

**Preliminary Assessment on
Impacts of the Tsunami
on Coastal Ecosystems and
Associated Livelihoods
in Aceh Province, Indonesia**

**Global Environment Centre
Wetlands International Indonesia
NORDECO**

**In conjunction with
Ministry of Environment Indonesia**

**With support from
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10 January 2005

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Introduction

This preliminary assessment on the impact of the Tsunami was initially made on the 5th January 2005 at the request of the Indonesian Ministry of Environment. It has subsequently been revised and expanded in scope based on comments and requests from other agencies. It is based on an analysis of selected satellite images of parts of the affected area, eyewitness reports as well as selected background information.

The report focuses on the northern tip and west coast of Aceh province which appear to be the most severely affected portions of Sumatra island.

This report is part of a larger programme being undertaken in conjunction with other partners to examine the impacts of the tsunami on the regions coastal ecosystems and communities.

Linkage between Coastal Ecosystems and livelihood

In Aceh province coastal ecosystems play a critical role in the livelihood of local communities. The coastal fisheries of the region which are key to livelihood and development are dependent on the functions of intact mangroves, coral reefs and coastal lagoons. Loss and degradation of these systems will have long term impacts on the recovery of coastal fish stocks and thus seriously affect the people living along the coast which largely will be deprived of their normal livelihoods. Coastal mangroves, freshwater and peat swamp forests provide a range of benefits to local communities including fibre, timber, fruits and other forest products. Peat swamp forests play an important role in the hydrology of the coastal plains – regulating freshwater levels and reducing saline intrusion into the groundwater.

Characteristics and Biodiversity of the Affected Region

Forest types

Aceh province comprises the northern tip of the island of Sumatra - dominated by a mountain ridge trending north west to south east. The northern and eastern coastal plains have been relatively well developed while the western coast is relatively little developed. There is a wide diversity of soils, geology and agro-climatic zones in Aceh leading to a high diversity of species. The coastal zone of the northern and western portions of Aceh have five of the 10 main vegetation types found in Sumatra Island namely mangrove forest, peat swamp forest, lowland evergreen forest, lowland semi-evergreen forest and forest on limestone (Whitten et al 1992) (see Map1). These forest types are of significant importance for plant, mammal, bird, fish, amphibian, reptile and invertebrate biodiversity.

Banda Aceh is built on the mainland as well as a series of low-lying islands in the delta of the Krueng Aceh River. This area originally would have been covered by mangrove forest but most of the forest was cleared during the development of the town. To the west of the town along the coast a large area of mangroves was cleared in the last 30 years or so and converted to fish and prawn ponds. A number of patches or small islands of mangroves remain in the branches of the delta or among the fish ponds.

The west coast of Aceh is lined by sandy beaches and mangroves are mainly restricted to relatively small areas in shallow lagoons along the beaches or near the mouths of the rivers along the coast. These mangroves were of significant importance in acting as nursery and feeding areas for coastal and riverine fish and prawn species as well as supporting a variety of wildlife.

Lowland evergreen forests occur along or near to the coast between 10-50km south of Banda Aceh but are progressively replaced by peat swamp forests to the south. These forests will contain a broad diversity of plants, mammals and bird species.

Lowland semi-evergreen forests only occur on a low range of hills at the very northern tip of Sumatra immediately to the west of Banda Aceh. These forests have a different range of plants and animal species compared to lowland evergreen forests.

