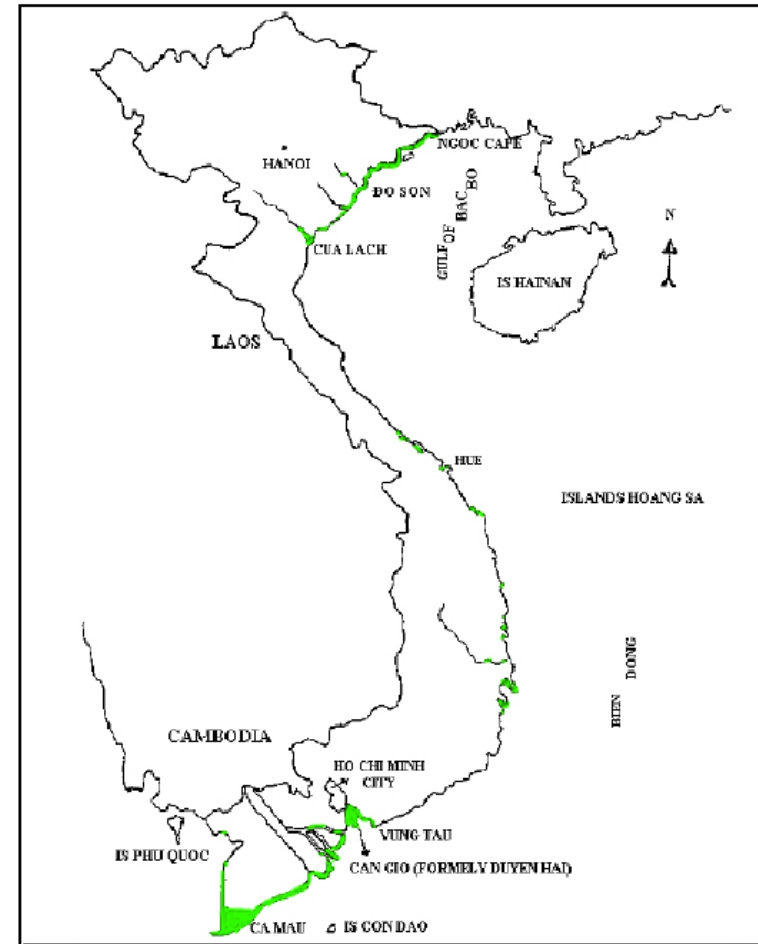


The coastal zone of Vietnam contained about 400,000 ha of mangroves in 1940 (Maurand, 1943) that were reduced to approximately 160,000 ha in 2007

(<http://vnexpress.net/GL/khoa-hoc/2004/07/3B9D4E4C/>)

due to over exploitation for wood, fuel-wood, charcoal, aquaculture, mining, tourism, and the US use of herbicides during the Vietnam war

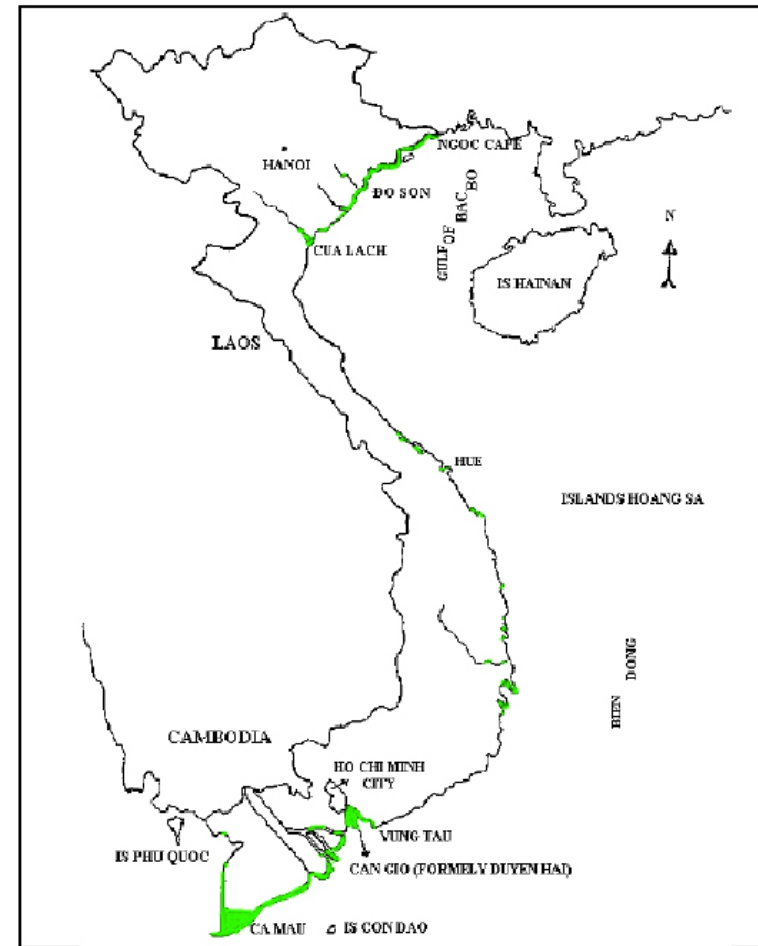
(www.landscaper.net/agent2.htm).



