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25 YEARS OF MANGROVE REHABILITATION IN CAN GIO DISTRICT, HO CHI MINH CITY, VIETNAM

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ABSTRACT

Results of rehabilitation and restoration of mangroves in 25 years in Can Gio, Ho Chi Minh City, Vietnam are outlined. Present situations of forest resources, diversity of mangrove species, and communities of natural and planted mangroves are described. It is confirmed that the natural resources are bases for sustainable development, biodiversity conservation, research and tourism. Methods for mangrove biodiversity conservation and importance of scientific research on mangroves, international cooperation and ecotourism are also described.

KEYWORDS: biodiversity, ecotourism, mangrove, reforestation, restoration, Vietnam

INTRODUCTION

Ho Chi Minh City (formerly Saigon) is located about 1,300 km south of Hanoi and includes a mangrove in Can Gio district, a suburban district and covers an area of 71,642 ha, at latitude 10°22'14" -10°40'00" N, longitude 106° 16' - 107°00' E. It is the poorest district of the city with the population of 59,000. A network of rivers and channels traverses the delta and the main waterways leading to the port of Ho Chi Minh City.

From 1964 - 1970, Can Gio mangrove forest (formerly Rung Sat) was sprayed heavily with herbicides: 665,666 gallons of Agent Orange; 343,385 gallons of Agent White and 49,200 gallons of Agent Blue. As a result, 57% of mangrove forest in the district was destroyed (Ross, 1975). In some areas, large trees of *Rhizophora*, *Sonneratia* and *Bruguiera* were killed by the herbicide spraying and in many areas the vegetation was completely destroyed. Only *Avicennia* and *Nypa* palm were able to survive and regenerate after the application of herbicide. Some species such as *Phoenix paludosa* and *Acrostichum aureum*, a fern that dominated elevated land, have expanded. After many years of chemical spraying, the degraded land still has only scattered small trees.

Since 1978, a vast program of reforestation has been undertaken by Ho Chi Minh Forestry Department. Up to now, the reforestation effort has brought vast ecological improvements to the environment, biodiversity, wild animals such as monkeys, otters, pythons, wild boars, crocodiles, and various kinds

of birds have returned to the artificially regenerated mangrove forests. In 1991, Can Gio mangrove forest has been declared an "Environmental Protection Forest" by the Council of Minister and Can Gio has become one of the most beautiful and extensive sites of rehabilitated mangrove in the world, and was approved as Mangrove Biosphere Reserve by UNESCO in 2000. The results of rehabilitation in 25 years are as follows.

FOREST RESOURCES

After the war, almost mangrove forest in Can Gio was destroyed by herbicide spraying and cut by local people for fuel wood in and adjacent area. Up to now, the forest resource of Can Gio covers an area of 30,385 ha or 43% of the total area. About 8,958 ha are natural mangrove forests in which 21,427 ha are forest plantation (Fig. 1, Table 1).



Fig. 1. Mangroves recovery in Can Gio (Photograph of July, 2002)

Table 1. Land use in Can Gio

Category	Area (ha)	Percent
1. Forested area	30,385	42.58
a. Forest plantation	21,427	30.03
b. Natural mangrove	8,958	12.55
2. Non forested area	40,976	57.42
a. Waterways	22,091	30.92
b. Wasteland	757	1.10
c. Utilized land	18,128	25.40
Total	71,361	100.00

MANGROVE FLORA

The result of study indicated that 157 species distributed in Can Gio and are categorized in three groups are as follows:

- True mangroves 34 species, 14 families
- Associate mangroves 33 species, 19 families
- Migratory flora (inland flora) 90 species, 42 families

There are 34 species, 19 genera and 14 families in Can Gio at present (Nam & Thuy,2000) compared with 27 species in 14 families before herbicide spraying (Cuong,1964). Most of the mangrove species in Vietnam can be found in Can Gio, in which *Rhizophora apiculata* is the main species of plantation.

To diversify mangrove species in Can Gio, besides *Rhizophora apiculata* the others species such as *Eucalyptus spp*, *Acacia auriciformis*, *Kandelia candel*, *Ceriops tagal*, *Ceriops decandra*, *Intsia bijuga*, *Thespesia populnea*, *Rhizophora mucronata*, *Bruguiera sexangula*, *Casuarina equisetifolia*, etc. are also planted in Can Gio on the suitable site for each species.

