



# The other half of climate change

Why Indonesia must adapt to protect its poorest people



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United Nations Development Programme  
Indonesia

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## Foreword

It is evident that climate change has affected Indonesia. The evidence of climate change negative impacts has been presented in the recently launched report *Indonesia Country Report on Climate Variability and Climate Change*. The report, which was prepared by a group of leading Indonesian experts from all relevant sectors and institutions, presents an analytical overview of climate impacts in Indonesia. The results presented in the report are in line with the work from the Intergovernmental Panel on Climate Change (IPCC). Climate change impacts are posing a challenge to Indonesia's sustainable socio-economic development and environment, and to the achievement of Indonesia's development goals. To respond, we need to embed climate change adaptation in our systems of development planning. We have to make our society more resilient to the risks posed by climate change. Responding to the challenges, the society requires more publications that contain information on climate change.

I am very pleased to see the publication of this report: *The other half of climate change: Why Indonesia must adapt to protect its poorest people*. It provides significant information on the effects of climate change and emphasizes the importance of adaptation in order to protect all society especially the poor and the vulnerable. Much attention is already being paid to the climate change mitigation, reducing greenhouse gas emissions. This report helps us not forget the adaptation side of the climate change story, the need to prepare for the inevitable impact of global warming on our country.

Indonesia is currently mobilizing all key stakeholders to play their roles in adapting to climate change. I hope that this report will contribute to these efforts, particularly in catalyzing and generating inspiration or idea in the designing/planning process of programmes in each institution paying special attention to the poor or vulnerable societies. This report complements the adaptation side of the recently prepared National Action Plan to Address Climate Change (RAN-PI), which clearly lays down the key principles and actions to be taken the coming years. Pushing the climate change agenda forward will need strong engagement from national and local government, as well as from civil society organizations, academia, the private sector – and every Indonesian citizen.

State Minister of the Environment  
The Republic of Indonesia

A handwritten signature in black ink, appearing to read 'Rachmat Witoelar'.

Rachmat Witoelar

# Preface

Climate change threatens to undercut Indonesia's recent progress in reducing poverty and achieving the Millennium Development Goals. Changing rainfall patterns will reduce the availability of water for irrigation and for drinking. Long droughts and floods will cause crop failures that will threaten the livelihoods of farmers. And climate change will hit hardest at the poorest and most vulnerable communities in agriculture, fisheries, forestry, coastal and urban areas.

This dramatic reality has in large part been overshadowed by the debate about Indonesia's contribution to the phenomenon of global warming – through rapid deforestation, forest fires, degraded peatlands, and diminishing carbon 'sinks'. But this is only half the story. As this report highlights, Indonesia will also be a major victim of climate change, especially poor and vulnerable communities.

UNDP is giving top priority to assist Indonesia in urgently addressing the impact of climate change. Our engagement in this area includes policy and analytical work; support to the Government in formulating its national strategy on climate change adaptation; integrating the impact of climate change into national and local development plans; intensifying disaster risk reduction efforts; and preparing a longer-term, multi-sectoral climate change adaptation programme.

As a contribution to this work, this report carries the voices of vulnerable communities, highlights the relationship between climate change and poverty, and underlines the importance of supporting community efforts to adapt to the challenges ahead. It provides concrete policy recommendations for what needs to be done to reduce the impact on rural livelihoods, health, food security, urban slums, and disaster vulnerability.

We look forward to working closely with the Government of Indonesia and key stakeholders in adopting a long-term, strategic approach that will safeguard Indonesia's recent progress in reducing poverty and promoting human development from the impact of climate change.



Mr. Håkan Björkman  
Country Director  
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# Executive summary

Rising sea levels that will swamp many islands and shrink Indonesia's national territory. Erratic planting and harvesting seasons punctuated by devastating droughts. Floods rushing through the streets of major coastal cities. Salt water intruding into river deltas destroying livelihoods of fishing communities. Children suffering from acute malnutrition.

This is not our usual climate change news. Usually the story in Indonesia is one of rapid deforestation, forest fires, degraded peatlands, and diminishing carbon 'sinks' – with Indonesia thus identified as a major contributor to global warming. All this is true, but it is only half the story. As this report highlights, Indonesians will also be major victims of climate change – and unless we rapidly learn to adapt to this new environment millions of people will suffer the consequences.

Climate change threatens to undermine Indonesia's efforts to combat poverty. Its impact is intensifying the risks and vulnerabilities facing poor people, placing further stress on already over-stretched coping mechanisms. In effect, climate change is holding back the efforts of poor people to build a better life for themselves and their families.

This report highlights some of the major threats for poor people, for example:

*Livelihoods* – The effects of climate change are being felt more acutely by the poorest communities. Many work in agriculture or fisheries so their livelihoods are acutely climate sensitive. Whether in urban or rural areas they are also likely to be living on the most marginal land that is vulnerable to droughts, floods or landslides. Water, too much or too little, is the major threat. And when disaster strikes poor communities have very few resources to fall back on.

*Health* – Heavy rainfall and flooding can overwhelm rudimentary systems of sanitation in slum areas of towns and cities, exposing people to water-borne diseases such as diarrhoea and cholera. Prolonged intense heat waves coupled with high humidity will also lead to heat exhaustion particularly among the urban poor and the elderly. And higher temperatures will also allow mosquitoes to spread to new areas – with the ensuing hazards of malaria and dengue.

*Food security* – The poorest regions are also likely to suffer food shortages. Some are acutely vulnerable to climatic variations. Long droughts followed by crop failure in the province of Nusa Tenggara Timur, for example, have already had severe consequences and acute malnutrition is evident across the province.

*Water* – Changing rainfall patterns are also reducing the availability of water for irrigation and for drinking. In coastal areas, the loss of groundwater combined with rising sea levels will also allow more sea water to intrude into water sources.

What can we do about this? So far, most of the global attention on climate change has been focused on 'mitigation' and principally on efforts to reduce emissions of carbon dioxide. These measures are vital, but for the poorest communities, who are responsible for very few of these emissions, the most pressing priority is to find ways to cope with this new environment – to adapt.

Though they might not have called it this, many already have long experience of 'adaptation'. People in flood-prone areas, for example, have built their houses on stilts. Farmers in drought-prone areas have learned to diversify their sources of income, cultivating more resilient crops, for example, and optimizing the use of scarce water, or even migrating temporarily in search of work elsewhere. Now the task is to assess and build on such traditional wisdom – helping people to protect their livelihoods and reduce their vulnerability.

This report points out some of the priority areas for climate change adaptation:

- *Adaptation in agriculture* – Farmers, for example, will have to consider yet more crop varieties, along with better water management and storage – supported by more accurate and relevant forecasts that will help them time their planting and harvesting.
- *Adaptation in coastal zones* – People facing rising sea levels can pursue three general strategies: 'protect', through planting soft barriers like mangrove trees; 'retreat', by living further from the shore, or 'accommodate' by, for example, switching to new sources of livelihoods.

- *Adaptation for water supplies* – We will need to use more integrated water resource management – sustaining healthy ecosystems, along with rehabilitating reservoirs and other infrastructure.
- *Adaptation for health* – In a more stressful environment, we will need to strengthen primary health care. And since a warmer climate allows mosquitoes to reach new areas, we need stronger health surveillance to monitor the spread of diseases like malaria and dengue.
- *Adaptation for urban areas* – In all parts of the country, but particularly in coastal zones and urban areas that are vulnerable to flooding, we will need much stronger strategies for reducing risks.
- *Adaptation in disaster management* – In a country that is already highly disaster prone, climate change makes ‘smart management’ of disasters all the more important. Rather than just responding after a disaster, the aim should be to reduce risks and prepare for disasters before they happen.

Adaptation on this breadth and scale clearly goes far beyond what are conventionally considered ‘environmental’ issues. All departments of government and of national planning need to take climate change into account in all their own programmes – on issues as diverse as food security, road maintenance, disease control and urban planning. But this is not a job only for the central government; it has to be a nationwide effort involving local government, communities and non-governmental organizations (NGOs), as well as the private sector.

Indonesia should also be able to rely on international support – not just for mitigation but also for the measures that will be needed to help the poorest people who will face the brunt of a more erratic and extreme weather conditions. Global warming is a global responsibility.