MANGROVE FOREST IN VIETNAM

Hong P.N (1984) distinguished MF in Vietnam into four zones:

- a) Zone 1: The northeast coast from Ngoc cape to Do Son cape. MF covered an area of 39,400 ha with highly suitable environmental conditions
- b) Zone 2: The north delta coast (from Doson cape to Lach river mouth). MF covered an area of 7,000 ha with large rivers, abundant alluvium and brackish water. But few protecting islands, and strong winds and waves.



MANGROVE FOREST IN VIETNAM

Hong P.N (1984) distinguished mangrove forest (MF) in Vietnam into four zones:

- c) Zone 3: The coast of central Vietnam (from Lach river mouth to Vung Tau cape). MF occupied 14,300 ha with less suitable conditions: Sloping seashore, short rivers, little alluvium, strong winds, waves and storms.
- d) Zone 4: The south delta coast (from Vung Tau cape to Ha Tien). MF covered 191,800 ha with favourable environmental conditions: Low topography, many rivers and canals, abundant alluvial deposits, half-day tide with large amplitude, very few storms and favorable tropical climate. This is the largest and richest mangrove area of Vietnam.

HUMAN IMPACTS ON MANGROVE FORESTS IN VIETNAM:

CASE STUDY OF MANGROVES ALONG THE COAST LINE OF BINH THUAN PROVINCE

- Binh Thuan, a coastal province in Southern-Center of Vietnam, has 192 km coastline length; along it there are MF.
- In the recent years, because of the large profits in the aquaculture, local people have destroyed MF to culture shrimps. This fact has affected a lot the precious natural resources of MF and provided the other negative effects.
- The presentation outlines some data about the biology and the change of soil properties in the studied area, where the MF is destroyed to culture shrimps. These are treated as the evidence of human impacts on the mangrove ecosystem.

CASE STUDY OF MANGROVES ALONG THE COAST LINE OF BINH THUAN PROVINCE, SOUTHERN CENTER OF VN

FIELD INVESTIGATION:

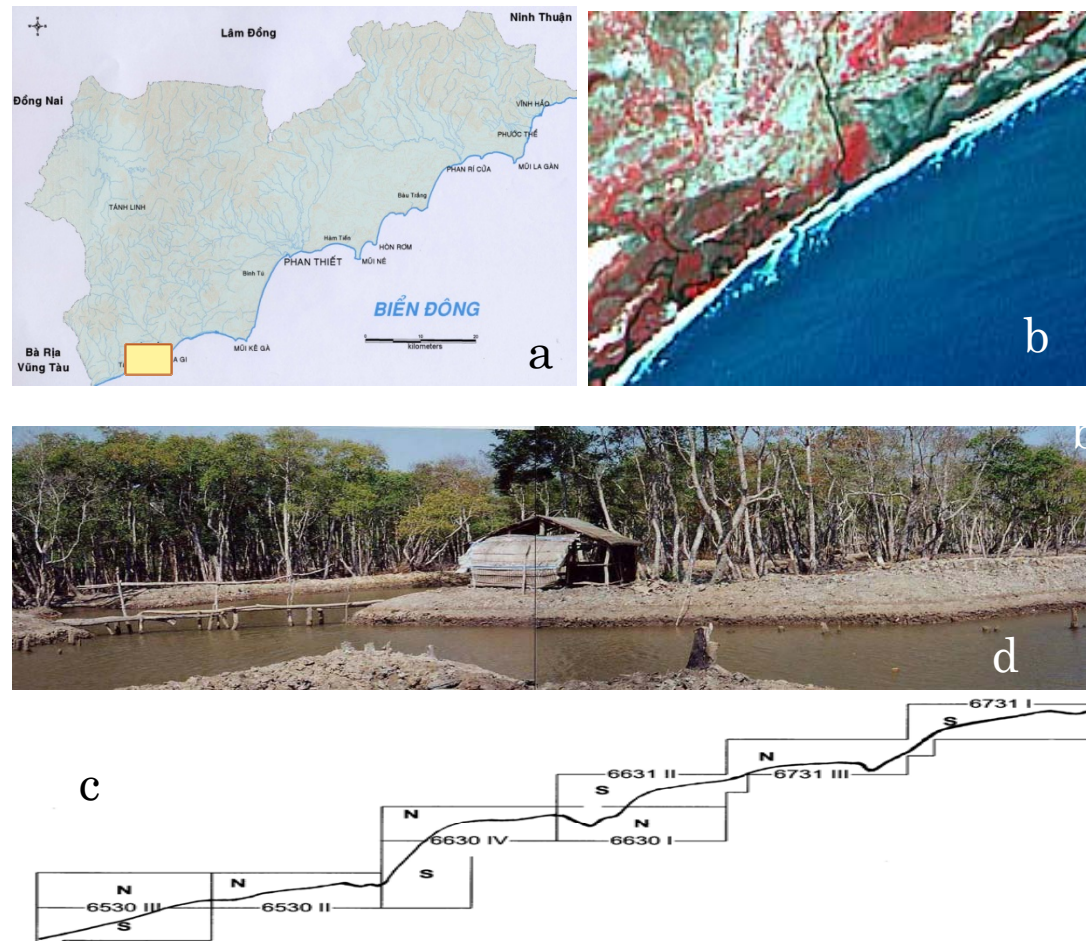
HA LANG PRECINCT, TAN THANG COMMUNE

- Ha Lang precinct, in Tan Thang commune, Ham Tan district, was chosen as the main studied site because this place has a special mangrove cover of remained forests, hopefully to be recovered with damage level about 37.4%. (Fig.1).
- The studied site located at the outer edge of Song Chua estuary, its altitude changes from 0 m at shoreline to 22 m at the top of the dunes located 1km from the shoreline. Special topography of Song Chua shows the crests and troughs are alternative running out to two sites of the estuary. The active dunes have mild slopes oriented to wind direction from east-northeast and the lee site is abrupt with a lot of trees. Mangroves develop well between two these sand bands.

CASE STUDY OF MANGROVES ALONG THE COAST LINE OF BINH THUAN PROVINCE, SOUTHERN CENTER OF VN

○ FIELD INVESTIGATION: HA LANG PRECINCT, TAN THANG COMMUNE

Fig.1. Studied site:
(a) Terrain map
(b) Satellite image.
(c) Map sheet mosaic of Binhthuan coastline
(d) Actual state at the time of the study in 2002.



CASE STUDY OF MANGROVES ALONG THE COAST LINE OF BINH THUAN PROVINCE, SOUTHERN CENTER OF VN

MATERIALS AND METHODS

1. Meteo-hydrological factors

- Statistical method, meteorological data collected from the meteo-hydrological stations of Binh Thuan,
- Salinity
- pH

2. Coastal topography, geomorphology

- Topographic map , scale 1:25000 (1966), aerial images (1999), actual map with scale 1:100 000,
- Satellite Image SPOT (1995), LANDSAT, MESSR (2002)
- Field survey (2002), along the Binh Thuan coastline, from South to North.

CASE STUDY OF MANGROVES ALONG THE COAST LINE OF BINH THUAN PROVINCE, SOUTHERN CENTER OF VN

MATERIALS AND METHODS

3. Changes of soil properties in places in which mangrove forest was destroyed to culture shrimps

- Sampling the soil belong to four transects
 - from the coast to the land side
 - along the coastline
- Using AAS (Absorption Atomic Spectrophotometer) method analyses soil sample; Olsen method for assimilable P_2O_5 , Kjeldah method for N.