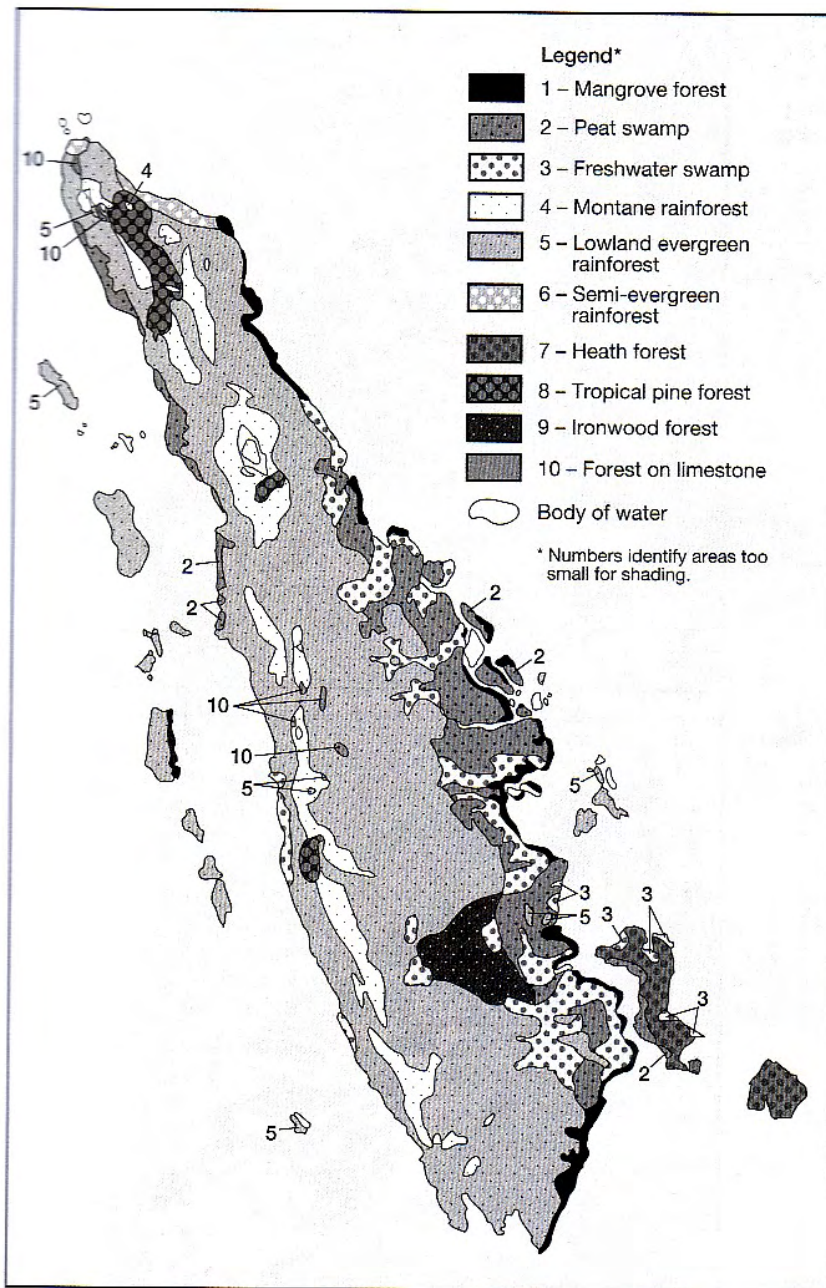


Figure 1.11. Natural vegetation.

After MacKinnon 1997

Map 1: Natural vegetation types of Sumatra (from Whitten *et al* 1997)

On the west coast, forest on limestone only appears to occur at one point about 10 km south-west of Banda Aceh at a point where they are partly exploited for use by a large cement factory. Forests on limestone are of significant importance for their floral diversity.

Peat swamp forests in Aceh occur mainly along the west coast especially in the coastal plain between 50-250km south of Banda Aceh. These peat swamp forests have developed over the last 5-7000 years and comprise a tropical forest growing on top of a layer of peat or organic soil (formed from layers of un-decomposed plant materials) between 1-4m thick. While little or no ecological studies have been undertaken in these forests they are thought to contain a broad diversity of species including likely rare or endemic species as a result of their relatively isolated nature. Map 2 shows the distribution of peat soils in Aceh Province.



Map 2: Distribution of Peat soils in Aceh province (from Wahyunto et al 2003)

Marine resources

The coastal waters of Aceh are rich in marine life with significant areas of coral reef fringing the shore and also the coastal islands (see map 3). These areas are of significance for fish including shark, whales and other marine mammals, nesting turtles and birds (Cheung *et al* 2002).



Conservation status

Terrestrial Conservation Areas

According to available information (Map 4 from Whitten *et al*), the main conservation areas for terrestrial habitats along the coast of Aceh is a portion of the Gunung Leuser National Park in the southern section of the west coast. Other conservation areas have been proposed along the coast but their status is not certain.

Marine Conservation Areas

Cheung *et al* (2002) list two marine protected areas on the north and west coast of Aceh – namely: Pulau Weh marine reserve (3900ha) established in 1982 and situated near to the northern tip of Aceh; and Kepulauan Banyak Marine Recreation Area (227,500ha) established in 1996 and encompassing many of the islands and adjacent marine waters adjacent to the west coast of Aceh.