Ultimately, however, the only way for all of us to adapt to climate change is to switch to more sustainable forms of development – learning to live in ways that respect and harmonize with the natural environment. From the remotest villages to the most modern cities we are all parts of a complex natural system, and subject to powerful forces of nature. As the climate changes, we have to change too – and quickly.

# The other half of climate change

The climate change story in Indonesia usually concerns deforestation and our rising contribution to greenhouse gases. We seldom hear the other half of the story – the impact of global climate change on Indonesia. We have always had to deal with natural disasters – droughts, floods, earthquakes, tsunamis – but now as a result of global climate change we will be faced with even more erratic and extreme weather, with serious implications, especially for our poorest people.

What is climate change, and what can we do about it? This report aims to explain the challenge ahead, and highlight the opportunities to switch to more sustainable forms of development – that can help reduce poverty while also making poor communities more flexible and resilient in the face of massive and shifting forces of nature.

## Why is the climate changing?

The first thing to be clear about is that climate change is not new. The global climate has always fluctuated. Millions of years ago, some parts of the world that are now quite warm were covered with ice, and over more recent centuries, average temperatures have risen and fallen in cycles, as a result of fluctuations of solar radiation, for example, or the periodic eruption of volcanoes.

What is new, however, is that current and future climate changes will be caused not just by natural events but also by the activities of human beings. Our accelerated economic development is having a serious impact on the world's climate, burning large quantities of coal, oil and wood, for example, and cutting down forests.

The damage is being caused principally through the production of 'greenhouse' gases, so called because they have an effect similar to the glass roof of a greenhouse. They allow the sun's rays to penetrate the atmosphere so as to heat up the earth, but they prevent part of the energy from being radiated back into space. As a result, the earth and its atmosphere are slowly heating up (Box 1).

### Box 1: The greenhouse effect – a balance of radiation

Agriculturalists in temperate climates who want to protect vegetables from colder temperatures plant them in structures consisting largely of panes of glass – greenhouses. During the day as the sun's rays penetrate the glass, they raise the temperature inside the greenhouse. This heat does not escape again so quickly because radiation from within the greenhouse is of a different type – having a longer wavelength – and is blocked by the glass.

You do not need a greenhouse to experience the same effect. Any closed room that allows sunshine to enter through glass will trap the heat. Similarly a car that has been exposed to sunlight with all the windows closed can have a steering wheel too hot to touch.

We now think primarily of the global greenhouse effect as damaging; but the problem is really one of degree. Without atmospheric carbon dioxide to trap some of the heat, the average temperature of the earth would be around -50°C, too cold for life. Unfortunately from a period just having sufficient carbon dioxide, we now have too much.

The main increase in greenhouse gases is coming from carbon dioxide. This is one of the gases that you breathe out when you exhale, but it is also produced by burning coal, or wood or using gasoline or diesel in cars. Some of this carbon dioxide can be reabsorbed, partly in the process of 'photosynthesis' that forms part of the growth of plants, for example, or trees. But nowadays most countries are producing carbon dioxide much faster than trees or plants can absorb it, so the concentration in the atmosphere is gradually increasing.

There are also other greenhouse gases. One is methane, which can be emitted from wetlands and paddy fields as well as from waste dumps and livestock manure. Other greenhouse gases, though usually produced in smaller quantities, include nitrous oxide and sulphur hexafluoride which has often been used in refrigerators.

Countries all over the world have been sending greater quantities of these gases into the atmosphere. The developed countries emit more per person, largely because they have more cars or generally burn more fossil fuels, but as poorer countries develop, they too are catching up and emitting more of these gases. Regardless of who produces the emissions, everyone shares the effects. There is only one earth and only one atmosphere: each country's emissions are adding to a common global crisis.

The problem is made worse because we have fewer trees to absorb carbon dioxide. Brazil, Indonesia and other countries have been cutting down millions of hectares of forests and destroying wetlands. This not only produces more carbon dioxide when trees and other vegetation are burned or as peat from the wetlands dries out, it also reduces the number of trees and other plants that use the carbon dioxide in photosynthesis – that can act as carbon 'sinks', a process called 'sequestration'.

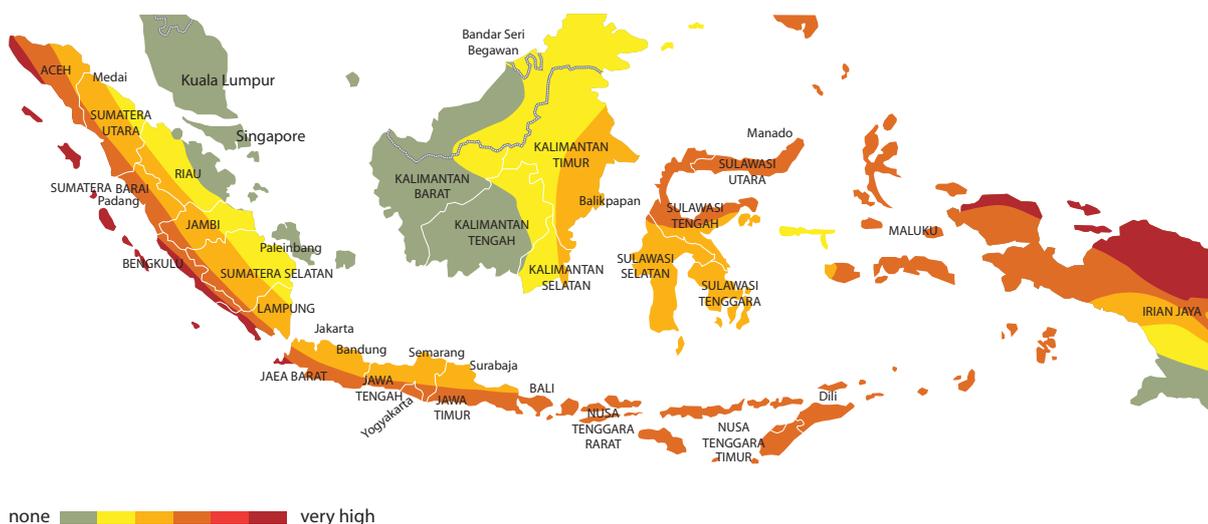
Indonesia has been losing forests at an ever faster rate – 600,000 hectares per year in the 1980s but around 1.6 million hectares per year by the end of the 1990s. As a result, forest cover has been declining rapidly – from 129 million hectares in 1990 to 82 million in 2000 and a projected 68 million in 2008. Thus, each year, Indonesia is now capable of sequestering much less carbon dioxide.

With increasing emissions and less absorption, the level of greenhouse gases in the atmosphere is now reaching very high levels. The global body charged with monitoring this issue, the Intergovernmental Panel on Climate Change has estimated that between 1750 and 2005, the atmospheric concentration of carbon dioxide increased from about 280 to 379 parts per million and has recently been increasing at a rate of 1.9 parts per million per year. As a result, by 2100, global surface temperature could rise by between 1.8 and 2.9 degrees centigrade.<sup>1</sup>

### The impact of global warming on Indonesia

The temperature rise may not seem very great, but in some countries such as Indonesia, it could have a major impact and particularly on our poorest people. Exactly what will happen is difficult to predict. The global climate is a very complex system and global warming will interact with many other influences, but in Indonesia, it will make many of our existing climatic problems worse. We are already subject to many climate-related hazards, including floods, droughts, storms, landslides and wildland fires (Figure 1). Now these will become more frequent or more severe.