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CASE STUDY OF MANGROVES ALONG THE COAST LINE OF BINH THUAN PROVINCE, SOUTHERN CENTER OF VN

MATERIALS AND METHODS

4. Biology

- Zoobenthos

- Using frame with 30 cm wide, net with 50 cm long, the length of handle is 1m.

- Vegetational cover

- Using the sample cell method. The size of sample cell is 10m x 10m.

5. Surveying situation of deforestation for building shrimp pools

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RESULTS

1. State of mangrove areas

👉 Based on available satellite image in 2002 and field survey (2002), along the Binh Thuan coastline, from South to North we can cite the actual state as follows:

→ In Tanthang commune, Ham Tan district: there were 120 ha. However, at the time we provided study (2002), 44,9 ha were destroyed for hatching shrimps. (10⁰36'33" N, 107⁰39'42" E).

CASE STUDY OF MANGROVES ALONG THE COAST LINE OF BINH THUAN PROVINCE, SOUTHERN CENTER OF VN

RESULTS

1. State of mangrove areas (cont.)

→ In Tan Hai area, Song Phan estuary, mangroves were destroyed almost completely. ($10^{\circ}43'02''$ N, $107^{\circ}52'10''$ E).

→ In Phan Thiet city, Ca Ty estuary, because of urbanization and tourism, there were no mangroves anymore. ($10^{\circ}55'12.05''$ N, $108^{\circ}06'20.51''$ E).

CASE STUDY OF MANGROVES ALONG THE COAST LINE OF BINH THUAN PROVINCE, SOUTHERN CENTER OF VN

RESULTS

1. State of mangrove areas (cont.)

- In Hoa Phu commune, Phan Ri Cua district remained only 0,2 ha mangroves at Song Luy estuary. (11⁰09'58" N, 108⁰33'46" E).
- In Chi Cong commune, there was a good ecological condition for some kinds of precious birds, but mangroves were destroyed almost completely (Fig. 2).

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CASE STUDY OF MANGROVES ALONG THE COAST LINE OF BINH THUAN PROVINCE, SOUTHERN CENTER OF VN

RESULTS: from studied field



Fig. 2a T Thang

CASE STUDY OF MANGROVES ALONG THE COAST LINE OF BINH THUAN PROVINCE, SOUTHERN CENTER OF VN

RESULTS: from studied field



Fig.2 b

CASE STUDY OF MANGROVES ALONG THE COAST LINE OF BINH THUAN PROVINCE, SOUTHERN CENTER OF VN

RESULTS

2. The Changes of Soil Properties of the Studied Site

2.1 Soil samplings: (Fig.3)

On transect 2, parallel with the shoreline; it was taken 3 samples by number 5, 6, 7.

On transects 1, 3, and 4, orthogonal to the shoreline from shore to inland, it was taken 13 samples (Sp) by number respectively 4, 3, 2, 1; 8, 9, 10, 11, 12, 13; 14, 15, 16.