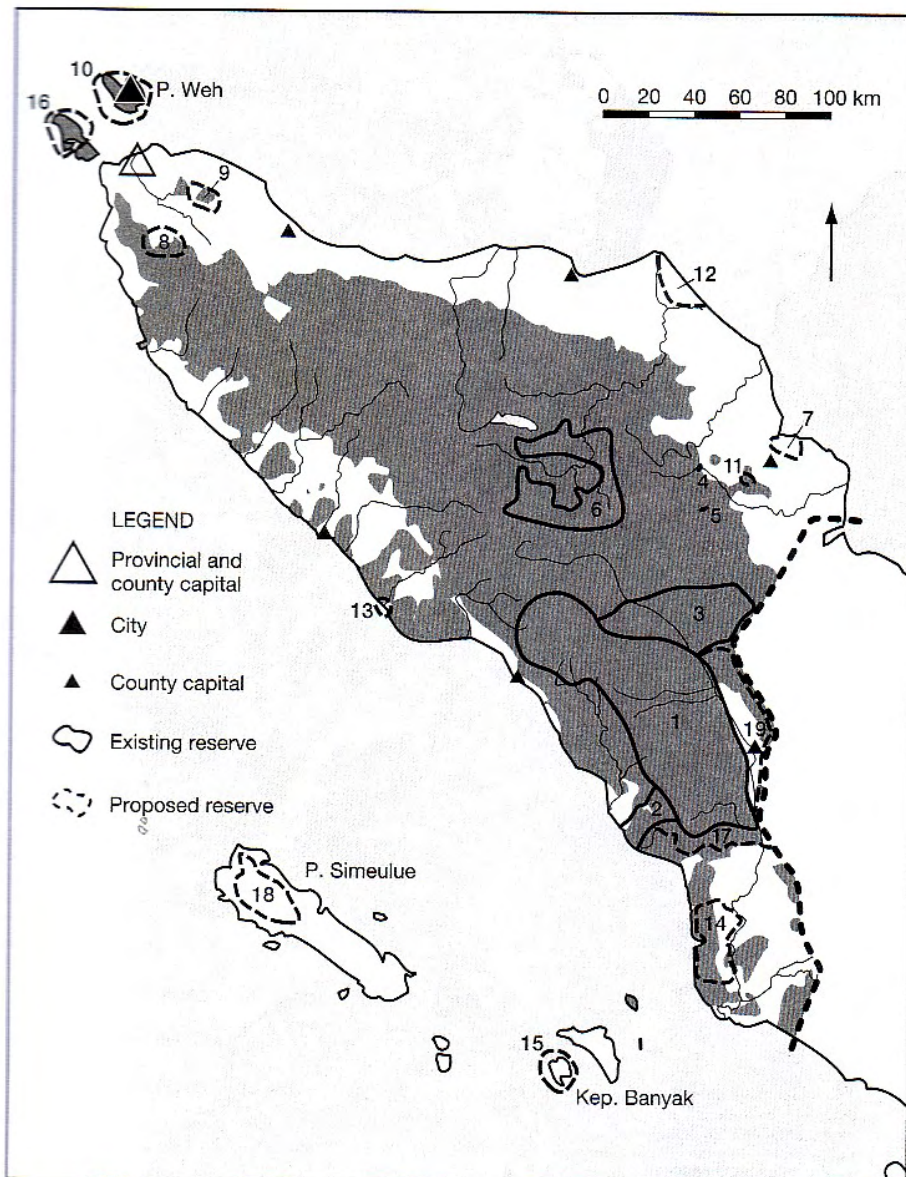


Figure 1.15. Remaining forest, reserves and proposed reserves in Aceh. 1, 2 and 3. Gunung Leuser; 4 and 5. Serbojadi; 6. Lingga Isaq; 7. Kuala Langsa; 8. Jantho; 9. Gunung Seulawah Agam; 10. Aneuk Laut; 11. Langsa Kemuning; 12. Kuala Jambu Air; 13. Rantau Pala Gadjah; 14. Singkit Barat; 15. Pulau Bangkaru; 16. Perairan P. Weh and P. Beras; 17. Perluasan Gunung Leuser Bengkong; 18. Pulau Simeulue; 19. Curah Serbolangit.

After FAO/MacKinnon 1982a

Map 4 Remaining forests, reserves and proposed reserves (from Whitten *et al* 1997)

Importance of Natural ecosystems to sustain livelihoods

Preliminary assessment of the impacts of the Tsunami on natural ecosystems

An analysis of a number of paired satellite images showing comparable areas before and after the tsunami has generated initial information on very significant changes to selected coastal ecosystems. Five paired images are presented in this preliminary report.

Image Pair 1: Overview of Northern Tip. The image shows the northern tip of Aceh province with Banda Aceh in the top right hand corner of the image and the west coast extending down the left hand side. Mangroves and fish ponds and some mangroves are seen near to west of Banda Aceh town along the coast. In the second image these have almost completely disappeared leaving the open sea and mud flats. On the left centre of the image are coral reef in front of sand beaches backed by agriculture land. After the tsunami the coral reef remains but all other features have been removed leaving bare soil and a large dark lake of sea water in the former rice fields.