Figure 1: Degree of exposure to natural hazards



Source: UNOCHA, 2006

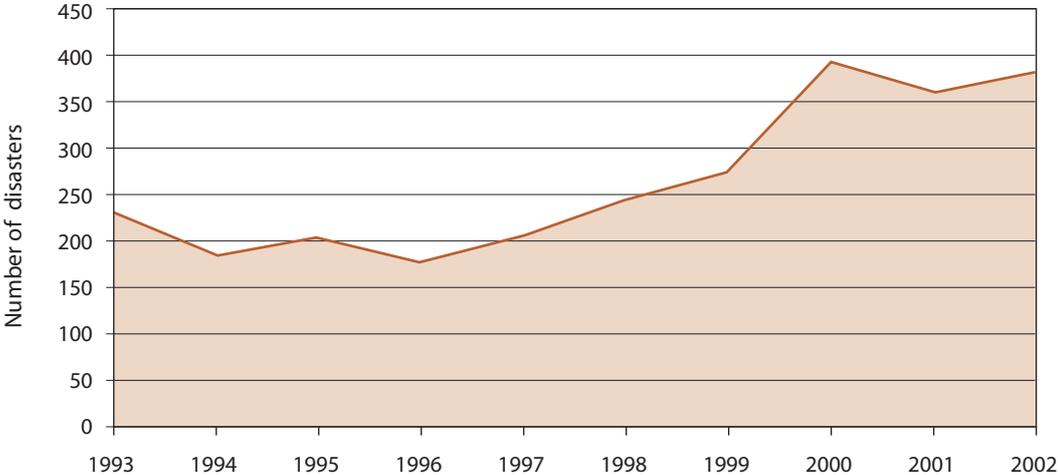
One of the main climatic influences on Indonesia is the 'El Niño-Southern Oscillation' which, every few years, provokes many of our extreme weather events. The El Niño refers to changes in ocean currents in the Pacific Ocean, making them unusually warm. The opposite case, when the currents are unusually cold, is called La Niña. Linked with these events is the 'Southern Oscillation' which refers to changes in atmospheric pressure in the southern hemisphere. Taken together, they are called the El Niño-Southern Oscillation (ENSO).

When there is an El Niño, we usually have more droughts. When there is a La Niña, we have more floods. Over the period 1844-2006, out of 43 droughts, 37 were associated with an El Niño. The ENSO is also one of the main factors in the frequency of major forest fires and the creation of a choking atmospheric haze.

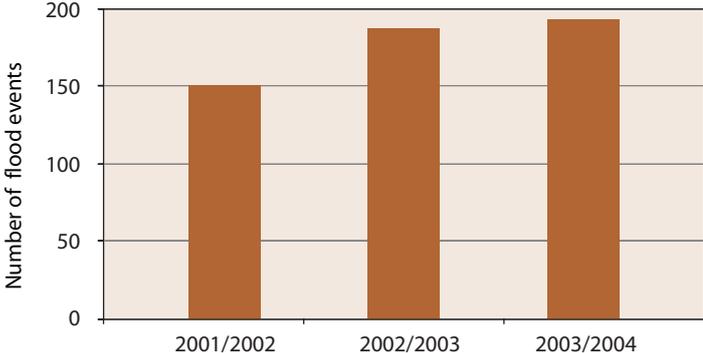
Climate-related hazards in Indonesia are also caused by the location and movement of the tropical cyclones in the eastern south Indian Ocean (January to April) and the eastern Pacific Ocean (May to December). In some parts of Indonesia, this can result in very strong winds and heavy rainfall that can last for hours or days. Strong winds often also occur during the transition between the Northeast and the Southwest monsoons.

In recent years, these extreme climatic events have become more frequent and their impact has been more severe (Figure 2). Between 1844 and 1960, droughts happened on average every four years, but between 1961 and 2006, they occurred every three years.<sup>2</sup> Floods are also appearing more frequently. In the period 2001-2004, about 530 floods were reported, occurring in almost all provinces (Figure 3). The scale of damage is also increasing. The El Niño event of 1997-1998 was the most severe for 50 years; indeed, 1998 was the hottest year in the twentieth century.<sup>3</sup>

**Figure 2: Number of disasters, 1993-2002**



**Figure 3: Number of floods, 2001-2004**



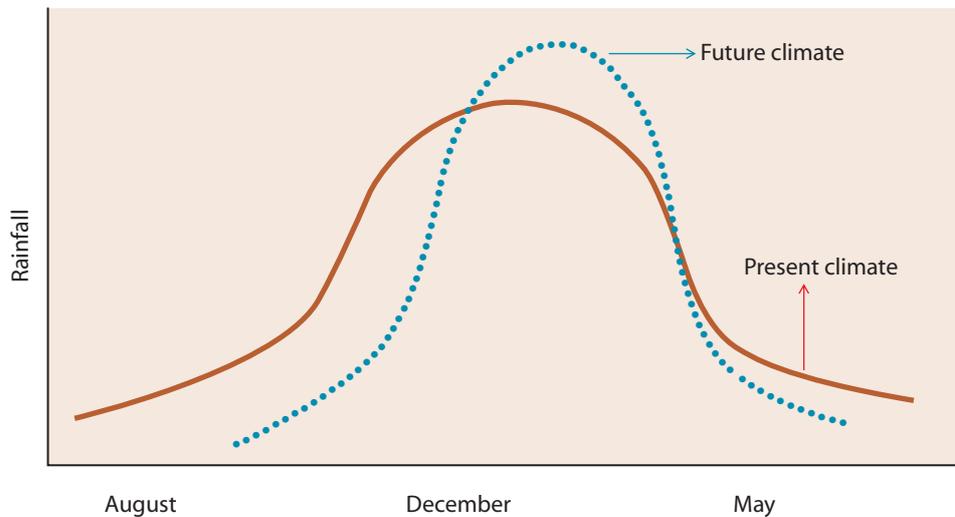
Source: Ministry of Public Works, 2007

These more frequent El Niños are occurring at a time of global warming. Data from the National Oceanic and Atmospheric Administration indicate that ten of the strongest El-Niño events occurred after the 1970s – as global warming started to accelerate. Whether changes we are now experiencing are coming from El Niño or from the greenhouse effect or a combination of the two, it seems clear that Indonesia is already experiencing climate change – and that the consequences could be felt for many generations to come.

Among the consequences we can expect are:

*Changes in seasons and rainfall* – For several years now, farmers in the villages of Java have been talking about the abnormal seasons. The ancient rice farmers' wisdom of *pranata mangsa* in Java, Palontara in South Sulawesi and many others – the structure of the seasons – have been devalued by climate change. In most of Sumatra, comparing the periods 1961-1990 and 1991-2003, the onset of the wet season is now 10 to 20 days later and the onset of the dry season is now 10 to 60 days earlier. Similar shifts have been seen in most of Java. These patterns seem likely to continue. In the future, parts of Indonesia, particularly in regions located south of the equator, could have longer dry seasons and shorter but more intense wet seasons with the kind of changes in the rainfall pattern indicated in Figure 4. In addition, the climate is also likely to become more variable, with more erratic rainfall. Higher temperatures will also dry out the soil, reducing groundwater resources, degrading the land and in some cases leading to desertification.

**Figure 4: Likely future rainfall pattern in Java and Bali**



Source: Based on Naylor et al., 2007

*More extreme weather events* – We will experience more frequent and fiercer coastal storms, along with droughts and floods and heavy rainfall that can trigger landslides.

*Rises in sea levels* – As a result of both the expansion of seawater and the melting of glaciers and polar ice caps, global warming could result in a rise in sea level of between 9 and 100 centimetres. This would accelerate coastal erosion, intrude salt water into groundwater, destroy coastal wetlands and submerge small islands.

*Warmer oceans* – Warmer seawater can inhibit the development of plankton and limit the supply of nutrients to fish. Some species of fish are likely to migrate to other areas that offer better conditions of temperature and food. Higher temperatures will also damage or 'bleach' coral.

*Higher air temperatures* – This will change patterns of vegetation, and also the distribution of insects such as mosquitoes, which will be able to survive in regions that were previously too cool.

## How climate change will hurt the poorest people

No one can escape from climate change. But the effects will be felt more acutely by the poorest people, who are living in the most marginal areas that are vulnerable to drought, for example, or to floods and landslides. Since they are likely to be working in agriculture or fisheries, their livelihoods are particularly climate sensitive. They also have very few resources to fall back on, so any disaster could cost them their few possessions. In periods of stress, they may be forced to sell off land or other assets – for example, livestock or farming equipment – making it very difficult to sustain their livelihoods. The effect on poverty can also be viewed through the lens of the Millennium Development Goals (MDGs), whose achievement is threatened by climate change (Box 2).