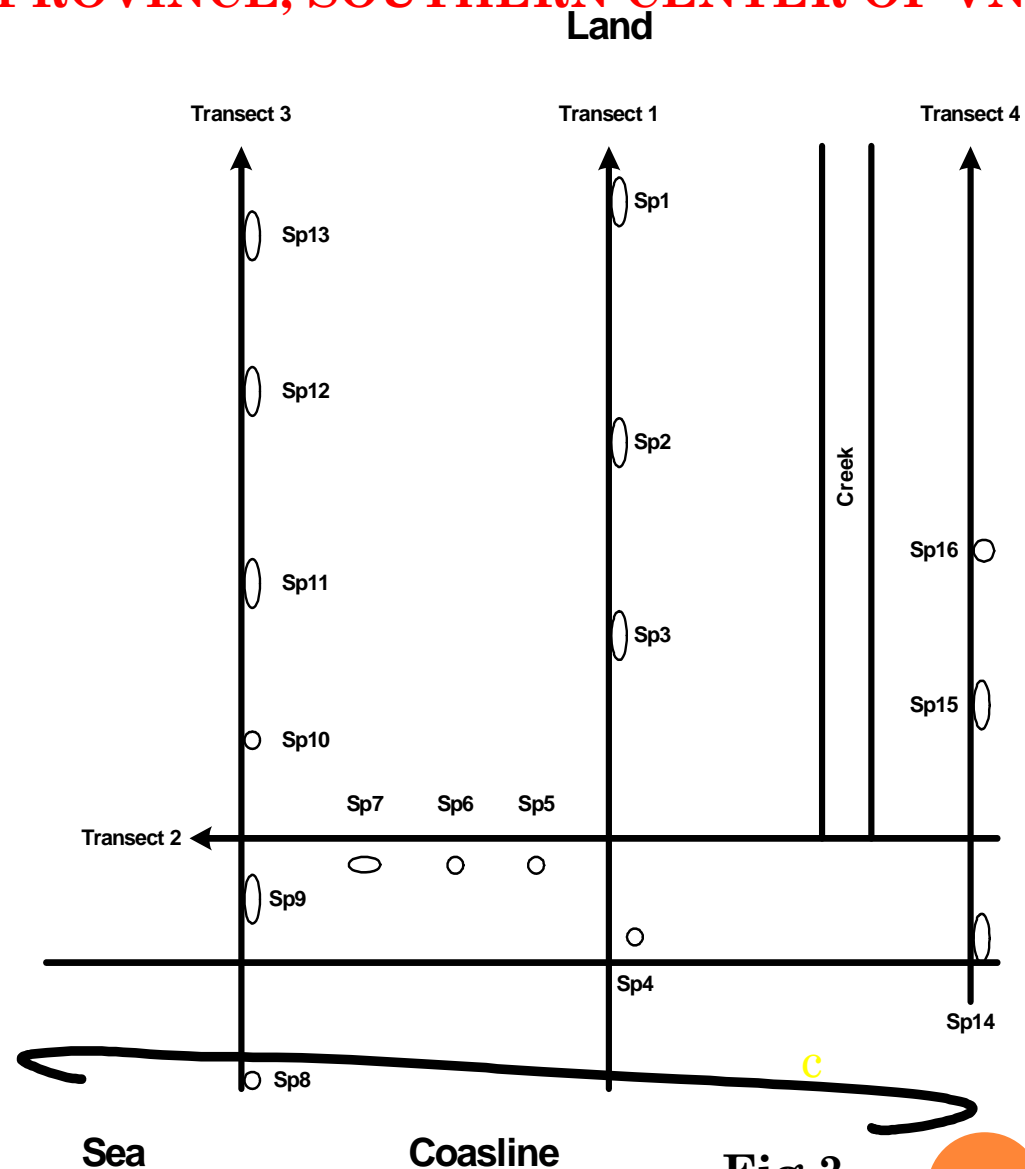


Fig.3

CASE STUDY OF MANGROVES ALONG THE COAST LINE OF BINH THUAN PROVINCE, SOUTHERN CENTER OF VN

RESULTS

2. The change of soil properties (cont.)

Soil structures

- The soil structures change from sand to heavy clay depending on sample positions. This is a special type of the MF, which has sand layer covering organic layer. It is quite different to soil structures of coastal zone of HCMC and Mekong Delta, being always tight. Soil analysis is presented in Tables 1, 2, 3, 4.

Table 1 Soil analysis at the studied site

Soil sample	Depth (cm)	pH H ₂ O	pH KCl	Clay %	Silt, %	Sand %	Mud, %	Acid humic %	CEC meq/100g
Sp 4 S. Sand	0.0	8,33	8,11	8	4	88	0,16	0,03	0,23
Sp 4	0- 20	5,03	4,81	38	22	40	1,59	0,26	1,56
Sp 4	20- 40	5,42	4,93	22	20	58	1,52	0,27	0,85
Sp 7	0- 20	6,46	5,83	46	38	16	2,52	0,49	1,62
Sp 7	40- 60	3,51	3,37	22	20	58	2,18	0,26	0,72
Sp 13	0- 20	3,25	3,12	18	12	70	2,07	0,59	0,73
Sp 13	60- 80	3,39	3,28	16	12	72	1,43	0,36	0,55
Sp 14	0- 20	5,76	5,34	12	6	82	0,63	0,11	0,27
Sp 14	60- 80	5,32	5,04	42	38	20	2,31	0,37	2,09

Table 2 Comparison with the results of two samples taken from Long An (Mekong Delta) and Do Hoa (coastal area of HCMC)