NORTH WEST TIP OF ACEH PROVINCE

10 JAN 2003



29 DEC 2004



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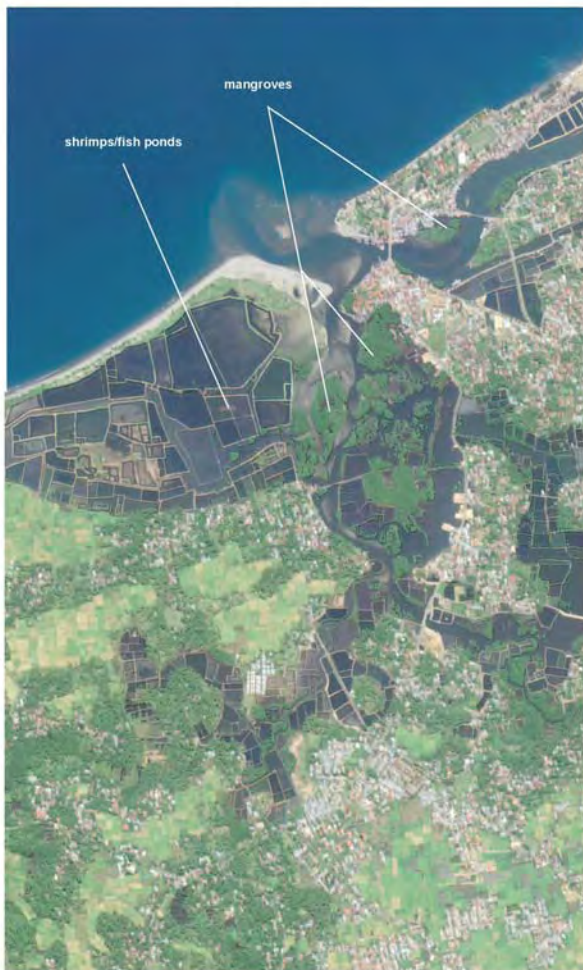


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Image Pair 2: loss of mangroves and fish ponds. This is a close up of the western portion of Banda Aceh together with mangroves and fish/shrimp ponds to the west protected by a sand spit. Following the tsunami almost all of the buildings in the town are obliterated and all of the fish/shrimp ponds have been destroyed along with the sand spit - making them part of the open sea. Remnants of the mangroves are still visible – but it is not possible to tell if the trees are still alive as the leaves seem to have turned brown.

NORTH WEST TIP OF ACEH PROVINCE

13 DEC 2004



29 DEC 2004



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Image Pair 3: Scouring of landscape. A close-up of the left central portion of image 1 showing the coral reef and coastal vegetation. It is possible to see that a considerable amount of sand has been deposited on the surface of the coral reef although its overall shape seems to be intact. The beach has totally been destroyed and the sand stripped back to expose the underlying rock. The coastal lagoon and area of mangrove on the southern portion of the cape has disappeared and become part of the open sea. The terrestrial vegetation has almost entirely been removed, except for a small area at the top of the image protected by a rocky headland.

NORTH WEST OF ACEH PROVINCE

10 JAN 2003

29 DEC 2004



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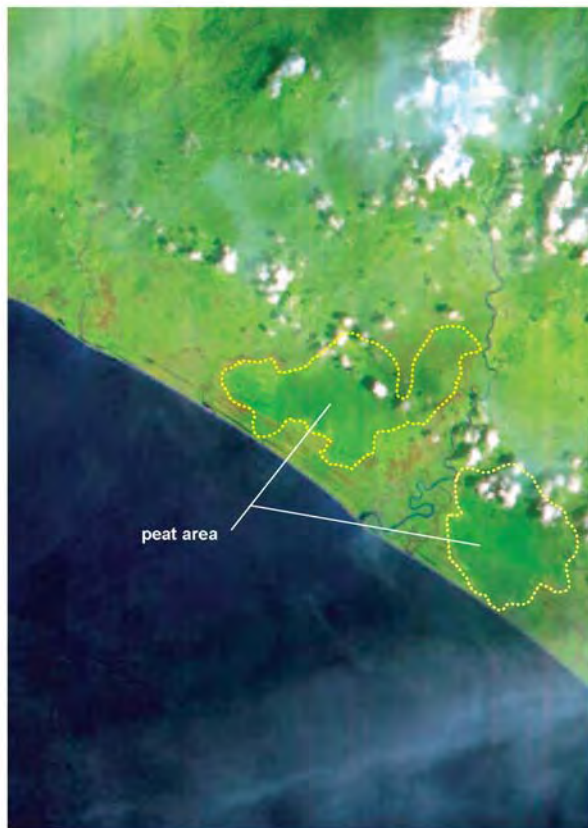
Image Pair 4: Peatlands. This depicts a section of the west coast of Aceh near the town of Keudeteunom about 40km north of Meulaboh. Two large areas of peat swamp forest (circled in yellow) are seen either side of the Teunom River. According Wahyuunto et al (2003) these peatlands are between 1-4metres deep and are roughly dome shaped with the centres deeper/higher elevation than the edges. The post tsunami image indicates that the wave inundated the edge of the peat – but because of its domed shape did not penetrate very far into the centre and so in this are the wave moved much less far in land compared to adjacent areas.