### Box 2: Climate change and the Millennium Development Goals

Goal	Potential impacts of climate change on the MDGs
1. <i>Eradicate extreme poverty and hunger</i>	Climate change is expected to: <ul style="list-style-type: none"> <li>• Degrade the forests, fish, pastures, and crop land that many poor families depend on for their food and livelihoods.</li> <li>• Damage poor people's homes, water supply, and health, which will undermine their ability to earn a living.</li> <li>• Exacerbate social tensions over resource use, which can lead to conflict, destabilizing livelihoods and forcing communities to migrate.</li> </ul>
2. <i>Achieve universal primary education</i>	Climate change could undermine children's ability to attend school. <ul style="list-style-type: none"> <li>• More children (especially girls) are likely to be taken out of school to help fetch water, care for ill relatives, or help earn an income.</li> <li>• Malnourishment and illness among children could reduce their school attendance, and impair their learning when they are in class.</li> <li>• Floods and storms destroy school buildings, and force migration.</li> </ul>
3. <i>Promote gender equity and empower women</i>	Climate change is expected to exacerbate current gender inequalities. <ul style="list-style-type: none"> <li>• Women tend to depend more on the natural environment for their livelihoods than do men, and so are more vulnerable than men are to its variability and change.</li> <li>• Women and girls are typically the ones to fetch water, fodder, firewood, and often food. In times of climate stress, they must cope with fewer resources and a greater workload.</li> <li>• Female-headed households with few assets are affected particularly severely by climate-related disasters.</li> </ul>
4. <i>Reduce child mortality</i>	Climate change will lead to more deaths and illness due to heat-waves, floods, droughts, and hurricanes.
5. <i>Improve maternal health</i>	<ul style="list-style-type: none"> <li>• It may increase the prevalence of diseases spread by mosquitoes (such as malaria and dengue fever) or of those spread in water (such as cholera and dysentery). Children and pregnant women are particularly vulnerable to these diseases.</li> </ul>
6. <i>Combat major diseases</i>	<ul style="list-style-type: none"> <li>• It is expected to reduce the quality and quantity of drinking water, and exacerbate malnutrition among children.</li> </ul>
7. <i>Ensure environmental sustainability</i>	Climate change will alter the quality and productivity of natural resources and ecosystems, some of which may be irreversibly damaged. These changes will also reduce biological diversity and compound existing environmental degradation.
8. <i>Develop a global partnership</i>	Climate change is a global challenge, and responding to it requires global cooperation, especially to enable developing countries to tackle poverty and inequality. It heightens the need for donors to honour their official development assistance commitments, and to provide additional resources for adaptation.

Source: Oxfam, 2007. Briefing paper. Adapting to climate change. What's needed in poor countries, and who should pay.

### **Impact on farmers**

The change in rainfall patterns will vary depending on the location. The farmers most likely to lose out are those in some upland regions that will lose soil cover through erosion. Yields of upland crops in Indonesia such as soybean and maize could fall by 20 to 40 percent.<sup>4</sup> But almost all farmers will be also affected. Even today, many are finding it difficult to decide when to plant their crops, or are suffering from crop failure because of erratic rainfall or drought. Those worst off are typically those at the end of the irrigation pipeline who, especially at times of shortage, find that most of the water has been taken by farmers upstream (Box 3).

#### **Box 3: Negotiating over scarce water**

*“If we could improve our system of water distribution – from upstream to downstream areas, people would be able to earn enough and not send their young women to work abroad where they face inhuman treatment”* (Haji Emod, Desa Sumur Gede, Sub-district of Cilamaya Kulon, Karawang District).

Cali Rahman irrigates his rice field with water from a secondary canal. But during a long dry season, when the water volume in the main canal is very low, he runs short. Farmers in the upstream areas have taken too much water, leaving very little for the farmers downstream. As a result, he and his neighbours have to pump groundwater which, aside from being expensive because of fuel costs, is increasingly being contaminated by the intrusion of seawater.

This water scarcity for rice field irrigation has triggered panic and water disputes. To help resolve these disputes, the farmers have chosen as a mediator one of their traditional respected leaders, Haji Emod. With his status and reputation for fairness, he has so far managed to reduce tension, making sure everybody gets their turn for water, often sacrificing his own supplies. He himself gets a side income as a traditional healer so he can afford to set aside his own interest for water for his own rice field.

These pressures have major implications for national food security. The Climate Laboratory at the Bogor Institute of Agriculture says that during the period 1981-1990, every district in Indonesia was losing on average around 100,000 tons of production per year; by the period 1992-2000, this amount had increased to 300,000 tons.

### **Impact on fishing communities**

Climate change has major implications for millions of coastal fishermen. They rely on highly sensitive ecosystems in which even small changes can have large effects: changing water temperatures that damage coral reefs, for example, will exacerbate other, human-induced stresses such as pollution and over-fishing and thereby cause a reduction in fish stocks (Box 4). Fishing boats will also have to cope with more erratic weather and high waves. Climate change has already undermined livelihoods in many islands in Maluku, for example, where fishermen say they can no longer predict the right times or places to catch fish because of the different climate pattern.<sup>5</sup> Rising sea levels could also inundate many of the shrimp and fish ponds in Java, Aceh and Sulawesi.

### **Impact on coastal communities**

As a vast archipelago of over 17,000 islands and with 80,000 kilometres of coastline, Indonesia is extremely vulnerable to sea level rise. A rise of about 1 metre could inundate around 405,000 hectares of coastal land, causing the disappearance of many low-lying islands along with coral reefs. This has implications for Indonesia's national borders: recent studies indicate that at least 8 of 92 of the outermost small islands that establish the baseline for Indonesia's territorial water are very vulnerable to sea level rise. Many sections of the coast have been rendered even more vulnerable by erosion – which has also been exacerbated by human activity such as the building of jetties and sea walls, the damming of rivers, sand and coral mining, and the destruction of mangrove forests. Currently, around 42 million people in Indonesia live in areas less than 10 metres above the average sea level.<sup>6</sup>

#### Box 4: Winds of change in a fishing community

Fishing off the coast of Indramayu has become much more difficult. Traditionally, fishermen have relied on signals from the seasonal winds. In the dry season during the east seasonal wind, the sea water becomes turbid and there is less plankton so the fish are scarce. During the wet season and west seasonal wind, the sea water is clear and rich with plankton and the catch is abundant – though the waves are higher, making it difficult for fishermen in small boats. But the seasons are changing. Recently, the west seasonal wind, which usually lasted for around four months, has extended to seven months and the waves have been so high as to threaten even the largest boats. In addition, fishermen have also been hit by the recent steep increase in the price of fuel. As a result, out of 150 small fishing boats, only 40 can now afford to sail and even then their owners are often heavily in debt to pay for fuel.

Drs. Royani is head of the fishermen's cooperation organization Mina Bahari, Eretan Kulon Village, Kandang Haur subdistrict. He says that fishermen would be better able to respond to climate change if they had more facilities and training, and alternatives to fishing. In response, the cooperative has started fish processing. The main catch during the dry season, *kuniran*, sells for Rp 700 per kilo when fresh, but after being semi-processed – cleaned, preserved, and packed – it sells for Rp 2,000 per kilo. This activity now employs 450 workers, offering fishermen the opportunity of three hours processing a day and a side income of Rp 23,000. Now, with a grant from the United States Agency for International Development (USAID), there are plans for a factory to produce finished products, with the potential to export to Malaysia.

The cooperative is also active with literacy programmes for fishermen, and courses to empower their wives for other income-earning opportunities. They also want to start a school that, in addition to the normal curriculum, will teach children marine skills. But they also emphasize the importance of traditional knowledge.

Pak Walim, for example, who has been a fisherman all his life, learned from his parents and grandparents how to read the wind and take direction from the stars. "I know where to cast my net by slipping my fingers into the water and gauging the temperature – warmer water means more fish. Another way is to use a rod made from jati wood to listen to activity below the surface. If it is quiet, I move elsewhere. Or if these ways do not work, I dive in to see where the fish are. Some of our boats are equipped with GPS [global positioning system]. This is of course useful. But my GPS is my head and it never fails!"