Place	Depth (cm)	pH H ₂ O	Clay %	Silt %	Sand %	Mud %	CEC meq/100g
Long An (Diep M. H., 1994)	0-20	3,37	56,13	27,63	3,95	7,62	5,91
	20-40	3,72	56,60	29,63	2,21	7,72	11,31
Do Hoa (Diep M. H., 1994)	0-20	5,53	48,19	22,68	12,53	8,61	33,1
	20-40	6,95	47,10	23,73	12,26	8,89	34,1

CASE STUDY OF MANGROVES ALONG THE COAST LINE OF BINH THUAN PROVINCE, SOUTHERN CENTER OF VN

RESULTS

2. The change of soil properties (cont.)

Soil chemical properties

- This is a kind of salty soil in the coastal areas, it has **jarosite**. So, it should be exploited carefully. If not, **jarosite** is brought on the surface, it becomes active alum. Most samples have large amount of Al, Cl, SO₄, Fe, Al. This proves that the area is influenced by salinity of sea water.



Fig.4 Shrimp *aquaculture* bringing underground jarosite to surface affected the restoration of the mangrove forest.

CASE STUDY OF MANGROVES ALONG THE COAST LINE OF BINH THUAN PROVINCE, SOUTHERN CENTER OF VN

Table 3 Analysis of chemical properties of the soil samples

Soil sample	Depth (cm)	Ca meq/100g	Mg meq/100g	Kts mg/100g	Kdt mg/100g	Na mg/100g	Cl mg/100g	SO ₄ mg/100g	Fe mg/100g	Al mg/100g
Sp 4 S. Sand		1,85	3,65	39,44	11,38	0,22	55,91	130,90	28,57	31,84
Sp 4	0-20	3,80	10,43	110,91	51,77	0,28	42,96	234,14	90,56	459,09
Sp 4	20-40	2,70	8,14	154,99	29,96	0,32	34,08	256,97	66,63	46,66
Sp 7	0-20	6,35	18,77	450,94	69,57	0,49	118,04	309,66	197,49	479,15
Sp 7	40-60	2,70	10,78	295,89	41,14	0,25	68,52	488,43	127,55	65,76
Sp 13	0-20	4,75	5,09	261,34	14,31	0,31	69,23	188,99	56,11	35,00
Sp 13	60-80	2,80	8,38	172,16	16,98	0,25	41,89	434,80	88,85	46,30
Sp 14	0-20	1,50	3,05	108,98	10,61	0,16	26,80	83,23	106,63	465,19
Sp 14	60-80	3,15	13,24	108,02	48,54	0,25	32,66	271,92	117,52	436,5

Table 4 Chemical properties of the soil samples at Long An and Do Hoa.

Soil sample	Depth	Ca meq/100g	Mg meq/100g	Kdt meq/100g	Na meq/100g	Cl meq/100g	SO ₄ meq/100g	Fe meq/100g	Al meq/100g
Long An (Diep M.H. 1994)	0-20 cm	1,0	1,73	0,19	0,07	6,61	16,72	0,026	1,85
	50-70 cm	0,78	0,19	0,23	0,04	9,87	17,07	-	7,56
Do Hoa (Diep M.H. 1994)	0-20 cm	0,84	2,31	0,70	21,70	25,38	4,7	0	0,023
	50-70 cm	1,98	6,96	1,20	24,10	24,81	17,0	0	-

RESULTS

2. The change of soil properties (cont.)

Soil chemical properties

- From comparison, it has showed that the studied site has higher Al, a damaging factor for soil. It was also observed that partly soil in this area was polluted by chemical substances used by shrimp – pond owners. (Table 4).

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CASE STUDY OF MANGROVES ALONG THE COAST LINE OF BINH THUAN PROVINCE, SOUTHERN CENTER OF VN

DISCUSION

SOIL

- This is the potential alkaline soil area of Vietnam because it has the structure of more sand than clay; the deeper the lower pH.
- ☞ It should not dig pond to culture shrimps because of transforming potential alkaline to active one. This will change physical soil properties and pH.
- ☞ Further, when soil is dug up, it exposes to the sun, pH will be more acid; and rain will change pH of water medium, so shrimp hatchery is badly influenced.



Fig. 5

RESULTS

3. Biological analysis

- **Phytoplankton:**

Through identification it was found 64 species belonging to four algae divisions: *Cyanophyta*, *Chlorophyta*, *Dinophyta* and *Chrysophyta*, among them *Chrysophyta* was dominant with 46 species.

