



After the Tsunami Coastal Ecosystem Restoration

Lessons Learnt





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Preface

The tsunami of 26 December 2004 swept along 800 km of the coast of the Indonesian province of Nanggroe Aceh Darussalam (NAD, or Aceh), causing the loss of at least 167,000 lives. A further 500,000 people lost their homes and livelihoods.

A year later, as many as 124 international NGOs, 430 national NGOs, dozens of donor and UN organizations, a variety of Government institutions and military institutions had been recorded, together with the community, to be working on rebuilding Aceh (BRR, 2005).

The first step in the reconstruction effort focused mostly on the emergency response, particularly with regard to fulfilling the victims' need for basic items such as food, clean water and shelter. As conditions in the field began to improve, the emergency gradually subsided and work moved to the next phase, rehabilitation. From that point on, attention began to be directed towards restoration of the environment, particularly in those areas hit by the tsunami.

A number of organizations, both governmental and non-governmental, initiated a variety of environmental restoration activities, in particular the planting of mangrove and other coastal vegetation in an effort to restore the coastlands. Within only a few months, coastal rehabilitation actions had mushroomed throughout the Aceh coast, and the hitherto unknown term 'mangrove' suddenly became familiar in the community, who had previously called it by its local name "*bak bangsa*".

After 18 months of coastal rehabilitation activity, the results are now clear. Only a few activities of it have been fully successful, the rest has failed. This can be seen simply from the low survival rate of plants in the field. Reasons given for the failures include: mistakes in the selection of planting sites, unsuitable choice of plants, insufficient preparation, inadequate guidance, no tending of the plants, and the low capacity of human resources.

Another weakness found in the field was the very limited amount of community involvement in the rehabilitation activity. Communities tended to be included only as workers, not as partners involved actively and continuously. Moreover, coordination and information sharing among the stakeholders concerned with the rehabilitation activity were very poor.

A mistaken perception among the implementers was that rehabilitation activity ended once the seedlings had been planted in the field. The result as they saw it, therefore, was the number of seedlings planted, not the number that survived after planting.

Apart from the matters mentioned above, the coastal rehabilitation activities underway in NAD province have provided a great many experiences and valuable lessons. Unfortunately, these lessons have not been brought to the attention of the stakeholders in Aceh. For this reason, Wetlands International-Indonesia Programme collaborated with the United Nations Environment Programme (UNEP) to undertake this study of lessons learned from coastal ecosystem restoration efforts in Aceh since the tsunami.

In this study, the causes of failures have been identified and extracted from a variety of stakeholders. In addition, this study also provides a range of information, experience, strategies and other matters relevant to supporting the rehabilitation activities undertaken by both government and NGOs. It is hoped that the suggestions and recommendations made here can be used to support rehabilitation efforts in NAD Province.

Executive summary

This report explains what is known about coastal ecosystems in the Indonesian province of Nanggroe Aceh Darussalam (NAD or Aceh), their status before the tsunami of 2004, and how they fared after it. It reviews the ecosystem restoration activities that were undertaken in 2005-2006 by a variety of governmental and non-governmental actors, in partnership with many different stakeholder groups, and updates findings into 2007. Specifically, it critically examines the various means by which the re-planting of mangroves and other coastal vegetation was attempted, and quantifies the outcome in terms of success as measured by long-term seedling survival. A total of almost 30 million seedlings were recorded to have been planted on 27,500 ha in Aceh since the tsunami. Unfortunately, the mangroves were often planted in damaged pond areas before the ponds were repaired, and many were destroyed by the heavy machinery used in repair work. Other mangrove planting areas were later destroyed through the construction of infrastructure, suggesting a lack of coordination among the various actors. The need to avoid such mis-sequencing and mis-location of planting effort is one of a number of lessons learned, the others being:

- that short-term, project-based, cash-for-work schemes in which local people are used as paid labourers, with limited supervision, training or education, tend to result in little after-care of planted seedlings, and high seedling mortality rates;
- that with 95% of planted seedlings being *Rhizophora* (mostly *R. mucronata*), the resulting mangrove monocultures lack structural and taxonomic diversity and zonation, which may render them vulnerable to environmental shocks and disease;
- that importing seeds and seedlings from Java to relieve local supply shortages meant that many (35-50%) died in shipping and the rest were stressed and weakened;

- that the use of mature and qualified seed and seedlings is essential to high survival rates after planting;
- that the choice of site for nurseries is important to seedling production, the best sites being tidal, flat and sheltered from the wind;
- that the use of growth media with too little mud content causes seedlings to die;
- that a 1-2 month 'hardening off' period is needed before planting, during which the seedlings are progressively deprived of fresh water and shade;
- that seedlings were often planted in the wrong sites, that is in sandy areas, in areas prone to drying out, and in high-energy locations vulnerable to currents and wind;
- that planting in privately-owned areas without the owner's permission may result in the seedlings being removed later;
- that various technical errors can kill or weaken seedlings, including planting at the hottest times of day, transporting seedlings with bare roots, and planting seedlings still in their plastic polybags;
- that young seedlings are vulnerable to pest attack, especially by barnacles, crabs and mud shrimps; and
- that seedlings need to be protected against browsing livestock.