#### Impact on urban dwellers

A sea level rise of between 8 and 30 centimetres would also have a serious impact on coastal cities such as Jakarta and Surabaya, which will become even more vulnerable to flooding and storm surges. This problem has been made worse in Jakarta because at the same time as the sea level has been rising, the ground level has been falling: the construction of tall buildings and the increasing extraction of ground water have been causing the land to subside. But Jakarta has regularly been subject to regular flooding as a result of heavy rainfall: in early February, 2007, flooding which lasted for about 22 days killed 57 people and forced 422,300 to leave their homes, of which 1,500 were destroyed. Total damaged was estimated to be about US\$695 million.<sup>7</sup>

One study has estimated that the combination of a sea level increase of about of 0.5 metres and continuing land subsidence would lead to the permanent inundation of six locations – three in Jakarta (Kosambi, Penjaringan and Cilincing) and three in Bekasi (Muaragembong, Babelan and Tarumajaya) – with a total population of approximately 270,000 people.<sup>8</sup> Many other parts of the country have recently experienced flood disasters. Heavy floods in Aceh, for example, at the end of 2006 took 96 lives and displaced 110,000 people who saw their livelihoods and assets destroyed. In 2007 in Sinjai, South Sulawesi, several days of floods destroyed roads and bridges and isolated 200,000 people. Later in the year, floods and landslides in Morowali, North Sulawesi forced 3,000 people to move into tents and barracks.

## Cumulative pressures

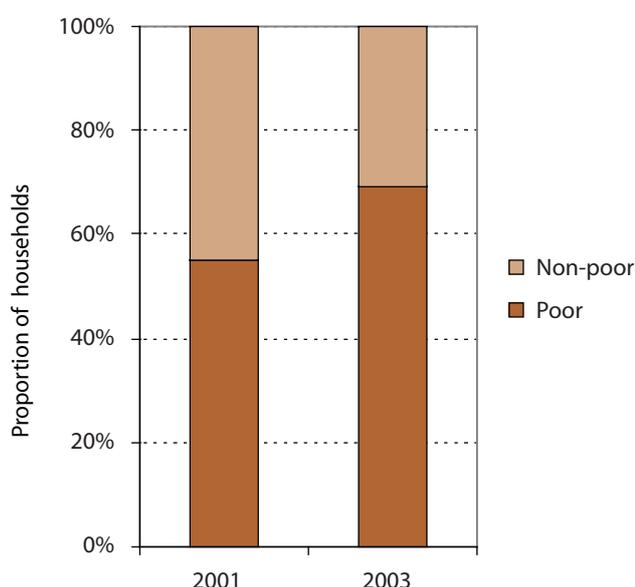
Poor communities are thus likely to suffer as a result of climate change. But these impacts will also compound the existing pressures they face. These include:

### *Increasing levels of poverty*

For people living close to the margins of survival, the additional stress of climate change adds further anxiety – and cost. Most rice farmers, for example, currently use hybrid varieties of rice that demand large quantities of water. When the rain fails to arrive on time, many now have to borrow money to buy fuel for their pumps to extract ground water. But even if they get a harvest, they have to use most or all of the revenue to pay back their debts to the diesel supplier.

A clear illustration of the effects of climatic disaster on poor communities comes from Indramayu in West Java – a district that, during an El Niño, usually experiences a drought. Figure 5 shows the levels of poverty in a normal year, 2001, compared with an El Niño in year 2003.<sup>9</sup> This will be the combined result of climate changes along with rises in the prices of food and fuel.

**Figure 5: Proportion of households living in poverty in Indramayu, West Java, 2001 and 2003**



Note: Poor households are defined as households that cannot meet basic needs (Pra-KS) and households that can meet basic needs but not socio-psychological needs, i.e. education (KS-1).

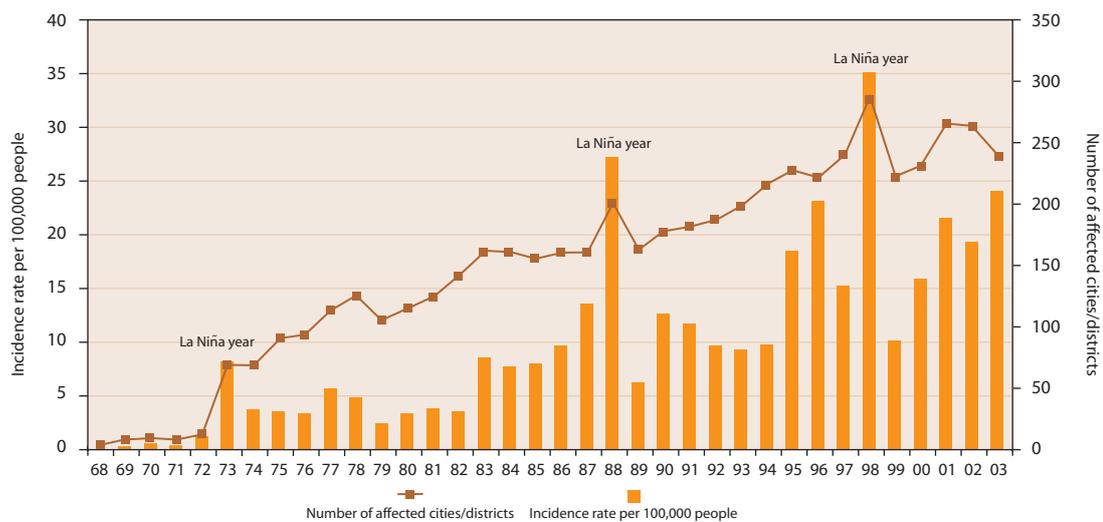
In addition to fishing, the coastal areas of Indonesia offer some of the other main sources of employment – for about 15 percent of the workforce – this includes oil and gas exploration, transport, agriculture and tourism. These economic activities contribute to about 25 percent of the gross domestic product (GDP) so a rise in sea level will have a major impact on socio-economic activities.

### *Damage to health*

Global warming will also have serious implications for health. Again, the impact will be greatest on poor communities that have the least protection. Heavy rainfall and flooding can overwhelm the rudimentary systems of sanitation in slum areas of towns and cities, exposing people to water-borne diseases such as diarrhoea and cholera. Prolonged intense heat waves coupled with high humidity will also lead to heat exhaustion particularly among the urban poor and the elderly.

Poor families are also more likely to be living in environments vulnerable to mosquitoes. Communities in Indonesia have traditionally considered the transition from the dry to wet season, the *pancaroba*, as a dangerous period, and older people would caution the young to take extra care. Climate change will heighten the risk for young and old alike by allowing mosquitoes to spread to new areas. This was demonstrated in the 1997 El Niño, when mosquitoes moved to higher altitudes in the highlands of Papua. Higher temperatures could also cause some viruses to mutate – as may already have happened with the dengue virus, making the disease more difficult to treat. Dengue cases in Indonesia have also been found to increase significantly in La Niña years (Figure 6).

**Figure 6: Incidence of dengue and the number of affected cities and districts, 1968-2003**



Note: 1973, 1988 and 1998 were La Niña years.

Source: Data, Department of Health, chart from [www.tempointeraktif.com](http://www.tempointeraktif.com)

Other health problems caused by thick haze include acute respiratory infections, bronchial asthma, bronchitis, and eye and skin irritation. The 1997 fires in eight provinces resulted in around 9 million cases of respiratory infections.

### Rising malnutrition

The poorest regions are also likely to suffer food shortages. In Nusa Tenggara Timur, West Timor, East Sumba and the islands east of Flores, many communities are already acutely vulnerable to climatic variations – with poor soils that degrade during the erratic rainfall and longer droughts of El Niño years. More than one third of the population in many of these areas are below the poverty line. In the El Niño years of 2002 and 2005, around one quarter of children under five suffered from acute malnutrition, compared to 8 to 12 percent in a non-El Niño year. In Belu district, Nusa Tenggara Timur, for example – the district with the lowest rainfall in Indonesia – a long drought followed by crop failure has had severe consequences. Malnutrition is widespread across the province – between 32 and 50 percent.<sup>10</sup>

### Loss of water sources

Changing rainfall patterns are also reducing the availability of water for irrigation or for drinking. In Lombok and Sumbawa islands, between 1985 and 2006, the number of water sources for irrigation and drinking water fell from 580 to 180.<sup>11</sup> Meanwhile, the islands are also suffering from ‘season breaks’ – droughts during wet seasons – which have now become much more common, leading to crop failure. Across the country, many more rivers now have much lower flows, such as the Ular (North Sumatra), the Tondano (North Sulawesi),<sup>12</sup> the Citarum (West Java), the Brantas (East Java), the Ciliwung-Katulampa (West Java), the Barito-Muara Teweh (Central Kalimantan), and the Larona-Warau (South Sulawesi). In coastal areas, the loss of groundwater combined with rising sea levels will also allow more sea water to intrude – contaminating water resources for both drinking and irrigation.

