

Learning from Cyclone Nargis

Investing in the environment for
livelihoods and disaster risk reduction

A Case Study



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Cover photo: Tropical Cyclone Nargis makes landfall in Myanmar, 2 May 2008, Source: NASA

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Acronyms and abbreviations

ASEAN	Association of Southeast Asian Nations
CBO	community-based organization
DFID	United Kingdom's Department for International Development
DRR	disaster risk reduction
FAO	Food and Agriculture Organization of the UN
FREDA	Forest Resource Environment Development and Conservation Association
ha	hectare(s)
JICA	Japan International Cooperation Agency
km	kilometre(s)
MAPDRR	Myanmar Action Plan for Disaster Risk Reduction
MIMU	Myanmar Information Management Unit
NAPA	National Action Plan for Adaptation
NCEA	National Commission for Environmental Affairs
NDPCC	Natural Disaster Preparedness Central Committee
NGO	non-governmental organization
PONJA	Post-Nargis Joint Assessment
PONREPP	Post-Nargis Recovery and Preparedness Plan
TCG	Tripartite Core Group
UN	United Nations
WASH	Water, sanitation and hygiene

Executive summary

Cyclone Nargis struck Myanmar on 2 and 3 May 2008, making landfall in Ayeyarwady Division, approximately 250 kilometres (km) southwest of Yangon. A category 3 cyclone, Nargis affected more than 50 townships, mainly in Yangon and Ayeyarwady Divisions, including Yangon, the country's largest city. Strong winds and heavy rain caused the greatest damage in the Ayeyarwady Delta, where a storm surge compounded the impact of the cyclone. Nargis was the worst natural disaster in the history of Myanmar. More than 140,000 people were killed, mainly by the storm surge.

Cyclone Nargis caused devastating damage to the environment of the Ayeyarwady and Yangon Divisions, an area where local livelihoods are heavily reliant on the natural resource base. Cyclone Nargis destroyed 38,000 hectares (ha) of natural and replanted mangroves, submerged over 63 percent of paddy fields and damaged 43 percent of freshwater ponds.

The cyclone's impacts were exacerbated by earlier damage to the environment, including deforestation and degradation of mangroves, over-exploitation of natural resources such as fisheries, and soil erosion. For example, the heavy loss of life as a result of the storm surge was primarily due to prior loss of about 75 percent of the original mangrove cover in the Delta, which could have served as a buffer against the storm surge. The deterioration of the natural resource base, in effect, reduced people's resilience against the

impacts of Nargis. The damage caused by the cyclone in the Ayeyarwady and Yangon Divisions poses a major challenge for recovery efforts that are striving to achieve sustainable development in the region.

Experiences from Cyclone Nargis clearly demonstrate the vicious circle in which pre-existing environmental degradation increased vulnerability, turning a natural hazard into a major disaster. The disaster resulted in further environmental damage, jeopardizing the sustainability of livelihoods and ecosystem functions. The root cause of environmental degradation in the Ayeyarwady Delta is poverty.

Unless remedial action is taken to restore livelihoods, the impacts of Cyclone Nargis will likely increase poverty as communities have little in reserve to cope with the disaster. One key lesson from Nargis is that developing more sustainable livelihoods can not be achieved by focusing solely on natural resource management interventions. Ensuring sustainability will require a coherent and integrated approach across a number of sectors, including livelihoods and food security; shelter; education and training; water, sanitation and hygiene; disaster risk reduction (DRR); and protection of vulnerable groups. At the same time, these sectoral approaches will need to be augmented by capacity-building and institutional strengthening for national and local governments as well as civil society, an enabling framework at the national level to provide laws and policies that support sustainable development, and a reliable information base on the environment.

1 Introduction

Myanmar is the largest country in mainland Southeast Asia with a total land area of 676,578 square km (261,228 square miles) and a population of 51.5 million. Its long coastline of about 2,000 km covers almost the entire east coast of the Bay of Bengal. As a country prone to heavy rainfall, floods occur regularly during the mid-monsoon period (June to August) in areas traversed by rivers or large streams. The country is also prone to cyclones, landslides, earthquakes, tsunami, fire and drought.

Nargis, a category 3 cyclone, struck Myanmar on 2 and 3 May 2008, making landfall in the Ayeyarwady Division, approximately 250 km (155 miles) southwest of Yangon. The cyclone affected more than 50 townships, mainly in Yangon and Ayeyarwady Divisions, including Yangon, the country's largest city and most important commercial centre. With wind speeds of up to 200 km per hour (124 miles/hour) and accompanied by heavy rain, the cyclone caused the greatest damage in the Ayeyarwady Delta region. The effects of extreme winds in this area were compounded by a 3.6 m (12 foot) storm surge. Nargis was the worst natural disaster in the history of Myanmar, and the most devastating cyclone to strike Asia since 1991. More than 140,000 people were killed, mainly by the storm surge.

Nargis also had a devastating impact on the environment of the Ayeyarwady and Yangon Divisions, an area where the livelihoods of the majority of the population remain heavily dependent on natural resources. It destroyed 38,000 ha (93,900 acres) of natural and replanted mangroves, submerging over 63 percent of paddy fields and damaging 43 percent of freshwater ponds.

The impact of the cyclone was exacerbated by pre-existing environmental degradation in this

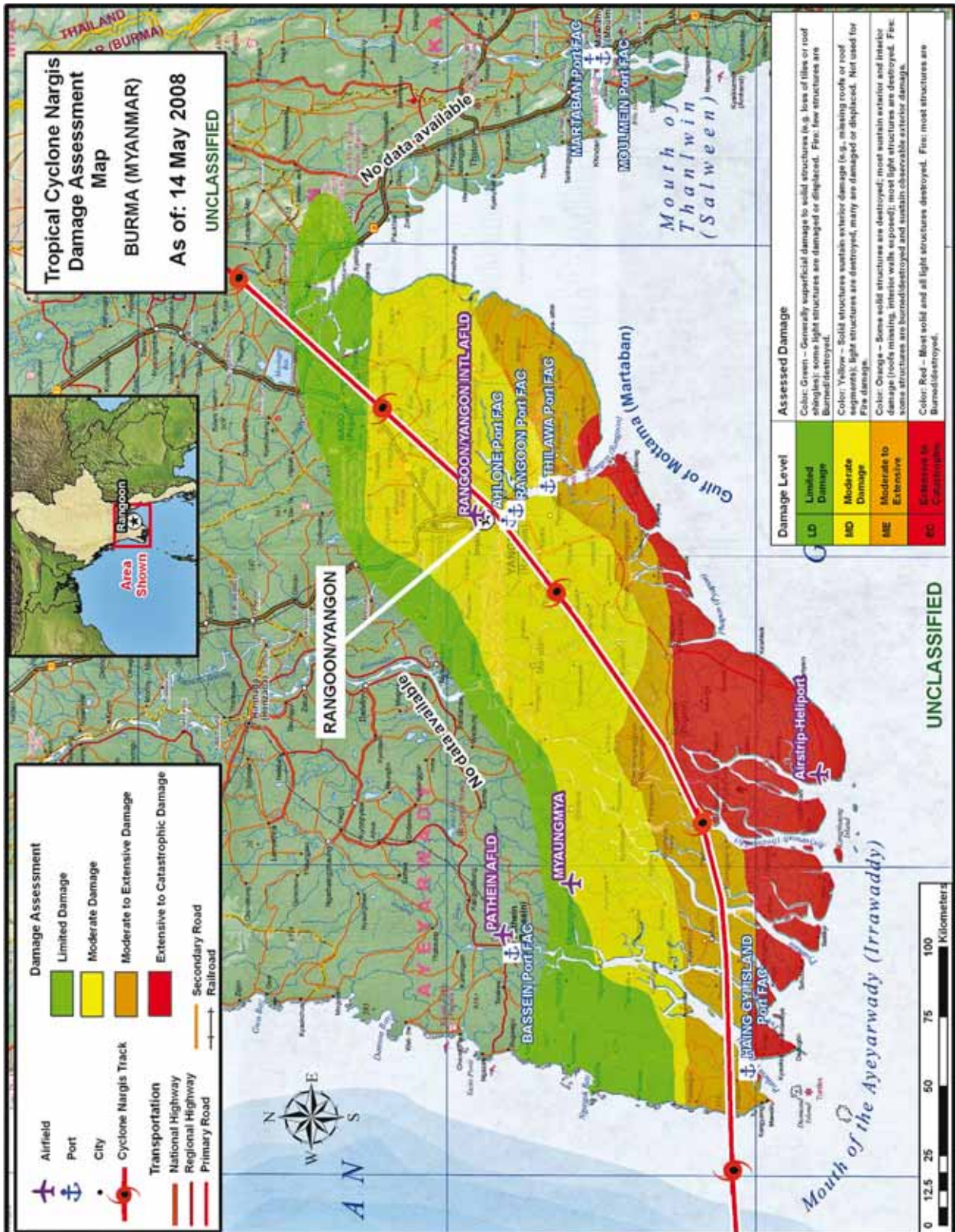
region, including deforestation particularly of mangroves, over-exploitation of natural resources and soil erosion. The extent of damage in the Ayeyarwady and Yangon Divisions has posed a major challenge to recovery efforts that strive to achieve sustainable development for the region.