The net result of a failure to address these challenges was that around half the planted mangroves did not survive. The study concludes that key priorities include a need for stakeholder coordination, full long-term community participation in all stages of the process and its planning, and awareness of the correct techniques, sites and species for planting, and of the key indicators that suggest good sites (i.e. mud skippers) and bad ones (i.e. barnacles). Educational and awareness-raising activities are therefore important. Diversification of species planted should also be encouraged.

1. Introduction

1.1. Profile of Aceh

The Indonesian province of Nanggroe Aceh Darussalam (NAD, or Aceh) is situated between latitudes 2–6° North and longitudes 95–98° East, and occupies the northern tip of the island of Sumatra. It has an area of 57,365.57 km², and is divided into the four municipalities (kota) of Banda Aceh, Langsa, Lhokseumawe, and Sabang, and 17 districts (kabupaten), each divided into sub-districts (kecamatan). To the north and east lies the Strait of Malacca, to the west is the Indian Ocean, and to the south Aceh's only land frontier, with the province of North Sumatra.

Figure 1-1. Map of NAD Province



Aceh lies in the moist equatorial zone and has a mean annual rainfall of 1,500-5,000 mm depending on location and rain-shadow effects, being drier in the north and west, and wetter in the south and east, and in the mountains. The geology is largely granitic and volcanic but there are significant areas of limestone (karst) in the north. Farmland includes wet rice, which may be irrigated or rain-fed, mixed gardens of fruit

trees and vegetable crops, and many areas are suitable for coconut, cocoa, coffee and other pan-tropical crops. There is a clear distinction between the flat coastal plain and the steeper upland areas, which are more suitable for tree crops. The main crops grown are rice, maize, soybean, ground-nut, green beans, cassava and sweet potato. The dominant food crop is rice, while maize and cassava are the most important supplementary starch sources.

In 2003, NAD Province had a population of 4,218,486, which was growing at 1.26% annually. In-migration had declined since 1999 due to the conflict, and there was significant out-migration as well. Average population density in 2003 was 74 people/km², but varied considerably from one district to another. The six districts most severely affected by the tsunami included Banda Aceh, the most densely populated with 3,669 people/km², the others being Aceh Jaya, Nagan Raya, Aceh Barat, Simeulue and Aceh Besar. The total population after the tsunami had been reduced to about 4,010,860.

1.2 Apparent changes in land cover

Figures 1-2 and 1-3 show land cover conditions for NAD Province based on the interpretation of Landsat Satellite Imagery ETM 7 in 1999-2000 and in 2002-2003 respectively (Ministry of Forestry, 2002, 2005). These interpretations appear to show that, within three or four years, land cover in Aceh province had undergone drastic change, especially in the reduced area of Primary Dry Forest relative to Secondary Dry Forest. These differences in forest cover interpretation between 1999-2000 and 2002-2003 are summarised in Table 1-1.

Table 1-1: Changes in forest cover in Aceh (source: satellite image interpretation by Ministry of Forestry, 2002, 2005)

	Area in hectares	
	1999-2000	2002-2003
Primary dry forest	1,471,000	480,000
Secondary dry forest	1,179,000	2,413,000
Primary swamp forest	1,000	0
Secondary swamp forest	117,000	165,000
Secondary mangrove forest	24,000	18,000
Plantation forest	269,000	36,000
Total forest cover	3,061,000	3,112,000

Figure 1-2. Land cover conditions for NAD Province, based on interpretation of Landsat imagery 1999-2000 (Ministry of Forestry, 2002).