CASE STUDY OF MANGROVES ALONG THE COAST LINE OF BINH THUAN PROVINCE, SOUTHERN CENTER OF VN

RESULTS

3. Biological analysis

- **Zooplankton and Crustacea:** Protozoa appeared very few. *Rotaria* with species *Brachionus urceus* appeared more in some places of the studied site. *Copepoda* was dominant in salty environment. They are the natural food source for larva of shrimps, fish and many other sea products.
- **Benthos:** It was found 11 species which belong to *Macrura*, *Amphipoda* and *Pices*; in which *Macrura* had 3 families, 4 genus and 5 species.

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CASE STUDY OF MANGROVES ALONG THE COAST LINE OF BINH THUAN PROVINCE, SOUTHERN CENTER OF VN

DISCUSCION

○ Biology

Due to deforestation for shrimp hatching, the bottom of the water body used to culture *Penaeus monodon* has pasty mud, stench from rotten botany, not supported to benthos development.

The component of Protozoa, Rotatoria is small, sometimes no *Cladocera*. *Copepoda* is dominant with large amount. In some places, because of bottom with sand mixing benthos components are poor, *Mollusca* do not appear, and natural shrimp is also rare.

CASE STUDY OF MANGROVES ALONG THE COAST LINE OF BINH THUAN PROVINCE, SOUTHERN CENTER OF VN

THE ACTUAL STATE OF MANGROVE FRINGES ALONG BINH THUAN COASTLINE

We have paid attention on mangrove fringes along Binh Thuan coastline a few years after the end of our research project and noticed that the local people continue to overexploit them not only for shrimp farming but also for mining and building seaside resorts (Fig.6).

Without further human intervention, mangrove trees rehabilitate naturally and slowly but unfortunately, only in some small areas.



(a) Titan mining



Fig.5



CASE STUDY OF MANGROVES ALONG THE COAST LINE OF BINH THUAN PROVINCE, SOUTHERN CENTER OF VN

CONCLUSION

Deforesting, included coastal mangroves for shrimp hatching, mining, tourism and other purposes brings economic benefits for only a concrete group, not for whole community, meanwhile the benefits which forests, specially mangrove forests, bring for human are quite enormous.

Losses which are not compensative through flushing floods, droughts and storms due to deforesting are conclusive proofs. So, we now should face with the suitable framework of immediate profits and the long run sustainable environment.

CASE STUDY OF MANGROVES ALONG THE COAST LINE OF BINH THUAN PROVINCE, SOUTHERN CENTER OF VN

CONCLUSION (cont.)

In order to deal with this problem some measures are proposed

- To intensify basic studies and interdisciplinary research on other factors in general and climate/tides in particular in preparation for international cooperation on the sustainable development and management of mangroves, sea grass beds, coral reefs, and other coastal resources.
- Policies/recommendations for the conservations and sustainable management of the ecosystem in general and remaining mangrove forests in particular need to be reviewed and completed.
- Based on local conditions, application of new technology for the rehabilitation, production and sustainable management of mangroves should be creative and skillful.

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CASE STUDY OF MANGROVES ALONG THE COAST LINE OF BINH THUAN PROVINCE, SOUTHERN CENTER OF VN

CONCLUSION (cont.)

In order to deal with this problem some measures are proposed

- Local people need to be involved in any conservation program affecting to their life.
- Local leaders should have strong political will and broad view to implement laws and regulations within their jurisdiction.
- Close cooperation among people involved: scientists, community educators, local leaders, businessmen, government, and non-governmental organizations.
- Appropriate knowledge relating to the conservations and sustainable management of the ecosystem needs to be shared among scientists, policy-makers and through mass media the general public.

CASE STUDY OF MANGROVES ALONG THE COAST LINE OF BINH THUAN PROVINCE, SOUTHERN CENTER OF VN

CONCLUSION (cont.)

In order to deal with this problem some measures are proposed

To prepare human and physical resources against natural disasters and to use reasonably natural resources, particularly mangroves forests, which provide invaluable ecological, social and economic benefits. They should be remained intact, protected or to be restored.

It is necessary to have workshops on technology, long term monitoring, and protection of environment, techniques achieving high quantity in aquasilviculture method, for aquaculture farmers.

To set a portion of profits on aquaculture, mining, development and tourism to rehabilitate mangrove forests.

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THANK YOU FOR ATTENTION