In the aftermath of the cyclone, a Tripartite Core Group (TCG), consisting of the Government of the Union of Myanmar, the Association of Southeast Asian Nations (ASEAN) and the United Nations (UN), was set up to coordinate relief efforts. One of its first tasks was to conduct a Post-Nargis Joint Assessment (PONJA) to determine the full scale of the impact of the cyclone and requirements for both immediate humanitarian assistance and medium- to long-term recovery. The PONJA report recognized the key role of the environment in sustaining livelihoods in the Delta and concluded that recovery and long-term development efforts must be founded on sustainable management of the natural resource base.

The catastrophic impact of Cyclone Nargis clearly demonstrated that underlying risk factors, in this case pre-existing resource degradation that is closely linked to poverty, increase people's vulnerability to natural hazards – turning hazards into a major disaster. Nargis has contributed to the additional deterioration of the environment, which in turn jeopardizes the viability of local ecosystems and livelihoods.

This case study analyses the root causes of environmental degradation in the Ayeyarwady Delta and illustrates the inter-relationship between environmental management, livelihoods and disasters. Key lessons from Cyclone Nargis are drawn out, highlighting the importance of addressing disaster risks over the long term, through improved environmental governance and resource management and the development of more sustainable livelihoods.

Map: Cyclone Nargis caused major destruction as it passed through the Ayeyarwady Delta and Yangon Division



Source: Myanmar Information Management Unit (MIMU), Office of the UN Resident Coordinator, Myanmar

2 Extent of impact from Cyclone Nargis

Nargis had a devastating impact in the Ayeyarwady Delta due to the heavy dependence of households on the natural environment as a source of livelihood and food security. Environment-related issues emerging from the consequences of Nargis can be summarised into three broad areas: (i) impact on natural resources and biodiversity, (ii) impact on livelihoods and basic needs, and (iii) increased vulnerability to natural hazards.

2.1 Impact on natural resources and biodiversity

The loss and damage of mangrove forests as a result of Nargis is particularly critical, which affected about 16,800 ha (41,514 acres) of natural forest and 21,000 ha (51,892 acres) of forest plantations.¹ Surveys by Maung Maung Than² indicated significant destruction of mangroves in the direct path of the cyclone and in adjacent areas. Defoliation and damage to branches ranged from 38.9 to 55.6 percent and damage to crowns was between 12.8 and 19.8 percent. Uprooting of trees was notably higher in the direct path of the storm (56.7 percent) than elsewhere (4.2 percent).³

In addition, the author carried out surveys of mangrove plantations consisting of six to nine year old trees to examine how different mangrove species were affected by the cyclone. His conclusion was that three mangrove species – *Rhizophora apiculata*, *Sonneratia apetala* and *Avicennia officinalis* – were more susceptible to storm damage than three others – *Bruguiera sexangula*, *Avicennia marina* and *Heritiera fomes*.

The loss of both natural and plantation trees has significant implications for the environment and livelihoods in the Ayeyarwady Delta. Mangroves are an important source of subsistence and income for local communities, particularly for landless labourers, through the collection of firewood, production of charcoal, and the harvesting of fisheries as well as material for shelter (Box 1). They also serve as natural barriers to surges and floods and as fish breeding grounds. The maintenance of these different values (economic, social, biodiversity conservation) is therefore critical to supporting livelihoods, reducing disaster risks and increasing resilience through an improved ability for post-disaster recovery.

High winds associated with Cyclone Nargis as well as the storm surge also resulted in damage to trees other than mangroves, such as nipa palm (*Nypa fruticans*), toddy palm (*Borassus flabellifer*) and



Destruction of mangroves on the Meinmahla Kyun Island Reserve Forest

SOURCE: DEPARTMENT OF FORESTS, MINISTRY OF FORESTRY, MYANMAR



SOURCE: DEPARTMENT OF FORESTS, MINISTRY OF FORESTRY, MYANMAR

Intact mangroves on Meinmahla Kyun Island Reserve Forest

Box 1. Mangroves as a natural defence against the impacts of Cyclone Nargis

There is much anecdotal evidence regarding the role of mangroves in providing refuge from the cyclone's impacts and in protecting lives. According to one source⁴, "Interviews [with villagers] revealed that mangrove forests played a crucial role in protecting human lives and property. Survival rates were higher in villages surrounded by mangrove vegetation than in villages without forest cover. Most villagers indicated that they saved themselves from tidal waves by hanging in mangrove trees, especially *Avicennia* trees, overnight. In many cases, people were swept for a few kilometers by the tidal surge until they grabbed hold of mangrove vegetation. The interviews also suggested that local people think that where mangroves had been destroyed, the tidal surge was able to penetrate far inland and destroy homes, inundate farmland, and wash people away."

Other examples of the importance of mangroves for communities in the Delta include:

- In Kan Bala Tabin village in the Labutta township, where villagers planted and maintained 380 ha (940 acres) of mangroves, seven out of the 300 inhabitants were killed by the storm surge. The low mortality rate was attributed to the presence of mangrove plantations (*Personal communication, U Htun paw Oo, FAO, Myanmar, April 2009*).
- In Nga Pwe Tan, a forest village where villagers worked as forest labourers on *Avicennia officinalis* mangrove plantations, was in the direct path of Cyclone Nargis. An estimated 200 people, or two-thirds of the village's inhabitants, sought protection in mangroves and survived the impact (*Personal communication, U Htun paw Oo, FAO, Myanmar, April 2009*).
- In Gwe Chaung, villagers reported that *Avicennia officinalis* mangroves provided effective cover, with eight to ten people finding shelter under one tree (*Personal communication, U Htun paw Oo, FAO, Myanmar, April 2009*).



SOURCE: DEPARTMENT OF FORESTS, MINISTRY OF FORESTRY, MYANMAR

A crocodile on Meinmahla Kyun Island Reserve Forest, an example of its rich biodiversity

bamboo, which are used by communities for timber and thatching. The cyclone's impact exacerbated the already degraded forest cover, leading to further destruction of many of these trees.

In addition to affecting forest resources, Nargis caused damage to wetland and coastal ecosystems, many of which provide important habitats for wildlife such as birds and crocodiles.⁵ For example, the estuarine island of Meinmahla Kyun in the Ayeyarwady Delta is a reserved forest and a wildlife sanctuary, and hosts a number of reptile species including the estuarine crocodile *Crocodylus porosus*, mammals such as *Panthera tigris*, *P. pardus*, *Cuon alpinus*, *Lutra* sp and *Elephas maximus*, as well as resident and migratory birds.⁶

However, it is unclear to what extent the flora and fauna in the Ayeyarwady Delta has been impacted, since reliable baseline information prior to Nargis is limited. According to one government survey in 2002, the region had a rich biodiversity.⁷ Flora included 53 families and 143 species of plants, including 26 native herbal and medicinal plants. The fauna included 44 families and 93 species of birds, 12 families and 19 species of mammals, and five families and eight species of reptiles. There is clearly a need to assess the current status of biodiversity following the impact of Cyclone Nargis.

2.2 Impact on livelihoods and basic needs

The environmental damage caused by Nargis in turn has had adverse effects on local livelihoods. The storm surge resulted in salinisation of agricultural lands and increased soil erosion and degradation, leading to production losses. Food security has therefore become a major problem for the survivors, who have increasingly turned to subsistence fisheries, especially during the early recovery phase. The sustainability of local fisheries is therefore a key issue.

The storm surge also contaminated groundwater sources, affecting the quality and safety of drinking water. Salinisation of groundwater has aggravated prevailing problems in water supply due to ingress by seawater as a result of climate change-induced rise in sea levels (discussed further in Section 3).

Moreover, Nargis caused heavy destruction of dwellings in affected areas, destroying 57 percent of houses and damaging another 31 percent. Because the storm destroyed sources of building materials (i.e. nipa palm, Palmyra spp, and bamboo), recovery efforts have therefore been hampered, and wood for rebuilding shelters has had to be sourced from outside the Ayeyarwady Delta.