Table 2: Comparison of true mangrove species in 1964 with 2000

No	Scientific name	Family	1964	2000	No	Scientific name	Family	1964	2000
1	<i>Acanthus ebracteatus</i>	Acanthaceae	*	*	20	<i>Ceriop decandra</i>	Rhizophoraceae	*	*
2	<i>Acanthus ilicifolius</i>		*	*	21	<i>Ceriop tagal</i>		*	*
3	<i>Sesuvium portulacastrum</i>	Aizoaceae		*	22	<i>Bruguiera gymnorhiza</i>		*	*
4	<i>Avicennia alba</i>	Avicenniaceae	*	*	23	<i>Bruguiera parviflora</i>			*
5	<i>Avicennia officinalis</i>		*	*	24	<i>Bruguiera sexangula</i>		*	*
6	<i>Avicennia marina</i>		*	*	25	<i>Bruguiera cylindrica</i>		*	*
7	<i>Lumnitzera racemosa</i>	Combretaceae	*	*	26	<i>Kandelia candel</i>		*	*
8	<i>Lumnitzera litorea</i>		*	*	27	<i>Rhizophora apiculata</i>		*	*
9	<i>Exoecaria agallocha</i>	Euphorbiaceae	*	*	28	<i>Rhizophora mucronata</i>		*	*
10	<i>Thespesia populnea</i>	Malvaceae		*	29	<i>Rhizophora stylosa</i>			*
11	<i>Hibicus tiliaceus</i>			*	30	<i>Rhizophora lammarkii</i>			*
12	<i>Hibicus macrophyllus</i>			*	31	<i>Schyphiphora hydrophyllacea</i>	Rubiaceae	*	*
13	<i>Xylocarpus granatum</i>	Meliaceae	*	*	32	<i>Sonneratia alba</i>	Sonneratiaceae	*	*
14	<i>Xylocarpus moluccensis</i>		*	*	33	<i>Sonneratia ovata</i>		*	*
15	<i>Aegiceras corniculatum</i>	Myrsinaceae	*	*	34	<i>Sonneratia caseolaris</i>		*	*
16	<i>Aegiceras floridum</i>		*	*	35	<i>Heritiera littoralis</i>	Sterculiaceae	*	*
17	<i>Phoenix paludosa</i>	Palmae	*	*		Species		27	35
18	<i>Nypa fruticans</i>		*	*					
19	<i>Acrostichum aureum</i>	Pteridaceae		*					

(Data of 1964 are from Vo Van Cuong (1964))

MANGROVE COMMUNITIES

Following natural and planted mangrove communities and populations are observed in Can Gio.

Natural mangrove communities and populations

- *Rhizophora apiculata* – *Phoenix paludosa* community
- *Rhizophora apiculata* – *Acrostichum aureum* community
- *Rhizophora apiculata* – *Avicennia officinalis* community
- *Rhizophora mucronata* – *Acrostichum aureum* community
- *Rhizophora mucronata* – *Avicennia alba* community
- *Avicennia alba* pioneer population
- *Avicennia alba* – *Sonneratia alba* community

- *Avicennia marina* population
- *Avicennia marina* – *Lumnitzera racemosa* community
- *Ceriops tagal* population
- *Ceriops tagal* – *Lumnitzera racemosa* community
- *Ceriops decandra* – *Phoenix paludosa* community
- *Sonneratia alba* population
- *Sonneratia caseolaris* – *Avicennia alba* community
- *Lumnitzera racemosa* – *Sesuvium portulacastrum* community
- *Phoenix paludosa* population
- *Phoenix paludosa* – *Acrostichum aureum* community
- *Phoenix paludosa* – *Avicennia officinalis* community
- *Phoenix paludosa* – *Excochcharia agallocha* community
- *Acrostichum aureum* population
- *Sesuvium portulacastrum* population

Artificial mangrove populations

- *Rhizophora apiculata* population
- *Rhizophora mucronata* population
- *Nypa fruticans* population
- *Intsia bijuga* population
- *Thespesia populnea* population
- *Xylocarpus granatum* population

BIODIVERSITY CONSERVATION

(a) Objectives

Based on the result of mangrove rehabilitation in Can Gio after the war, the objectives of mangrove biodiversity conservation can be set as follows:

1. Conserve plant communities typical for primary succession, natural succession and secondary succession.
2. Conserve genetic diversity including variation of different families, species, population genotype and their frequency.
3. Sustainable exploit floral resources and their value.

(b) Conservation activities

Activities have not been taken on specific solutions to preserve mangrove flora. Therefore, in the mean time it is proposed that the ongoing wise use, well management and sustainable development.

In situ conservation

Its most important objective is to maintain the genetic structure in existing population. As natural environment constantly changes, if the populations are left to be self-conserved without management, their species composition and gene complex distribution will change while the populations swift through different succession stages (Snedaker et al. 1984)

Conservation and exploitation should be closely linked together. This means apart from strict determination of protected area, self-help forests should be developed on the basis of stable productivity. Income is earned from the ecotourism, thinning products and non-wood forest products in

the mangrove. Local people will involve in the conservation of forestry as well as ecotourism activities by participatory approach.