### More frequent fires

Droughts combined with changing patterns of land use have led to an increasing fire risk. In Central Kalimantan, for example, the Peat Project in the 1990s aimed to convert one million hectares of peatland for palm oil plantations. This proved to be a failure, causing enormous environmental damage. It has also undermined the livelihoods of communities in the surrounding areas that relied on rubber plantations as their main source of livelihood. Many of their trees have caught fire as a result of the burning of the peat land. Since then, the fires have proved very difficult to control, especially during El Niño years, and particularly because of building canals to drain the swamps and using fire to clear lands. In El Niño 1997, the total area of fire-damaged peat land in Indonesia was estimated at 6.8 million ha.<sup>13</sup> These fires have not only caused health problems but also damaged people’s livelihoods – increasing poverty rates by one-third or more.<sup>14</sup> Fire in El Niño years has caused major damage across the country: in 1997 alone, the cost was estimated at between US\$662 million and US\$1,056 million.<sup>15</sup>

# The adaptation imperative – a call for action

Adapting to climate change is an urgent priority for Indonesia. All departments of government and of national planning need to take climate change into account in all their own programmes – on issues as diverse as poverty reduction, community empowerment, food security, disaster management, disease control, and urban planning. But this is not a job only for the central government; it has to be a nationwide effort involving local government, communities and NGOs, as well as the private sector.

In recent years, the global community has become increasingly concerned about the effects of global warming. In the early 1990s, the United Nations Framework Convention on Climate Change was drafted, which came into force in 1994. In this framework, they envisaged two main strategies: mitigation and adaptation (Box 5). Mitigation involves finding ways to slow the emissions of greenhouse gases or to store them, or to absorb them in forests or other carbon 'sinks'. Adaptation, on the other hand, involves coping with climatic change by making appropriate adjustments – taking measures to reduce the negative effects, or exploit the positive ones.

## Box 5: Mitigation and adaptation, which is which?

When talking about climate change, scientists can use words in distinctive ways that differ from normal usage. When they talk about 'mitigation' with respect to climate change, for example, they are referring to measures to reduce the emissions of greenhouse gases. When they talk about 'adaptation' they are referring to measures to cope with the impact of climate changes.

In normal usage, however, we might instinctively use the terms mitigation and adaptation interchangeably – talking about 'mitigating the effects of climate change' for example. This might cause some confusion, but usually the intention should be clear. And in any case, we have to take both sets of measures, regardless of what we call them. At the end of this report, you will find more explanations of climate change terminology.

Clearly, emissions of greenhouse gases have to be reduced, so mitigation is essential. This is primarily an issue for the richer countries and the faster-growing developing countries, which need to change the way they use fossil fuels. That is why many governments signed the Kyoto Protocol to the Convention, committing themselves to targets for reductions in the emissions of greenhouse gases. But mitigation on its own will not be enough. Even if many countries do find ways to reduce emissions, we still need to cope with the effects of emissions that took place decades ago, because climate change occurs only after a long time-lag. So we have no choice; adaptation is not just essential but inevitable (Box 6).

## Box 6: International support for adaptation

While most resources for adaptation will have to come from local communities, or from local or national governments, there are also some opportunities for international support. At a Conference of the Parties to the UNFCCC in 2001, governments established some funding mechanisms. These include the Special Climate Change Fund to support adaptation activities which can include, for example, improved monitoring of diseases, early warning systems and responses, disaster planning, and preparedness for droughts and floods.

Another fund of particular relevance to Indonesia is the adaptation fund – about 2 percent of carbon credits of Clean Development Mechanism (CDM) projects. Under the Kyoto Protocol of the UNFCCC, developed countries can purchase carbon credits resulting from CDM projects such as reducing greenhouse gas emissions through the use of renewable energy and increasing carbon sequestration through reforestation in developing countries, and count these as part of their own contribution to reducing greenhouse gas emissions. Although these mechanisms are designed principally for mitigation, they also have adaptation potential. For example, replanting coastal zones with mangrove forests to increase carbon sequestration contributing to mitigation would also contribute to adaptation by increasing protection against storms and coastal erosion. The 2007 Conference of the Parties in Bali is also likely to include further discussion on funding mechanisms.

How can Indonesia and especially its poorest communities adapt? This may appear to be a new question, but the answers are not necessarily new. In fact, most poor communities have already had no option but to respond to the vagaries of the climate. So the task essentially is to enable them to respond more effectively – helping them to be more resilient to all kinds of shocks: economic, social or environmental.

### ***Adaptation in development planning***

The danger at present is that climate change can be seen simply as an environmental issue – and a responsibility only of the Ministry of Environment. In fact, however, all departments of government and of national planning need to take into account the impact of future climate change on their own programmes. Issues as diverse as poverty reduction, community development, spatial planning, food security, infrastructure maintenance, disease control, urban planning, disaster management, all have to be readdressed from the perspective of climate change.

The challenge is to ‘climate proof’ development planning. The impact of climate change on the economy and on human development needs to be properly assessed and mapped out. Then adaptation strategies need to be integrated into plans and budgets, at both at national and local levels. Poverty reduction efforts need to be scaled up in areas especially affected by climate change, and additional investment is needed to promote disaster risk reduction.

These efforts also need to be closely integrated with the efforts of communities and households. They, after all, have had a long experience of adaptation – with measures that have been practised for many centuries. People in flood-prone areas have built their houses on stilts and many continue to do so, even if they use more modern materials such as concrete pillars or corrugated iron roofs. In areas vulnerable to landslides, people have built strong retaining walls. Farmers exposed to drought have learned to diversify their sources of income, cultivate drought-resistant crops and optimize the use of scarce water, or even migrate temporarily in search of work elsewhere.

Whether through public or individual initiatives, adaptation has to be about strengthening livelihoods and reducing vulnerability. This will require a change in development direction. In the past, much of Indonesia's development has been based on the exploitation of natural resources – with the economic benefits being reaped in the cities and the ecological costs being borne by the rural areas. That pattern has to change. Communities in both rural and urban areas should already be aiming for sustainable human development, but the threat of climate change adds extra urgency. If we do not change the pattern of development, then the resources available to all – food, water, and living space – are likely to diminish.

This implies a broader adaptation strategy involving governments, civil society and the private sector – combining approaches at the government and institutional level with bottom-up approaches rooted in regional, national and local knowledge. While adaptation is vital across a whole range of development activities, it is particularly important for agriculture, coastal zones, water supplies, the health sector and for urban areas, with water playing a cross-sectoral role in all these areas.

### ***Adaptation in agriculture***

Among those most exposed to climate change are Indonesia's farmers. So far, rice farmers in Java have managed two crops a year, but with climate change, the second harvest is now looking ever more vulnerable. As a result, farmers who already have considerable experience of coping with adverse climatic events will have to adapt even more in future. They will need to consider, for example, different crop varieties. Some plants have a natural adaptive capacity, such as certain rice cultivars that flower early in the morning, enabling them to avoid the damaging effects of higher temperatures later in the day. Farmers will also want to consider adopting varieties that are tolerant of extreme conditions – drought, or deep water, or salt – or new fast-maturing rice varieties that are suitable for a shorter wet season. They will also need to look at ways of increasing the amount of organic matter in the soil so as to help it retain water – by using more natural fertilizers (Box 7).

### Box 7: Organic farming – easier, cheaper and more resilient to water shortages

*“Everybody, including my wife, was against me when I decided to start organic farming. But in fact, after 18 harvests, this practice is much better. I do not have to worry so much about water shortages or the cost of pesticides and chemical fertilizers” (Ade Saeful Komar, 41 Sukahaji village, Sub-district of Ciasem, Subang District).*

Ade started organic farming in 1998 after discussions with field officers from the Nastari Foundation. His wife was sceptical, believing this would give lower yields. She was right – their harvest dropped from six to four tons. But keen to keep learning, he persevered, and by the fourth harvest, his yields returned to normal. “I made a mistake earlier. I did not process the manure by fermentation. When I did this, the yields got better and better.”