SOURCE: OFFICE OF THE UN RESIDENT COORDINATOR, MYANMAR

Cyclone Nargis destroyed livelihoods and homes in the Ayeyarwady Delta



SOURCE: OFFICE OF THE UN RESIDENT COORDINATOR, MYANMAR, PHOTO TAKEN BY UNICEF

Post-Nargis contamination of drinking water sources necessitated potable water to be transported into the Ayeyarwady Delta

2.3 Increased vulnerability to natural hazards

The devastating impacts of Cyclone Nargis on the environment and livelihood base of local communities have increased people's vulnerability to future natural hazards. Deforestation and forest degradation as a result of Nargis, salinisation of groundwater and agricultural lands, and the loss of property pose major challenges to recovery efforts. Loss of income from natural resources as well as building materials for shelter signify that capacities of local communities to cope with and respond to the cyclone's impacts are

significantly compromised, which makes them more vulnerable to future disasters.

This increased vulnerability to natural hazards is compounded by underlying risk factors which exacerbate disaster impacts. These risks are driven by the prevailing environmental degradation in the region. Inadequate environmental governance both at the national and sub-national levels further contribute to poor resource management practices. In addition, climate change has the potential to increase disaster vulnerability in the region, as a result of rising sea levels as well as increased frequency and magnitude of natural hazards. The next section elaborates on these issues.

3 Natural resource management and environmental degradation in the Ayeyarwady and Yangon Divisions prior to Cyclone Nargis

The areas affected by Cyclone Nargis, in particular the Ayeyarwady and Yangon Divisions and especially the Ayeyarwady Delta, illustrate the interdependent linkages between the environment, livelihoods and disaster vulnerability. The driving forces of environmental degradation in the Delta and in the Yangon Division are closely related to people's livelihoods and their natural resource management practices as well as the way in which government policies are implemented.

Poverty is the root cause of environmental degradation in Nargis-affected areas. The limited ability of local people to appropriately manage their natural resources is motivated by their struggle for survival in what has become an increasingly over-exploited environment. This is a classic example of the **poverty–environment nexus**. The vicious circle of unsustainable natural resource management results in environmental degradation, forcing households to over-extract resources just to meet daily subsistence needs. This leads to a downward spiral of dwindling resources,

jeopardising food security and livelihoods. This phenomenon reflects the current state of the environment in the Ayeyarwady Delta as well as in parts of Yangon Division.

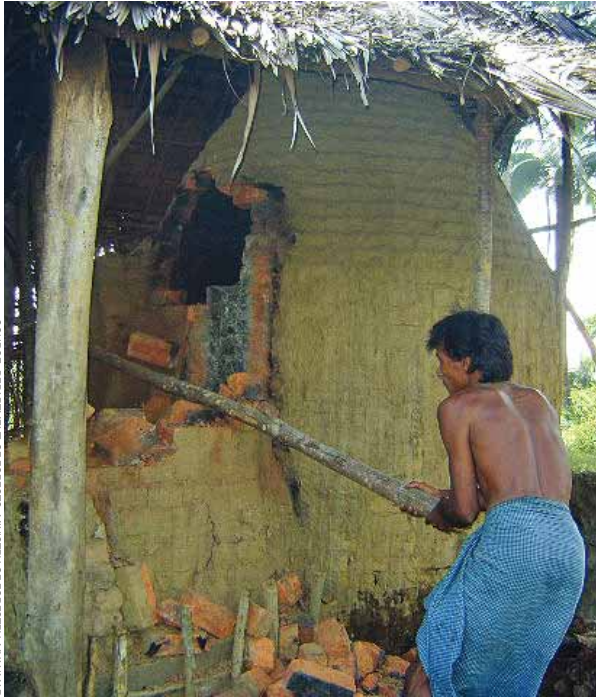
3.1 Natural resource management in the region

While the sources of income for those households with land tenure remain diverse, people's livelihoods rely mainly on the natural environment. Sources of employment include crop farming (mainly paddy rice cultivation), livestock raising, horticulture (mostly fruit trees), paid agricultural labour, fishing (fishponds, shrimp farms, inland and offshore fisheries), small and medium-scale agricultural and fish processing, small-scale forestry activities (firewood, charcoal and timber) and salt production. Some income is derived from commerce and small-scale local trade, but this income is also indirectly reliant on the environment as it relies on servicing those households whose livelihoods are resource-dependent. Landless labourers, on the other hand, derive their income from various sources which are also environment-based, including casual and seasonal labour in agriculture, salt farms, rice mills, fisheries and aquaculture, and fish processing.



SOURCE: OFFICE OF THE UN RESIDENT COORDINATOR, MYANMAR

Rice cultivation is a major source of livelihood in Myanmar



SOURCE: DEPARTMENT OF FORESTRY, MINISTRY OF FORESTRY, MYANMAR

Charcoal kiln in Bogale District: The use of timber for charcoal production is one of the main causes of mangrove deforestation in the Ayeyarwady Delta

Low-input and unsustainable farming practices

Although the Ayeyarwady Delta is known as the “rice bowl of Myanmar”, rice yields have not improved significantly over the last decade, averaging around 3.1 to 3.3 tonnes per hectare.¹¹ In the early 1990s, the main increase in rice production was due to the expansion of land under cultivation, which increased by about 25 percent between 1990 and 1994.

Although the introduction of modern high-yielding varieties in the 1980s initially led to improved yields, crop production has stagnated in recent years,¹² as technical inputs such as fertilizers and improved farming practices have failed to keep up. As reported by the International Rice Research Institute, “Modern varieties are cultivated widely with very little application of chemical fertilizers, contributing to a decline in soil fertility.”¹³

Low-input agriculture is mainly a result of poverty. Farmers do not have the financial resources to acquire inputs (fertilizers and pesticides) needed to make the best use of modern rice varieties and sustain yields. In parts of the Ayeyarwady Delta, land degradation and declining soil fertility due to exploitative farming practices have also contributed to decreasing agricultural yields. As a result, in order to maintain agricultural incomes and food production, farmers have resorted to cultivating even more land. For instance, in coastal areas, converting mangroves areas to rice farms has resulted in seawater encroachment and salinisation of soils, providing a source of income for only a short period of time before yields drop below economic levels. In parts of the Labutta township, for example, farmers have abandoned paddy fields or converted land to salt farms.¹⁴

Lack of awareness and knowledge

Communities lack awareness and knowledge about the importance of sound natural resource management practices, essential for ensuring the sustainability of their livelihoods. Prior to Cyclone Nargis, most communities in the Ayeyarwady Delta had little or no access to training or awareness-raising activities on sustainable resource management. Government extension services in forestry, agriculture and fisheries remained insufficient, as there was a serious lack of human and financial resources. The

The traditional role of women in income generation includes small-scale trade, shopkeeping, fish processing and crafts. They also play a key role in subsistence agricultural and fishing activities and maintaining food security for their household. Women, however, have less control over resources than men.⁸

In addition to providing a source of income and employment, natural resources in the region enable communities to meet other household needs. Forest resources, for instance, are used for building shelter, including thatching materials, and for cooking fuel.⁹ In addition, the entire population depends on either home gardens, backyard animal husbandry (poultry, pigs and goats) or subsistence fisheries to supplement household food sources.

Despite having a range of livelihood opportunities, the overwhelming majority of the people in Nargis-affected areas live from harvest to harvest, sometimes relying on loans from moneylenders to tide them over to the next season.¹⁰ This is a fact of life for the 50 percent of households in the Ayeyarwady Delta with rights to use paddy land as well as for the 20 percent of the population who derive their main income from fishing and the remaining 30 percent of landless labourers.

shortage of civil society organizations also meant that very few non-governmental organizations (NGOs)¹⁵ were available to fill the gap in capacity-building needs.

Limited community awareness is compounded by poverty and the lack of alternative livelihoods, which are driving causes of the over-exploitation of forest resources, fisheries and agricultural land. One positive outcome of Cyclone Nargis is that NGOs now have access to donor funding and technical assistance that will enable them to provide capacity-building activities to improve resource management practices (discussed further in Section 5).¹⁶

Uncertainty over land tenure or land use rights

In Myanmar, the government owns the land and leases it to individuals. In many cases, the initial lease is to wealthy individuals on a 99-year lease. They in turn sub-lease the land on a short-term basis (for a year up to a few years) to individual farmers who then grow crops such as rice. A similar situation applies in the fisheries sector. Fishing licences are granted to wealthier individuals, who then sub-lease (frequently through several "layers" of sub-leases) to the individual fisher on short-term leases, which often run from season to season.

One serious consequence of land tenure insecurity is that farmers and fishers have little motivation to think about long-term implications of how they manage their land or their fisheries. This uncertainty is a major disincentive to invest in more environmentally sustainable land use practices that may be costly and only yield benefits over an extended time period. It also discourages enterprise investment, such as in the aquaculture sector.