1. Conserving naturally-regenerated communities of primary succession and the biotope for the wild animals, and upgrade of *Avicennia* and *Sonneratia* which have been formed relatively stable on muddy flats.
2. Developing natural communities, which have not been stable in term of species composition and distribution, improve the quality of newly planted communities, and intensively implement selective silviculture methods. Thinning regimes for manmade forest and enrichment of the natural forest following specific process reserved for the mangrove forest.
3. Recovering species, which are limited in number and have not formed yet populations. Experimental planting of native species has produced positive results. Location for planting the mangroves is based on ecological conditions of each species.
4. Establishment of seed stands. There is about 140 ha of *Rhizophora apiculata* population that was converted into seed stand. It is pertinent that seeds of plus trees from the seed stands, which have been established from existing plantations, are selected for planting and supplying in future plantation program.

Ex-situ conservation

This is the method of adopting measures to form collections of alive mangroves, of which major species or species confirming economic value will be chosen to plant. Solutions for *ex-situ* conservation are as follows:

1. Collection of alive mangroves taken from the field. The collected forest plants are preserved in botanic gardens. This aims mainly to collect seed sources for taxonomy (species, sub-species...). Advantages of these collections lie in the fact that they pave the way for the import of important trees for afforestation purposes.
2. Seed bank is most popular, practical and economic measure of preserving genetic resources of plants. Seeds can be preserved for a long time and they preserve sufficient genetic features of plants.
3. It is needed for including some valuable exotic plants in the strict of previously or newly planted forests to enhance biodiversity.
4. Species domestication such as *Calophyllum inophyllum*, *Barringtonia racemosa*, *Laguncularia alba*, etc.

SCIENTIFIC RESEARCH AND INTERNATIONAL COOPERATION

In recent 25 years, we get experiences on mangrove rehabilitation from practice and research. Since 1994, we started cooperating with many international organizations on mangrove research in which Japanese scientists play important role in helping us to study mangrove ecosystem. Besides, there are many Japan NGOs such as ACTMANG, TIERRA, NANYU NOKAI, etc. also took part in the promoting the education, awareness of environment protection for people in Can Gio, especially, on mangrove by planting, exchange culture between Vietnamese and Japanese students.

LAND ALLOCATION

Mangrove forest was divided into 24 forestry compartments in which the average size of the compartment was 1,000 – 1,500 ha to carry out the process of participatory of local people. About 167 poor households were selected in the village to sign in the contract for forest protection in 30 years. They get salary monthly with the rate of 185,000 dong/ha/year (about 1,400 yens equivalent). The

average area is 40 ha/person and 80 ha/household. Their living standards were improved and are satisfied with the present life.

ECOTOURISM

Can Gio is located in a big city with dense population so it is a good place for tourist. In the weekend, there are many people in the urban go to Can Gio for visit, sight seeing and get fresh air after a week for hard work. This situation impacted on environment and social conditions of Can Gio. Almost tourist companies belong to the state organization while local people are outsiders. So community-based ecotourism plays very important roles in natural conservation and sustainable development .

CONCLUSION

Can Gio mangrove forest was destroyed in the past due to many reasons by human being such as the war, herbicide spraying, over-exploitation, converse mangrove forest into shrimp culture, salt production, etc. Determining to rehabilitate mangroves by people in Ho Chi Minh City and Can Gio district reached reasonable results. The area was covered completely with many mangrove species in which *Rhizophora apiculata* played important role in the rehabilitation process. The diversity of genes needs to be studied on gene conservation of mangroves in rational ways. The living standard of forestry households is improved remarkably.

Can Gio mangrove forest was considered as “green lung and kidney” of Ho Chi Minh City, the biggest industrial city in Vietnam. As the environment is being improved, wild animals have come back to the forest. Natural regeneration will lead biodiversity. Approving as Biosphere Reserve will contribute the development of ecotourism and improving the living standard of local people. Besides the indirect effects of mangroves such as windbreak, microclimate improvement, stabilize the shoreline, safeguarding against erosion and oil spill, etc. must be evaluated. The natural resource of Can Gio will be a base for sustainable development, biodiversity conservation, research and tourism. Especially ecotourism is an important activity to bring back benefit to develop Can Gio in future to contribute in biodiversity conservation at worldwide. Besides, we need the cooperation on scientific research, exchange culture as well as environmental education programmes for local people and tourists.

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