One of the main advantages of organic farming is that it is less dependent on water than farming that uses the thirsty hybrid seed varieties. And when the soil is fertilized with organic manure rather than chemical fertilizer, it tends to have a better structure and be more resilient to dry conditions. Ade also makes his own natural pesticide. He mixes *nimbang/mindi* leaves with garlic in a blender. Or he might use *brotowali*, along with *sirsak* and *jaringan* leaves. “Cheap. Easy. I only need to buy half a kilo of garlic, about Rp 4,000,” he said. He also uses a practice called *legowo*, leaving more space between the paddy stalks to let the sunlight reach the roots because pests do not like sunlight. As a result, his paddy fields tend to get less infestation than before.

Ade’s success has not yet inspired other neighbouring farmers to emulate him. Accustomed to using chemical fertilizers and pesticide they mistrust other methods. Nevertheless some have started using less pesticides and chemical fertilizers.

At present, even if these farmers get information from the Meteorology and Geophysical Office, they may not know how to interpret it. One initiative to support this is a Climate Field School in Indramayu which aims to translate scientific forecasting into a simpler field language and train farmers in how to respond. Haji Sartim from Sukamandi village, Ciasem, Subang, for example, says that now when they see data on rainfall “farmers know the right time to plant crops so that by the time of the wet season, they will be strong enough to withstand floods”. The Climate Field School is a joint project of the Asian Disaster Preparedness Center and the Institute of Agriculture Bogor, in cooperation with District Agriculture Office of Indramayu, the Directorate of Plant Protection-The Ministry of Agriculture and the National Agency for Meteorology and Geophysical (BMG).

If farmers have access to the right information and tools, they should be able to make many of the necessary adaptations on their own. But some will find it more difficult, because of poor soil quality, perhaps, or inadequate water supplies or the lack of funds for investment. In addition, they may face institutional or cultural barriers. In these cases, the government may want to help through more deliberate and planned interventions, by offering new knowledge or equipment or seeking new technologies.

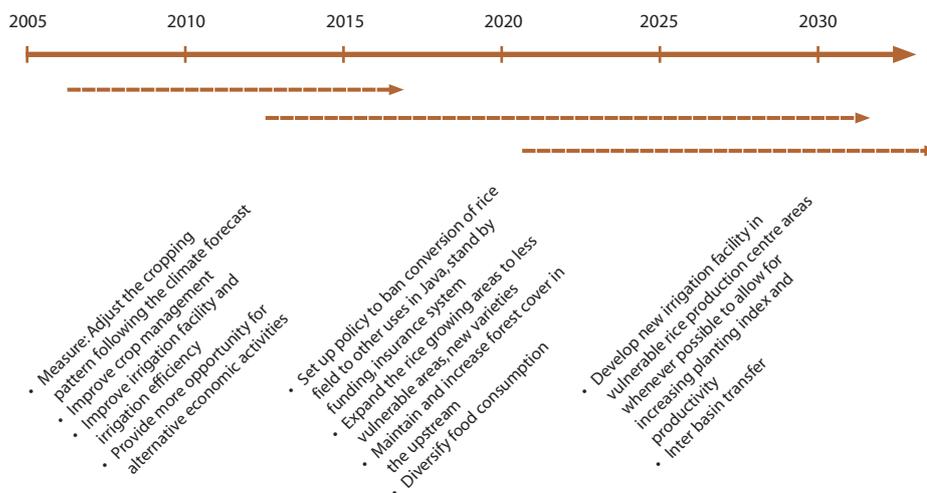
While some of these adaptation measures, such as changing cropping patterns, can take place quite quickly, others, such as reforestation or inter-basin water transfer, will take place over the longer term (Figure 7).<sup>16</sup>

#### **Adaptation in coastal zones**

Certain coastal environments will be at greater risk, such as tidal deltas and low-lying coastal plains, sandy beaches and barrier islands, coastal wetlands, estuaries and lagoons, and coral reefs and atolls. All of these will be threatened by rising sea levels. Faced with the effects of climate change, communities in coastal zones have a choice of three basic strategies: protect, retreat or accommodate.

- **Protect** - For protection, the most visibly reassuring option may be to build hard structures such as seawalls, but apart from being very expensive, these can have damaging side effects by displacing erosion and sedimentation. It is therefore generally better to use ‘soft’ options such as creating or restoring coastal wetlands and planting varieties of mangrove and vegetation that can cope with extreme changes of salinity.
- **Retreat** – This will simply involve moving. Many households and businesses can do this of their own accord, though local governments will also have a part to play in establishing ‘set-back zones’ requiring new developments to be at a specified distance from the water’s edge.

**Figure 7: Phasing of adaptation in agriculture**



Source: Government of Indonesia (2007). Climate Variability and Climate Changes and their Implications. Indonesia Country Report.

- *Accommodate* – Accommodation can also take various forms. It might, for example, involve introducing different varieties of fish to estuary, river mouth and lagoon areas and developing new forms of aquaculture. Coastal communities will also need much better warning systems for extreme weather events along with emergency evacuation plans for relocation in the event of a sudden inundation.

Much of this activity is the responsibility of local and national government. Nevertheless, at all stages there needs to be close community consultation since implementation of most measures will depend on local expertise. In some cases, there will be incentives for the private sector, as would be the case for combating beach erosion at tourist resorts. In addition, NGOs can help by raising public awareness and acting as intermediaries – identifying technologies, facilitating investment and providing management, technical and other assistance.

### **Adaptation for water**

Climate change is likely to have a major impact on water services – on both supply and demand. On the supply side, there are likely to be changes in rainfall patterns, with implications for food production, water-based transportation and many other forms of water-based livelihoods. On the demand side, global warming will increase people’s need for water and speed up evaporation from the surface of plants and from water sources such as ponds and lakes.

The most inclusive approach to sustaining water supplies is referred to as ‘integrated water resource management,’ which emphasizes the importance of maintaining healthy ecosystems. This takes into account such issues as deforestation, the management of water for irrigation and the relationship between this and the extraction of groundwater for households, businesses and agriculture.

Some of the options for securing water supplies involve increasing the supply – rehabilitating reservoirs, for example, relining canals, or harvesting rainwater. Others involve reducing demand – by cutting leakage from pipes or making more efforts to treat wastewater using ‘green infrastructure’ such as sand filters and wetlands.

In Indonesia, many water basins have more water than is needed for human activities, while others face serious shortages, especially the ones in Java and Nusa Tenggara. In these cases ‘inter-basin transfer’ can equalize the distribution of water from surplus to deficit regions.

### **Adaptation for health**

Many aspects of human health are affected by the climate. The impact may be direct – high temperatures causing heatstroke, say, or floods or landslides leading to death and injury. Or it can be more indirect – as environmental changes that accelerate the transmission of infectious diseases, or water shortages that undermine systems of hygiene or reduced crop yields leading to malnutrition.

For preventing the immediate physical impact of disasters, in some cases, the risks can be reduced by reforestation. In Madiun, for example, the government is planning to reforest hundreds of hectares of agricultural land on the slopes of the Wilis volcano to reduce the risks of landslides following heavy rainfall.<sup>17</sup> But all communities need to establish the zones that are at highest risk of flooding and landslide and make plans for early warning systems for evacuation.

Many of the other forms of adaptation for health will involve strengthening existing systems for primary and curative health care – expanding health awareness campaigns to encourage people to pay more attention to hygiene and the storage of water.

Combating the spread of disease will need closer surveillance of disease patterns. In floods, this will include monitoring for cholera. Over the longer term, it will mean monitoring the changing distribution of mosquito-borne diseases while ensuring that households are able to protect themselves, such as through the use of insecticide-treated mosquito nets.

### **Adaptation in urban areas**

Many of the health issues need to be given particular emphasis in the urban areas. For Jakarta, for example, the Indonesian Red Cross has a climate-change campaign to improve clean water storage and reducing vulnerability to dengue fever through cultivating fish that eat mosquito larvae. These activities are based on building local capacity and participatory planning – reaching out to youth and increasing awareness of adaptation among local government and community leaders.

As the floods in 2007 in Jakarta demonstrated, the vulnerable urban communities also need to be prepared in particular for the eventuality of floods – and should have emergency plans in place (Box 8).