In addition to land tenure issues, there has been significant illegal encroachment on reserved forests and harvesting of mangroves for fuelwood and charcoal in protected areas. This has been due mainly to the common perception that protected areas belong to the government rather than to the community as a whole, thus leading to the lack of ownership by communities and to over-exploitation.

By contrast, experiences of NGOs in community forestry demonstrate that communities are more likely to apply sustainable practices if they are

given clear responsibility over forest management. For instance, the NGO FREDA has been able to employ the government's 1995 Forest Instructions and obtain long-term forest leases for communities for up to 30 years to rehabilitate mangroves in 23 villages.¹⁷ However, in general local communities as well as local administration personnel remain unaware of these opportunities. The government is beginning to recognize this problem. In its post-Nargis recovery plans, the government makes use of the Forestry Instructions for the rehabilitation of mangrove forests (see Section 4).

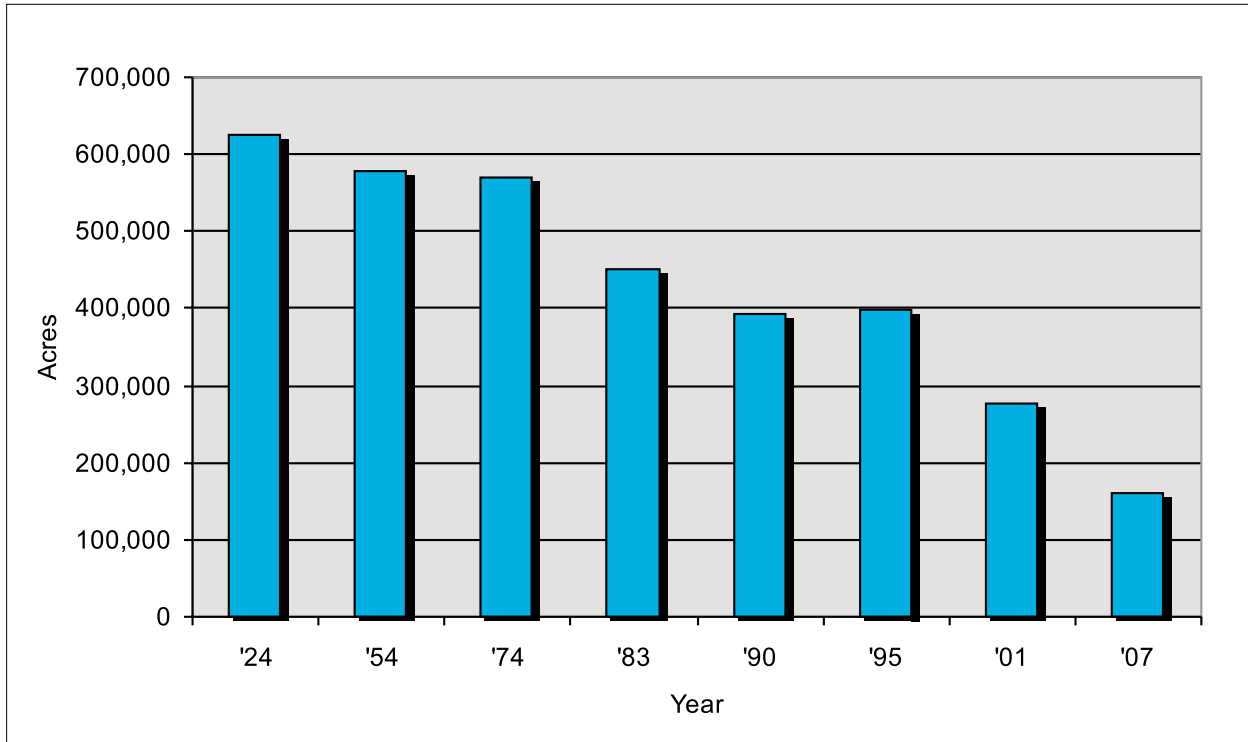
3.2 Extent of environmental degradation

Poverty, unsustainable land use, lack of knowledge and awareness of improved resource management techniques, as well as land tenure insecurity have all contributed to widespread environmental degradation which prevailed even before the impact of Nargis. The serious deterioration of natural resources in the Ayeyarwady and Yangon Divisions have subsequently imposed a limitation on local livelihoods and development, which has contributed to increasing disaster risks. The fragility of ecosystems in Nargis-affected areas means that communities lost a significant portion of their remaining natural capital as a result of the cyclone,¹⁸ thus further compromising people's capacities to effectively recover from this major disaster. The high level of poverty in the area signifies that most households had little or no economic capital in reserve to cope with the cyclone's aftermath.

Deforestation and over-exploitation of forest resources

The destruction of mangrove forests is an illustrative example of how the loss of this valuable resource has deprived communities from maximising their potential environmental, economic and risk reduction benefits. Over the last 80 years, nearly 75 percent of mangroves in the Ayeyarwady Delta have been lost, mainly as a result of human activities (see Figure 1).¹⁹ The data show that from a peak of about 260,000 ha (625,222 acres) in 1924, mangrove forests had declined to 67,000 ha (160,930 acres) by 2007. Nearly half of the decrease in mangroves has taken place over the last 15 years, and especially after 2001.

Figure 1. Mangrove areas in the Ayeyarwady delta



The main reason for mangrove deforestation is the harvesting of timber for firewood and charcoal for home consumption as well as income generation. Other driving factors include conversion to paddy fields, salt farms, shrimp ponds and settlement areas.²⁰ Mangrove deforestation has taken place in communal lands and land leased by individuals from the government,²¹ as well as in reserved and protected forests.

The loss of mangroves means that these natural habitats which serve as breeding grounds for a number of fish species can no longer provide communities with a sustainable source of income. Moreover, the reduction in fish catches has also impaired food security.²² In addition to their socio-economic benefits, mangroves play an essential role in coastal protection (Box 2)²³. Their loss has not only undermined livelihood sustainability in the Delta but also aggravated the catastrophic impact caused by Cyclone Nargis.

Deforestation of other forest resources other than mangroves has become a common practice in Nargis-affected areas.²⁴ Trees are cleared for other income-generating activities such as farming or for direct use (i.e. firewood/charcoal, building materials, fence posts, boats, and thatching for houses). For example, nipa palms (*Nypa fruticans*)

Box 2. Risk reduction values of mangroves

As stated in Maung Maung Than (2008: 32), “Many studies have highlighted that mangroves, along with beach and dune forests, help protect the coastline from erosion, storm damage and wave action, by acting as buffers and trapping alluvial sediments. The degree of protection offered by coastal forests depends on many factors related to the characteristics of the hazard, the site and the state of the forest. Mangrove forests have proven to be the most effective barriers to natural hazards resulting from storms and [smaller-scale] tsunamis.”

along riversides are over-harvested for thatching, while Palmyra spp on riverbanks and around paddy fields are utilised for both thatching and timber. Moreover, households with access to land generally encroach on adjoining forested lands (including mangroves) in order to raise production yields by expanding paddy fields. Forest cover loss in this region has consequently reduced natural protection against high winds and tidal surges as well as the availability of forest products.

Over harvesting of fisheries

Over-extraction of fishing resources, for both subsistence and commercial production, is threatening the sustainability of this very important source of income and food security for the people of the Ayeyarwady Delta.²⁵ As a result, it has decreased the resilience of communities to cope with and recover from disasters.²⁶ Loss of mangrove forests has adversely impacted the breeding grounds of economically-productive fish species, further reducing yields and exerting pressure on resources that are already under stress.

Salinisation and salt farms

Although salt farming has long been a traditional income-generating activity in the Ayeyarwady Delta, the number of salt farms has grown. This trend can be attributed to the decline in farming and fishing income as well as to land salinisation in some coastal areas, which takes more land out of food production. Salt farming is both a consequence and a cause of environmental degradation.

Erosion of river embankments

Prior to Nargis, gradual erosion of river embankments has been occurring over the last 30 years, resulting in the partial loss of structures that were constructed or fortified during the Paddy I and Paddy II projects in the 1970s and 1980s respectively. These embankments were constructed with assistance from the World Bank in order to protect existing cultivated areas from floods and saline-water inundation and to reclaim abandoned paddy land.²⁷ Nargis caused significant additional damage to these embankments.²⁸ Substantial investment will be required to repair the damage and provide continued protection from both tidal surges and increased salinisation due to sea-level rise.

Climate change as an emerging threat

Climate change is another growing threat to natural resources which people depend on for their livelihoods. Prior to Nargis, incremental changes to the local environment, in terms of the salinisation of soils due to seawater rise, had

already been observed. As a result of increased salinity in soils, villagers converted areas that were no longer viable for rice production into salt farms, which has implications for household food production and security.