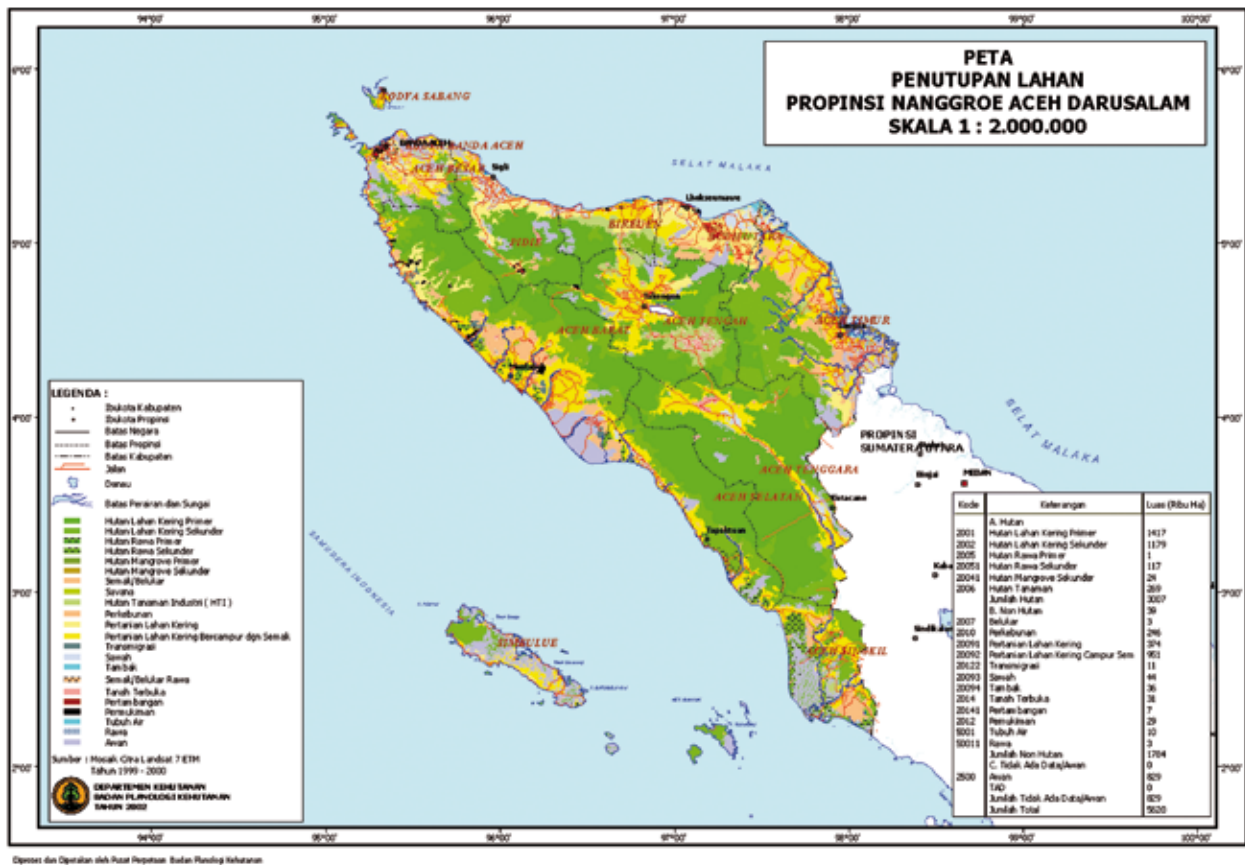
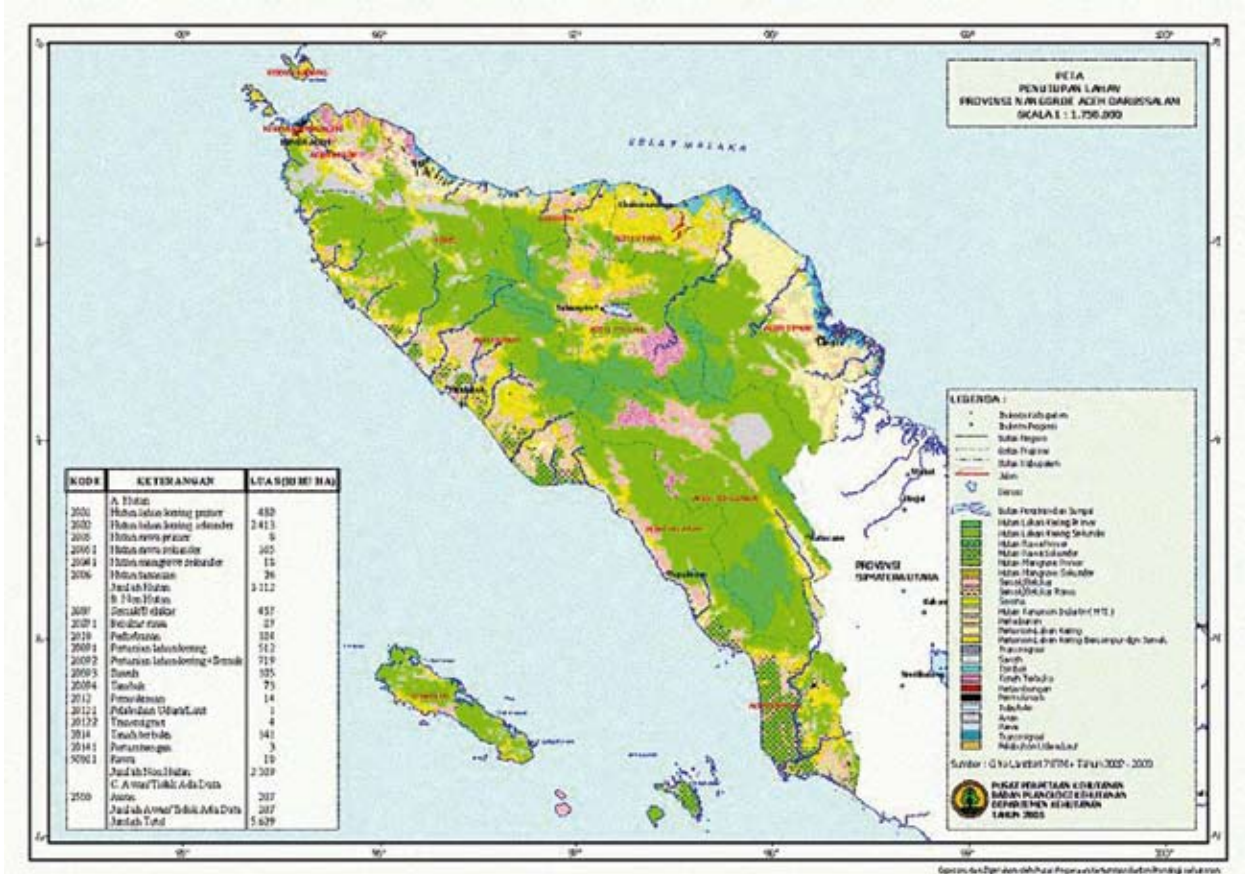