Coastal peatlands play an important hydrological function. Peat soil is 90% water and a peatland thus acts as a large freshwater reservoir. It also plays a role in ensuring that the flow of surface an sub-surface water is towards the sea and so naturally flushes out sea water. Since the majority of these peat areas seem to be intact they may be an important source of fresh water for surviving community members and may help in the rehabilitation of adjacent areas – provided that they are maintained intact and not cleared, drained or burnt for agricultural or other purposes.

COAST OF WESTERN ACEH

8 DEC 2004

29 DEC 2004



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Image Pair 5: Lagoon Formation. These images are along the coast immediately north of image 4 to the south of the town of Calang. Prior to the Tsunami, the left hand image shows that there were extensive rice fields adjacent to the river as well as other agricultural lands and degraded forest. There are small lagoons among sand dunes running parallel to the coast. Three weeks later following the tsunami the rice fields have all be stripped bare revealing a network of drainage channels implying that these areas were formerly freshwater swamp forests. The two coastal lagoons have been dramatically enlarged especially the one to the south of the river channel and new mouths have been established for the river and the lagoons.

With these dramatic changes in the landscape it is probably not feasible or advisable for the local communities to return to the growing of rice in this area. It may be more appropriate to explore options for growing mangroves and swamp forest vegetation and developing lagoon fisheries and forms of aquaculture in the new brackish water aquatic environment.

NORTH WEST TIP OF ACEH PROVINCE



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Initial Conclusions and Recommendations

The coast of Aceh is very near to the epicenter of the earthquake which generated the tsunami. The coastline has thus been hit with the full force of the tsunami and as a result has suffered almost unprecedented damage.

Data from the area indicates that the disaster has altered the ecosystems of the coastal areas to such an extent that the current occupation and livelihood base has been affected. As is often the case in these situations, this affects the poorer population disproportionately, as they are directly dependent on the ecosystem e.g., through coastal fisheries.

The tsunami impact at Banda Aceh has totally destroyed all of the fish ponds which are now part of the open sea and seriously damaged the remaining mangroves. Given the loss of the protecting sand spit it is not feasible to recreate fish ponds in these areas. However it may be appropriate that the mangroves could be restored to create habitat for coastal fisheries, livelihood options as well as act as a barrier against future storms or waves.

The section of coastline which has been totally scoured by the force of the tsunami has totally changed in character and may hold few immediate options of rehabilitation or use. Detailed field assessments will be needed in these areas.

Further south along the west coast of Aceh the damage to the coastal strip is very severe with beaches disappearing, new lakes and lagoons being created and most of the vegetation being washed away. Serious changes in the salinity and landform have taken place which may require radical changes in the land use strategy. It is suggested that options of use of the new brackish water lagoons for fisheries, and aquaculture may be appropriate following establishment of mangroves and other appropriate vegetation.

Further south the peatlands seemed to have played a role in limiting the inland flow of the tsunami wave. If they can be protected they may provide an important resource of water supply for the remaining communities as well as helping in the longer term rehabilitation of the landscape. Care needs to be taken to maintain their integrity and prevent their degradation during the current "survival period" of the local community.

Rehabilitation and long-term local development will need to incorporate effective protection of the coastal zones, sustainable natural resource management and improved protection against future floods. It will be crucial from the very start that rehabilitation and reconstruction work in the damaged area to draw upon practical knowledge and information on: a) the consequences of ecological change on local livelihoods (e.g. fishing) and the rehabilitation possibilities in this regard, b) the potential role of mangrove forests, peat swamps and other natural ecosystems in the economic and physical rehabilitation and reconstruction of the affected areas and c) local development possibilities in terms of natural resource management.

It is very clear that further work will be required to assess in detail the situation of these ecosystems on the ground and develop strategies where the future protection and rehabilitation of the ecosystems can be integrated with the recovery efforts for the local communities.

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