Moreover, a recurring problem in recent years has been the contamination of groundwater sources (e.g. ponds and wells) during the dry season.²⁹ Due to the salinisation of groundwater, which is an important source of drinking water, villages in the Delta have increasingly resorted to importing fresh water from other villages.³⁰ Limited access to drinking water is now a common problem in many of the coastal villages of Labutta and Bogale townships,³¹ especially during the dry season (from November to May). Given limited household incomes for purchasing potable water, there is added pressure to generate cash which can only be sourced by further eroding the natural resource base.

In addition, the region is increasingly vulnerable to the greater incidence and scale of hazardous events, such as cyclones and prolonged droughts, as a result of climate change. There are also indications that patterns of storm paths may be changing. For example, of the 11 tropical storms to hit Myanmar over the last 60 years, only two made landfall in the Delta, and both of them in recent times: Cyclone Mala in 2006 and Cyclone Nargis in 2008. The increased vulnerability to severe storms is likely to be a consequence of climate change.³²

Climate change not only heightens disaster risks but also reduces local resilience to disaster impacts by degrading water and soil resources and diminishing agricultural production. As a result, climate change will likely aggravate existing vulnerabilities (i.e. declining natural resources and poverty).³³ A strategic approach to disaster risk reduction (DRR) in the region is therefore needed to minimise future disaster impacts but also build response capacities and resilience.

3.3 Environmental governance

Government policies and their implementation have been a contributing factor to environmental degradation and therefore indirectly to increased disaster vulnerability.

Pursuing development priorities over environmental sustainability

In the past, the government focused on development priorities rather than on natural resource sustainability. Attention was directed towards increasing production by harnessing more land area and building infrastructure such as embankments (e.g. the Paddy I and Paddy II projects in the 1980s), without fully considering environmental impacts.

Established in 1990, the National Commission for Environmental Affairs (NCEA) deals mainly with policies related to multilateral environmental agreements, but has neither the staff nor the resources to provide technical advice and coordinate environmental management across all line agencies. Moreover, it has limited capacity to play a significant role in environmental management at the local level. Although the NCEA has drafted an environment law, it has not yet been enacted. Hence, there are few legislative provisions to ensure that the environment is taken into account in formulating and implementing policies and plans that impact on natural resources.

In the aftermath of Cyclone Nargis, the government has committed to developing and implementing a national disaster preparedness plan.³⁴ This provides opportunities for ensuring that long-term planning addresses both resource management issues as well as other prevailing risk factors in an integrated manner.

Poor implementation and enforcement of laws and policies

Although many laws, regulations and policies at the national level support environmental sustainability, such as the 1995 Forestry Instructions and the Fisheries Legislation, those responsible for their implementation do not fully comprehend the purpose of promoting sustainability nor how to apply these instruments in practice. As a result, these directives are often implemented in a rigid manner that does not support the spirit of the law. In addition, there is variable interpretation of these laws, which means that their full implementation remains largely ad hoc and differs from district to district. Similarly, many laws, particularly those

affecting biodiversity and the management of natural resources such as forests, fisheries and land, are poorly enforced. The lack of understanding of these laws and regulations by national and local officials as well as by communities is made worse by inadequate human and financial resources for law enforcement.

Inadequate coordination

Another key factor contributing to environmental degradation is weak coordination between sectoral government agencies at the national and sub-national levels (horizontal coordination). Each sectoral agency develops and implements their own sector-specific policies, without consultation and regard of their impacts on other sectors. This compartmentalization is aggravated by the lack of vertical coordination between different layers of government at national, divisional, district and village levels. National policies tend to apply a blue print approach, which makes it difficult for local authorities to implement the laws and policies effectively in their localities, especially as they strive to meet national targets for rice or timber production.

Lack of technical capacity

Government staff across national line agencies have little or no technical capacity to adequately integrate environmental considerations into their sectoral policies, programmes and plans. This problem also applies at sub-national levels. Local authorities in general have little awareness of how to promote sustainable natural resource management. Moreover, local staff of different line agencies (i.e. agriculture, forestry, etc.) who are charged with implementing their department's sectoral policies are unable to address the environmental aspects of their work. They may have technical knowledge within their own discipline but with limited understanding of the environmental impacts and implications of their advice to farmers and fishers.

Weak land use planning

The National Land Use Commission was established in 1995, with its subordinate regional and community-level land use supervision committees.

The Commission is responsible for reviewing and developing policies on land management.³⁵ In addition, the 1995 Forest Policy highlighted the importance of land use planning and set out policy measures to determine programme strategies and action plans. Although the Forest Department has initiated a number of land use planning activities in the Ayeyarwady Delta, there has been little or no coordination among key stakeholders, especially between relevant government agencies. This has resulted in ineffective land use planning processes in the Delta. Consequently, land use practices remain geared towards income generation regardless of their sustainability and long-term environmental consequences. Instead, decisions are made based on the basis of short-term financial gain. For example, as discussed previously, mangrove forest areas were converted to paddy land, which then experienced creeping salinisation and thus limited rice cropping to just a few harvesting seasons. Once rice yields declined, farmers had to switch to salt farming. Financial gains were therefore short-lived, resulting in the permanent loss of a valuable resource with multiple benefits including ecological, socio-economic, and risk reduction values.

The lack of land-use planning also constrains the ability of local areas to respond effectively to national government targets in the production of agricultural (paddy rice), forestry (timber) and fish products. For example, local authorities presently address national government directives for increased production of rice or timber in their area by expanding areas under paddy cultivation or through deforestation respectively, without any consideration of their environmental impacts. However, if local authorities are able to develop coastal zone management plans or land-use

plans, they could then pursue national production targets through a more rational allocation of their land and water resources which would take into account the environmental consequences of their decisions.

Inadequate information on natural resources

As environmental monitoring and surveillance systems are lacking in Nargis-affected areas, there is limited or no reliable information to inform policy development or decision-making, at both national and local levels. Recovery efforts to address the impacts of Cyclone Nargis have highlighted the information vacuum on environmental conditions in the Ayeyarwady Delta. There is lack of data on forest, land and fishing resources, biodiversity (ecosystems, flora and fauna) as well as water sources including drinking water. Hence, policy development and planning remains seriously hampered from the start, which undermines their effective implementation.

Serious under-investment

There is a major lack of investment in human resources, extension services, agricultural research, information management, as well as in improved farming technology, which could sustainably raise production yields. Local authorities are therefore forced to meet their production quotas by encouraging farmers to extend paddy cultivation on marginal or fragile lands unsuitable for farming. In addition, the lack of investment has resulted in the deterioration of tangible assets. For instance, the erosion of embankments has not only placed agricultural lands under threat of seawater incursion but also increased vulnerability to natural hazards such as floods and storm surges.

4 Post-Nargis recovery and long-term development

The PONJA report officially recognized that pre-existing environmental degradation worsened the impact of Cyclone Nargis on people's livelihoods and the environment.³⁶ In their recovery plans, both the Government of Myanmar and the international community have acknowledged the important role of the environment in building resilience to future disasters as well as in supporting livelihoods and achieving food security. The importance of sound natural resource management is highlighted in recovery plans, which aim towards developing sustainable livelihoods as well as disaster preparedness in the Ayeyarwady and Yangon Divisions. Recovery and reconstruction efforts have paid particular attention to the protection, restoration and enhancement of forests, land and freshwater resources in the region.

4.1 Government of Myanmar's response

In response to the damage caused by Cyclone Nargis, the National Disaster Preparedness Central Committee (NDPCC) issued a "Programme for

Reconstruction of Cyclone Nargis Affected Areas and Implementation Plans for Preparedness and Protection from Future Natural Disasters", which summarizes the recovery plans of sectoral agencies. Sector-specific recovery plans which have cross-cutting impacts on the environment and resource management include:

- housing, with an emphasis on "building back better";
- improving access to safe drinking water for communities;
- restoration of agricultural livelihoods and food security;
- restoration of fisheries;
- rehabilitation of salt fields;
- rehabilitation of forests and mangrove resources; and
- preparedness and protection from future natural hazards.

The Ministry of Forestry's recovery plans, in particular, provide for extensive replanting and rehabilitation of mangrove forests, using a combination of modalities that include protected areas managed by the government, community forestry and private plantations, income-generating activities and capacity-building (Box 3).



Women preparing thatching material to rebuild houses damaged by Cyclone Nargis

Box 3. Recovery plans by the Ministry of Forestry³⁷

Forest restoration activities

Designated already as a wildlife sanctuary, the Meinmahla Reserved Forest will now be fully protected. The Forest Department will implement a five-year plan to restore 12,592 ha (31,115 acres) of damaged mangroves, comprising 2,023 ha (5,000 acres) of gap planting, 8,555 ha (21,140 acres) of natural regeneration and 2,013 ha (4,975 acres) of plantation establishment.