Figure 1-3. Land cover conditions for NAD Province, based on interpretation of Landsat imagery 2002-2003 (Ministry of Forestry, 2005).



2. Coastal Conditions Before the Tsunami

Aceh's eastern coastline is 761 km long and is mostly muddy beach which had once been covered by extensive areas of mangrove forest. The eastern coastal districts comprise Aceh Besar, Banda Aceh, Pidie, Bireun, Aceh Utara, Lhokseumawe, Aceh Timur, Langsa and Aceh Tamiang. The western coastline is 706 km in length and is dominated by sandy beach covered by casuarina (sea pine), coconut, hibiscus, and other species of coastal vegetation. The western coastal districts are: Aceh Besar, Aceh Jaya, Aceh Barat, Meulaboh, Nagan Raya, Aceh Barat Daya, Aceh Selatan, Simeulue Island and Aceh Singkil. The following is a description of the condition of the various coastal ecosystem types as they existed before the tsunami; these are mangrove, coastal forest, peatland, swamp, aquaculture ponds, and sandy beach together with the surrounding vegetation formations.

2.1 Mangrove forest

2.1.1 Condition of mangrove vegetation

Mangroves are a common type of vegetation found on muddy tropical shores, in the inter-tidal zone. Based on a number of studies in Aceh during the period before the tsunami (Noor *et al.*, 1999; Iwan Hasri, 2004; Siswani Sari, 2004) and field visits by a Technical Team from Wetlands International Indonesia Programme (Suryadiputra *et al.*, 2006), it is known that the mangrove species in Aceh comprise: *Avicennia marina*, *A. officinalis*, *A. alba*, *A. lannata*, *Rhizophora mucronata*, *R. apiculata*, *R. stylosa*, *Bruguiera gymnorhiza*, *B. parviflora*,

salinity. Landwards from this, in the middle or mesozone, grow a variety of species, in particular *Rhizophora* spp., *Lumnitzera* spp., *Scyphiphora hydrophyllacea*, *Bruguiera* spp., and *Ceriops* spp. Further inland where the land is drier (i.e. not affected by tides), species of *Xylocarpus* and *Aegiceras* grow well (Noor *et al.*, 1999).

Figure 2-1. *Scyphiphora hydrophyllacea* (a), *Ceriops decandra* (b), *Bruguiera gymnorhiza* (c), and *Lumnitzera littorea* (d)



Even before the tsunami, Aceh's coastal areas had already been extensively degraded, mainly along the east coast where serious damage had been done. The main causes of this were the development of shrimp ponds, oil palm plantations, and the felling of mangrove trees for charcoal, all of which had been going on many years.

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