#### **Box 8: “If only we had been better prepared”**

*“During the wet season, floods are a fact of life and in the past, we have not been too worried about them. But after the chaos and panic last February, I am concerned that things will get worse in the future. It was never this bad before. We could not save our possessions. Nobody knew what to do or where to go” (Ilham, a local of Rawa Kepa, Kelurahan Tomang, Jakarta Barat).*

Like Ilham, most people in Rukun Warga, Kelurahan Tomang have built their homes along the bank of the Jakarta West Canal. Even the tops of the canal are occupied with shelters and temporary structures for informal economic activities. Although nobody died here as a result of the floods in February 2007, many people lost possessions, such as motorcycles and household appliances, as well as their houses.

This was mostly due to a lack of warning. News spread only through word of mouth when the floods were already bearing down. Since there were no evacuation plans, many people panicked and simply rushed to the highest building: 2,000 people fled to a commercial building in Roxy Square. Here, however, they were trapped with no electricity or water, and no place to cook food. With cellular phones discharged and without radios, it was difficult to know what was happening.

Reflecting on this experience at a meeting organized later by the Urban Development Institute, local representatives of the households discussed what had happened and what could be done differently. They agreed on the need for anticipation and preparedness and mapped out the resources and facilities in their community that could be used in the future. They also formed a community working committee responsible for coordinating early warning information and evacuation.

### **Adaptation in disaster management**

In many respects Indonesia is a dangerous place to live – prone to a wide range of natural disasters. Earthquakes, tsunamis, volcanic eruptions, floods, fires, and extreme weather events are all too common. Climate change will make things worse – especially for urban slum communities living precariously on flood-prone riverbanks or for rural communities living in with the threat of landslides or the ravages of drought and forest fires.

Climate change will also usher in other new, slow-onset disasters such as rising sea levels and the intrusion of salt water into river deltas, destroying some coastal ecosystems and undermining people's livelihoods. The result? More lives lost, human suffering, increasing poverty, disruption of essential social services, destruction of property and infrastructure, setbacks to development and economic growth and damage to the environment.

It is all the more important, therefore, that we move to 'smart' disaster management. Rather than just responding after a disaster, the aim should be to reduce risks and prepare for disasters before they happen. Historically in Indonesia, people have taken such measures as a normal part of everyday thinking – on decisions about building a house, for example, designing a new mosque, or expanding a village, though in the rush to modernize, some of this wisdom seems to have been lost.

Fortunately, a shift is underway to re-establish this kind of thinking. Over the last few years, the Government of Indonesia has taken important steps in this direction. For example, the Government has passed new legislation on National Disaster Management (Risk Reduction) which should encourage communities to invest in their own safety by reducing the risk of disaster damage. The Government also initiated an intergovernmental public-private dialogue on a National Action Plan for Disaster Risk Reduction. Some local governments are moving even faster: those in Yogyakarta, Central Java and Maluku, for example, have leapt ahead, preparing their own Local Action Plans for Disaster Risk.

The challenge now is to build the capacity necessary for local governments to implement these plans and strategies, and most importantly, to empower communities to take matters in their own hands to ensure that everyone in Indonesia lives within a 'culture of safety' (Box 9).

#### **Box 9: Building a culture of safety**

The United Nations Development Programme (UNDP), with funding from the United Kingdom's Department for International Development (DFID), is helping bring international experiences and expertise to Indonesia through a new programme called 'Safer Communities for Disaster Risk Reduction in Development'.

Implemented by Indonesia's National Development Planning Agency (BAPPENAS), the programme will help strengthen and expand the growing regulatory and policy environment for disaster risk reduction actions by individuals, businesses, local governments and national government agencies. It will also help build partnerships to support decentralized decision-making while at the same time developing education and public awareness programmes.

Most importantly, the programme will provide local government and communities with opportunities to implement a range innovative disaster risk reduction demonstration project throughout the county.

These demonstrations will include:

- Carrying out community-based risk assessments and risk reduction programmes;
- Teaching masons how to build flood-resistant houses;
- Developing and implementing local building regulations;
- Introducing credit programmes for people who want to strengthen their houses;
- Supporting people who want to move away from flood-prone areas;
- Helping communities prepare for disasters and plan for evacuation; and
- Reviving and capitalizing on traditional wisdom, knowledge and practices.

The projects should demonstrate that it is better to invest a relatively small sum now on reducing disaster risk than a much larger amount later on cleaning up the mess after disasters strike – avoiding unnecessary suffering and building a culture of safety.

## Aiming for secure and sustainable development

Across all sectors, many of the adaptation measures will demand effective government action – which at the local government level will require much stronger coordination between different sectoral departments.

The government has prepared the National Action Plan on Mitigation and Adaptation to Climate Change (RANMAPI). The RANMAPI recognizes that climate change is a serious threat to Indonesia's socio-economic development and environment and that the climate change impacts are exacerbated by the unsustainable patterns of development in Indonesia. It lays down the strategic principles and also details the short-term, medium-term, and long-term action plans on both mitigation and adaptation. The action plan aims at supporting the achievement of both national and local development goals.

Ultimately, the best way to adapt to climate change is to switch to more sustainable forms of development – learning to live in ways that respect and harmonize with the natural environment. Climate change is a serious threat – a wake-up call. But we should also use this as an opportunity to give a fresh momentum to efforts at environmental protection. In Indonesia, we are fortunate to have a wealth of natural resources and are home to the world's greatest breadth of biodiversity. This is worth preserving itself – a heritage for succeeding generations. But there is also strong self interest. Just as we have to save the environment, so we are relying on the environment to save us.

From this perspective, mitigation and adaptation start to merge – replanting forests, for example, not only increases the absorption of greenhouse gases but also protects people against the immediate danger from landslides. Reducing the consumption of gasoline in cities not only reduces carbon dioxide emissions but also improves the health of city dwellers and helps people, particularly the young and the very old, to survive more extreme weather conditions. Such measures would make sense under any circumstances, but the need to adapt to climate change brings additional urgency.

Again we have much to gain by building on traditional wisdom. Many communities in Indonesia have always lived close to the natural environment; indeed, many seem like a part of it. In many areas of the country, people's homes are largely hidden under trees – they are more like parts of the forest. We would all do well to remember that from the remotest villages to the most modern cities, we are all parts of the natural environment – and for all our technological prowess, are subject to the powerful forces of nature.

When the climate changes we have to change too – and quickly.

# Endnotes

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# Some adaptation terminology

**Adaptation** – A response to actual or expected climate stimuli or their effects, which moderates harm or exploits beneficial opportunities. In human systems, adaptation can be both anticipatory and reactive and can be implemented by public and private actors.

**Climate** – Average weather, representing the state of the climate system over a given time period and is usually described by the means and variation of variables such as temperature, precipitation, and wind, most commonly associated with weather.

**Climate change** – Any change in climate over time, whether due to natural variability or as a result of human activity.

**Disaster risk reduction** – The systematic development and application of policies, strategies, and practices to minimize vulnerabilities and disaster risks throughout a society, to avoid or to limit adverse impact of hazards, within the broad context of sustainable development

**Ecosystem** – All living organisms and their environment; a group of living organisms that depend on each other and on the environment in which they live.

**Global warming** – The increase in the average temperature of the earth's near-surface air and oceans in recent decades, and its projected continuation.

**Greenhouse effect** – A process of reflecting heat to the atmosphere in the form of infrared rays. These infrared rays are absorbed by carbon dioxide in the atmosphere causing a temperature increase.

**Greenhouse gases** – Components of the atmosphere that contribute to the greenhouse effect. Some greenhouse gases occur naturally in the atmosphere, while others result from human activities such as burning of fossil fuels such as coal. Greenhouse gases include water vapour, carbon dioxide, methane, nitrous oxide, and ozone.

**Intergovernmental Panel on Climate Change (IPCC)** – A scientific panel established in 1988 to publish special reports on topics relevant to the implementation of the UN Framework Convention on Climate Change.

**The Kyoto Protocol** – This is an amendment to the United Nations Framework Convention on Climate Change that assigns mandatory emission limitations for the reduction of greenhouse gas emissions to the signatory nations.

**Mitigation** – All human interventions that reduce the sources or enhance the sinks of greenhouse gases.

**'No regrets'** – policies and measures that would generate social benefits whether or not there is human-induced climate change.

**Sustainable development** – Development that meets the needs of the present without compromising the capacity of future generations to meet their own needs.

**United Nations Framework Convention on Climate Change (UNFCCC)** – An international treaty which entered into force in 1994 aiming to stabilize greenhouse gas concentrations at a level that would prevent dangerous human-induced interference with the climate system.