Establishment of disaster prevention zones

Mangrove forests in high risk areas, i.e. those areas exposed to the sea, “will be designated as prevention zones and will be totally protected” as “reserved forests and/or protected public forests”. Reserved forests with extensive mangrove forest cover “will be restored through plantation establishment in degraded areas and tending operations in remaining areas”. With respect to protected areas, there are plans to establish a total of 89,298 ha (220,660 acres) of mangroves and carry out natural regeneration in 47,478 ha (117,320 acres) of the remaining stands that are less than five years old.

Expanding private tree plantations

The Ministry of Forestry’s private tree plantation programme, which began in 2007, suffered major impacts from Cyclone Nargis. Government intends to extend private plantations over the next five years to include an area of 20,987 ha (51,860 acres) and 607 ha (1,500 acres) in the Ayeyarwady and Yangon Divisions respectively.

Promoting community forestry

There are plans to revive forest users’ groups in three townships in order to establish community forests, windbreaks and woodlots totalling about 16,187 ha (40,000 acres) and 364 ha (900 acres) in the Ayeyarwady and Yangon Divisions respectively.

Involving local communities in mangrove planting along riverbanks

The government plans to plant 3,399 ha (8,400 acres) of mangroves along riverbanks in the Ayeyarwady Delta. The Forest Department will work in collaboration with local authorities and encourage people’s participation in planting activities.

Windbreaks

Windbreaks will also be established to protect villages against high winds and tidal surges. It will involve planting trees around settlements, along roads and in woodlots.

Reviving livelihoods of local populations

The plan aims to promote income-generating activities such as cultivating “migyaung kunbut” (*Hygrophila obovata*),³⁸ planting fruit trees, trapping crabs and fattening soft crabs in mangrove forest areas, as well as horticulture and livestock breeding suited to local conditions.

Awareness-raising and extension

The above activities will be supported by capacity-building for local populations to raise awareness on the full range of ecosystem services of mangrove forests and develop improved resource management skills.

4.2 The international community's response

The Post-Nargis Recovery and Preparedness Plan (PONREPP), prepared jointly by the international community and the Government of Myanmar under the auspices of the TCG, sets out a three-year framework to guide recovery efforts following Cyclone Nargis. It provides a platform for transition from emergency relief and early recovery towards a medium-term recovery across eight operational sectors. These cover three themes: productive lives, healthy lives and protected lives.³⁹

Located under the “protected lives” component, the recovery strategy for environment focuses on ensuring sound natural resource management

through strengthened governance systems at the community, township and national levels. Environmental initiatives include capacity-building activities, institutional strengthening, natural resources and biodiversity assessments, strengthening of environmental monitoring and surveillance systems, and support for livelihoods-related schemes based on sustainable management of natural resources.

PONREPP integrates environmental considerations across various sectors including: livelihoods (mangroves, fisheries and restoration of farmers' livelihoods); shelter (safer and more durable shelters); water, sanitation and hygiene (WASH) (access to safe drinking water); and disaster risk reduction.



Relief efforts distributed chemical fertilizers to help affected farmers recover and jump start paddy production

Box 4. Promoting productive lives through forestry⁴⁰

In its December 2008 report,⁴¹ PONREPP outlines its objectives towards rebuilding the forestry sector in the areas affected by Cyclone Nargis: “Improve livelihoods for households heavily dependent on forest resources, and ensure protection and extension of mangrove and other forests based on community-led resource use strategies in the context of coastal zone resource management.”

Planned activities include: “Regenerating natural mangrove forests and mangrove plantations along riverbanks and around villages, as well as replanting village woodlots, [which] will both contribute to livelihoods and reduce future disaster risks.” In addition, “user groups will be encouraged to adopt a community forestry approach that has been successfully tested in other parts of the country. Existing user groups will be assessed during the first year, with lessons learned used to expand the approach in other areas. Technical and vocational training initiatives for mangrove users will enable communities to meet the demand for simple products in local markets. While such a community-based approach to mangrove rehabilitation – usefully combined with community-led sustainable exploitation of inshore and inland fisheries – is necessary in the initial stages, it will also provide a foundation for higher-level comprehensive coastal zone management. A comprehensive coastal zone management concept – linked to community-level resource planning – will be developed and tested in selected areas during the first year, including intensive capacity-building and institutional development. The programme should be fully operational in 2010, and expanded in 2011.”

In addition to PONREPP, other donor-funded activities that are designed to restore the natural resource base (mainly mangroves) and to support livelihoods include:

- **UN Food and Agriculture Organization (FAO):** A project funded by the Italian Government to support small-scale fisheries and aquaculture livelihoods in coastal mangrove ecosystems and pilot community-based livelihood initiatives that will serve as demonstration models for the future.
- **International Tropical Timber Organization:** Assistance to the Government of Myanmar to develop mangrove plantations in reserve forests in three localities in the Ayeyarwady Delta as well as in community-owned forests covering 300 ha (741 acres).
- **Japan International Cooperation Agency (JICA):** Assistance for rehabilitation and replanting of community-owned forests in the Ayeyarwady Delta covering 2,780 ha (6,870 acres) and the establishment of a research plantation of 1,600 ha (3,954 acres) in Bogale township.
- **FREDA:** A national NGO with ongoing projects in 23 villages in Pyapon township, which are implemented on community-managed land in



SOURCE: OFFICE OF THE UN RESIDENT COORDINATOR, MYANMAR

Post-Nargis recovery assistance provided fishing equipment to support livelihoods restoration

cooperation with the Forest Department. The FAO project (above) is likely to provide further assistance to FREDA in their projects.

Most of the donor-funded initiatives described above are undertaken directly by the Forest Department, while some were already in the process of implementation even prior to Cyclone Nargis.

5 Lessons from Cyclone Nargis for the environment, sustainable livelihoods and disaster risk reduction

The aftermath of Cyclone Nargis and the enormous challenges of rebuilding communities illustrate the linkages between the environment, livelihoods and disaster risks. Pre-existing environmental degradation, as a result of inadequate land use and poor resource management, increases the vulnerability of communities, turning a natural hazard into a major disaster and resulting in additional environmental damage (Figure 2).

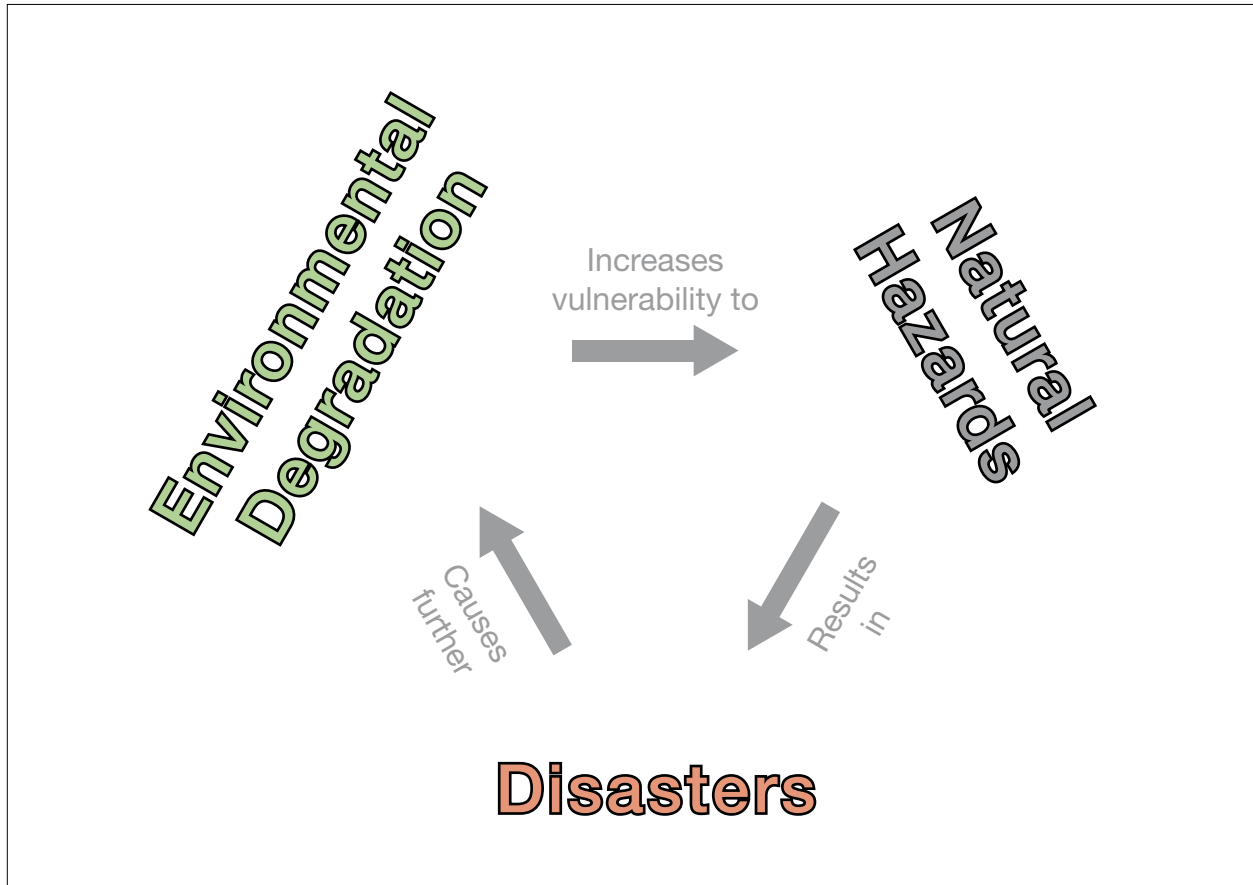
Long-term recovery and development plans must, therefore, recognize the key role of sound natural resource management in attaining sustainable livelihoods as well as in minimising or avoiding the adverse impacts of natural hazards. Lessons learned from Cyclone Nargis point out the necessary conditions for the sustainability of ecosystems and livelihoods as well as for disaster risk reduction, as elaborated below.

Lesson 1: Promoting an integrated approach towards sustainable livelihood development, environmental management and disaster risk reduction

As discussed in this case study, poverty is the root cause of environmental degradation in Nargis-affected areas, which in turn has increased vulnerability to natural hazards. However, protecting the sustainability of ecosystems can only be achieved if local livelihoods and household food security is assured. The poor cannot be expected to have an altruistic attitude towards protecting the environment, without having tangible benefits in return.

Recovery efforts should therefore focus on community-based livelihood initiatives through improved management of natural resources. The government's recovery and reconstruction plans as well as PONREPP emphasise the need to restore livelihoods, which creates a window of opportunity for integrating environmental considerations as part of long-term recovery and development interventions.

Figure 2. The vicious circle of environmental degradation, hazards and disasters



Moreover, as a result of the impacts of Nargis, there is now increased awareness of the need for disaster preparedness and risk reduction. A unique opportunity now exists to integrate DRR into the livelihoods–environmental management equation. It is essential, for example, that DRR planning processes such as the Myanmar Action Plan for Disaster Risk Reduction (MAPDRR) recognize that sustainable livelihoods development and risk reduction should be based on improving natural resource management, particularly in communities that are vulnerable to natural hazards such as those in the Delta.

This integrated approach towards sustainable livelihoods development, natural resource management and DRR should be built into and further enhanced in the government’s post-Nargis recovery and reconstruction plans. These plans should not only focus on the restoration and protection of the environment but also need to ensure sustainable livelihoods and food security for communities in affected areas. More integrated plans will be able to maximize the benefits of allocating government resources in Nargis-affected areas in the future. Similarly, it is equally critical to integrate environmental components across different PONREPP sectors, in particular into the “productive lives” component, since PONREPP will guide the allocation of donor resources to support government initiatives.⁴²

Lesson 2: Developing alternative livelihoods

In order to reduce pressures on natural resources, it is necessary to provide communities with alternative but viable sources of household income, food security and fuel. For instance, as shown in the case study, mangrove deforestation is mainly due to agricultural expansion as well as servicing household needs and income-generating activities (i.e. firewood and charcoal production). Therefore, development initiatives designed to introduce more sustainable natural resource management practices must also provide alternatives for securing food needs, income and household energy, which do not rely on the over-exploitation of resources. Small-scale efforts in this direction have been undertaken by NGOs such as FREDA.⁴³

Both PONREPP and the government should take a more pro-active role in promoting the use of renewable energy sources for household fuel and small-scale income generation. Alternatives for renewable energy currently being explored include biogas, use of fuel-efficient stoves and solar energy.⁴⁴ Current government plans to supply natural gas from the Andaman Sea to generate electricity for the Ayeyarwady Delta would, for example, reduce the pressure on mangrove forests.



SOURCE: OFFICE OF THE UN RESIDENT COORDINATOR, MYANMAR

Subsistence fisheries which can be combined with paddy rice cultivation could provide an alternative livelihood to communities

In addition, other sources of achieving household food security and income also need to be identified to shift dependency away from rice cultivation. This is currently being pursued by NGOs such as FREDA and Mingalar Myanmar on a small-scale, as well as by funding agencies through their development programmes, i.e. JICA's mangrove project, Pyopin (funded by the United Kingdom's Department for International Development) and the FAO project on mangroves and sustainable small-scale fisheries. Proposed pilot projects as part of PONREPP to be managed by the United Nations Development Programme should also help develop workable models for sustainable resource management and livelihoods which can be replicated in other villages.⁴⁵ It is equally important that the government develops alternative socio-economic opportunities for communities as part of their long-term plans for forestry and agricultural development in Nargis-affected areas.

Lesson 3: Establishing an enabling policy and legal environment

(i) Formulating and implementing policies and laws that promote environment and livelihoods

National government agencies, including the National Commission for Environmental Affairs (NCEA), need to ensure that their policies and programmes support environmentally sustainable development. There is an equal need to enforce policy and legal frameworks as intended by the government and translate these instruments into timely and responsive programme interventions. This will require capacity-building and institutional strengthening of sectoral ministries as well as for the NCEA as the central environmental coordinating body within the government. In particular, it is critical that the government enact the National Environment Law, which would help guide the formulation and implementation of policies to support sustainable development priorities and sound environmental management.

In addition, a national land use policy is needed to provide the overall direction for land use planning in the country, which takes into account environmental and livelihood priorities within the

context of adapting to climate change and reducing disaster risks. This policy would set national priorities for land use, while devolving decision-making powers to local administrations to develop their own specific land use plans which would articulate local needs and priorities within the national framework.

(ii) Improving coordination in the implementation of government policies

Effective implementation of government policies will require improving cross-sectoral coordination in order to balance development and environmental priorities. Increased collaboration across sectoral ministries and agencies (horizontal coordination) as well as between different levels of government (vertical coordination) is needed to ensure a coordinated approach to policy implementation. This would achieve the coherence necessary for implementing an integrated approach to environmentally sustainable development.

(iii) Enhancing community access and control of natural resources

Farmers and fishers must have long-term use rights over their natural resources in order to provide them with incentives to manage these resources in a sustainable manner. This is possible within the spirit of Myanmar's land tenure and fisheries licensing laws. In practice, however, the actual implementation of these laws generally does not provide farmers and fishers long-term access and control of land and fisheries. At the same time, there is a need to strengthen community participation in decision-making over the management of natural resources.

Presently, 50 percent of the local population remain landless and require sources of income and food security, especially those that also do not have access to fisheries. Although they earn cash incomes by working as agricultural labourers, it is not sufficient to meet household subsistence needs. Landless farmers need access to alternative livelihood sources, including community forestry schemes and subsistence fisheries, in order to minimise illegal encroachment of reserved or protected forests.

Lesson 4: Raising awareness and building capacity for improved environmental management and risk reduction

Limited awareness and capacity to apply appropriate and sustainable resource management are another important factor driving environmental degradation. This problem has been recognized by the government as well as the international community in Myanmar in their recovery plans. Any initiative to boost livelihoods and provide alternative employment options, therefore, will need to provide capacity-building support.

(i) Community training on sustainable resource management and DRR

Capacity-building on improved environmental management is especially needed at the community level to reduce pressures on resources and boost livelihoods. Training activities will enable people to manage their natural resources in a sustainable manner through better understanding of the linkages between the environment, livelihoods and DRR.

Towards this end, government plans in the forestry, fisheries and agricultural sectors include training for communities in resource management. Capacity-building activities provided by government, however, should be undertaken through collaboration between different ministries and administrative levels to maximise efficiency and effectiveness of trainings.

Capacity-building of communities would be best carried out by community-based organizations (CBOs) and NGOs, because they are trusted by local people and have the necessary on-the-ground knowledge and experience. However, CBOs and NGOs should work closely with extension services of relevant government agencies such as fisheries, forestry and agriculture. It will be important to ensure that trainings are based on a careful assessment of needs and address environmental, livelihoods and DRR priorities in an integrated manner. Capacity-building programmes should be complemented by the preparation of training materials, such as guidelines and manuals, which would be developed based on the experiences of recovery and development projects (whether implemented by NGOs, the government, the UN system or others) in the Ayeyarwady Delta.

(ii) Strengthening capacities of local authorities

Local authorities play a crucial role in implementing policies, laws and regulations to support sustainable development. They are at a level of governance closest to the people; therefore, their active engagement at the township, district and divisional levels in development initiatives is essential in carrying out coherent and responsive disaster preparedness strategies. Local authorities could also contribute effectively to undertaking local environmental assessments and monitoring as well as raising greater public awareness about the environment. Moreover, they can help address resource access issues.

However, local administrations also require training on the implementation of national rules and regulations, particularly those that affect the environment and livelihoods. Trainings would be complemented by the development of guidelines and manuals on how to effectively implement national laws and policies to achieve their intended objectives.

One major area for capacity-building is in developing appropriate, environmentally sustainable local land use plans at both divisional and district levels. To ensure more locally responsive and appropriate land use plans, there is a need to devolve decision-making on the allocation of land based on local contexts and priorities, though working within the framework of national policies. However, allocating greater powers to local authorities must be accompanied by strengthening institutions within local administrations and building capacities of public officials in divisions, townships or districts.

(iii) Strengthening civil society organizations

NGOs and CBOs serve a critical role in capacity-building and support for community-based initiatives. They fulfil an important advocacy role with local authorities and national government, for instance in clarifying land tenure issues and promoting greater community participation in decision-making processes. Increasing in number as a result of post-Nargis recovery efforts, national NGOs are often staffed by retired government officials or individuals from the private sector.

Civil society engagement is officially recognized in both PONREPP⁴⁶ and the government's national recovery and reconstruction plans, particularly in the forestry sector. Funding agencies are increasingly working in partnership with civil society organizations to implement community-based projects that promote sustainable natural resource management. NGOs as well as CBOs, however, need to develop skills in natural resource management, advocacy, mediation and facilitation in order to provide that essential bridge between government and communities.

Lesson 5: Developing a robust information base to guide decision-making

It is essential to recognize the importance of reliable and up-to-date information in helping to formulate and implement policies and programmes for sustainable development and disaster risk reduction. This calls for strengthening systems of assessment and the monitoring of natural resources at village, township, district and divisional levels in Nargis-affected areas. Not only would a reliable data base be useful for national policymakers but also would enable communities and local authorities to better manage their natural resources, for instance through appropriate land use planning or development of coastal zone management plans.

For Nargis-affected areas, monitoring and surveillance of key environmental features and resources (e.g. water, biodiversity, land and forests) will need to be strengthened, particularly with respect to the potential impacts of climate change including incremental environmental changes as well as increased vulnerability to natural hazards.

In addition, a strategic approach to DRR, based on a national vulnerability assessment, should be undertaken to develop effective strategies for climate change adaptation and for reducing future disaster impacts.

Conclusions

Applying the lessons from Cyclone Nargis will require recovery and development efforts to focus on the protection, restoration and enhancement of the environment in Nargis-affected areas, particularly forests, land and freshwater resources. Investing in sound environmental management can provide a more sustainable basis for livelihoods and food security and build resilience to future disasters and climate change.

Rehabilitating and protecting the natural resource base, however, is a cross-sectoral issue and will require a coherent and integrated approach. This will require an enabling framework for policy formulation and implementation that promotes environmentally sustainable development at both national and sub-national levels, specific programmes for capacity-building and institutional strengthening, and establishing a robust information base to inform decision-making.

Both PONREPP and the government's plans for recovery and development provide interventions across a number of sectors (forestry, fisheries, agriculture, etc.) which impact on the environment. While regarded as a significant and positive step forward, these initiatives should be undertaken in a more coordinated manner to achieve both livelihood and DRR objectives.

Annex – Endnotes

- 1 PONJA Report, July 2008, Annex 12.
- 2 Maung Maung Than. 2008. "Devastation of the 2008 cyclonic storms on mangroves and other coastal systems in Myanmar". Country Report, Bangkok Workshop.
- 3 Ibid.
- 4 Quotation from Ya Min Thant, Maung Maung Than and Kanzaki Mamoru (2008). Tropical Ecology Letters No. 73: p. 15.
- 5 Ibid.
- 6 http://www.arcbc.org.ph/wetlands/myanmar/mmr_meikyu.htm (downloaded June 2009).
- 7 Results of surveys by the Ministry of Forestry and JICA since 2002 (U Htun Paw Oo, FAO, Myanmar, personal communication, April 2009).
- 8 Post-Nargis Social Impacts Monitoring, TCG, January 2009.
- 9 PONREPP, December 2008, Chapter III.
- 10 Ibid.
- 11 See for example, International Rice Research Institute, "Myanmar", downloaded at <http://www.irri.org/science/cnyinfo/myanmar.asp> (June 2009).
- 12 Ibid.
- 13 Ibid.
- 14 PONREPP report, Chapter III.
- 15 These organizations have few resources and can only work in a limited number of villages. The most active NGO is FREDa, which has been operating for over ten years and is currently working in 23 villages.
- 16 Donors planning to support community-based resource management projects run by national NGOs include JICA, FAO and DFID.
- 17 Maung Maung Than, and C. Ohm, General Secretary, FREDa (personal communication); Maung Maung Than, op.cit. For further information, see also http://www.mangroveactionproject.org/news/current_headlines/the-mangrove-forests-burma2019s-best-bio-defense/
- 18 PONREPP, December 2008, Chapter III.
- 19 Figures taken from Ministry of Forestry, "Action Plan for Rehabilitation of the Cyclone Nargis-affected Areas and Prevention from Future Natural Disasters", August 2008.
- 20 Maung Maung Than, 2008, "Devastation of the 2008 cyclonic storms on mangroves and other coastal systems in Myanmar. Country Report, Bangkok Workshop" and International Society for Mangrove Ecosystems and International Tropical Timber Organization, November 2008, "Guidelines for the Rehabilitation of Mangroves and other Coastal Forests damaged by Tsunamis and other Natural Hazards in the Asia-Pacific Region".
- 21 All land is owned by the Government of Myanmar and leased to individuals to undertake farming and other production activities.
- 22 See for example "Periodic Review" in Chapter III, PONREPP, December 2008.
- 23 Maung Maung Than, op.cit.
- 24 Ministry of Forestry, August 2008, "Action Plan for Rehabilitation of the Cyclone Nargis-affected Areas and Prevention from Future Natural Disasters" and the PONJA report.
- 25 PONJA Report and PONREPP.
- 26 Ibid.
- 27 "Lower Burma Paddy Land Development Project" downloaded at <http://www.un.org/esa/agenda21/natlinfo/countr/myanmar/natur.htm> (June 2009).

- 28 See Nargis Recovery and Reconstruction plans of the Ministry of Agriculture and Irrigation.
- 29 Periodic Review, January 2009.
- 30 PONREPP, December 2008, Chapter IV.
- 31 For example, see PONREPP, December 2008, Chapter IV on WASH.
- 32 Intergovernmental Panel on Climate Change (IPCC) (2007). *Working group III Summary for policymakers*. <http://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-spm.pdf>
- 33 Ibid.
- 34 The Myanmar Action Plan for Disaster Risk Reduction (MAPDRR) is being developed by government with technical assistance from the Asian Disaster Preparedness Center and input from an interagency task force, of which the NCEA is a member.
- 35 Helen James. 2005. *Governance and civil society in Myanmar: education, health, and environment*. New York: Routledge.
- 36 PONJA Report, July 2008.
- 37 All quotes in Box 3 are taken from Ministry of Forestry, "Action Plan for Rehabilitation of the Cyclone Nargis-affected Areas and Prevention from Future Natural Disasters", August 2008.
- 38 A locally-used medicinal plant. See Mangrove Forest Project, "The Mangrove Forest: Burma's Best Bio-defense", http://www.mangroveactionproject.org/news/current_headlines/the-mangrove-forests-burma2019s-best-bio-defense/ downloaded on June 2009.
- 39 PONREPP, December 2008.
- 40 PONREPP, December 2008, Chapter III.
- 41 See Chapter III on "Productive lives, outcome 4, forestry", PONREPP, December 2008.
- 42 See for example, Chapter V of PONREPP (December 2008) which seeks to integrate environmental considerations into the various sectors, including livelihoods and food security.
- 43 Maung Maung Than, op.cit.
- 44 UNEP, 2009, "Opportunities in Environmental Management for Disaster Risk Reduction." Discussion paper.
- 45 Ibid.
- 46 PONREPP, 2008, Chapters III to V.

Further information

Further technical information may be obtained from the UNEP Disasters and Conflicts Programme website at: <http://www.unep.org/conflictsanddisasters/> or by Email: postconflict@unep.ch

