PESTICIDE ACTION NETWORK ASIA AND THE PACIFIC

WEATHERING THE CLIMATE CRISIS

The Way of Ecological Agriculture

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FOREWORD

The last two years have seen a series of floods, typhoons and hurricanes in most countries of the world, in all the continents – From Pakistan, Tajikistan, China, India, Bangladesh, Philippines, Indonesia, Vietnam, Fiji, Australia; to Angola, Malawi and Namibia; to Austria, Czech Republic, Germany, Turkey; to Brazil, Peru, Ecuador, Guatemala; to Mexico, USA, Canada. The flood in Pakistan in August 2010, the world's worst so far, left a fifth of the whole country under water, at least 2,000 people dead, a million homes devastated and some 20 million people displaced. Torrential rains have caused landslides that took many lives in Guatemala. The list can go on and on.

The last two years also saw severe droughts and temperature increase – From Australia, China, Tajikistan, Kyrgyzstan, and Uzbekistan; to Turkey, Syria and Jordan; to Pakistan, India, Bangladesh and Burma; to Benin, Ghana and Senegal; to Argentina, Paraguay, Uruguay, Bolivia and Chile. Russia's extraordinary heat wave which slapped the country in June of 2010 recorded nearly 11,000 deaths and cost some $15 Billion in economic backlash as fires and drought ravaged the country. Severe drought has left millions short of water in the southwest region of China, believed to be the worst in a hundred-year period.

But 2010 is not an unusual year. Similar floods, typhoons, hurricanes and droughts have occurred across a range of countries in the world in 2009, 2008, 2007, *et.al*. as well. The only difference is that their intensity and frequency are increasing year after year.

Are these 'natural' disasters? When such disasters are happening almost simultaneously at the regional (and global) levels, and with unprecedented and increasing frequency, these cannot any more be called 'natural' disasters. These disasters are now human-made and consequences of global warming and climate change problems are exacerbated by our development priorities, policies and projects.

In the last several decades, climate change has become one of the most severe and pertinent crisis that threatens the lives, livelihoods and survival of the people of the world and, in fact, the very existence and well-being of the earth. Reckless greenhouse gas emissions have caused the global temperature to rise abnormally, which has completely upturned the concept and patterns of seasons and weathers. Rains do not come in proper cycles anymore. The warming winters are forming less ice and the hotter summers are melting glaciers and mountaintop ice faster, causing immediate flooding, with longer lasting prospects of water scarcity in the future. The small island nations are facing prospective extinction from the rise in sea levels through global warming.

What is ironic is that though this rapid climate change is largely caused by the unsustainable production and consumption patterns of industrialized Northern countries, it is the people of the South, and particularly the majority small food producers, who suffer the most from its effects.

But be it the rising sea levels, floods, droughts, water scarcity or uneven and untimely rains, the most critical impacts of the climate crisis are on the food and agriculture of the world, and the survival of the majority food producers – the small peasants, fishers, pastoralists and gatherers. Various studies have projected water stress, agro-biodiversity loss, cereal quality and yield drop, and increased pest and disease infestation. All these portend more poverty, more hunger, more malnutrition and more misery for the people in general and the small food producers in particular.

Even as the small, majority food producers of the world struggle to keep their heads above water against uncertain and erratic weather challenges and catastrophes, climate change also has social, cultural, and particularly economic and political dimensions, which have made the situation more complicated and critical for the people of the South, and which most of the common people have yet to understand.

Since the setting up of the UN Framework for Convention on Climate Change at the Earth Summit in Brazil in 1992, governments and world bodies have been discussing the problems and issues of climate change. Yet, no decisive action has been taken, no concrete and effective solutions realised, while the climate change problems continue to worsen. On the solutions, the world has got divided into the developed, developing and undeveloped countries – and climate change which ought to have been taken as a human rights concern, has been turned into a trading issue and opportunity by the developed countries, their corporations and the financial institutions. In such a scenario, it is obvious that the issue of food and agriculture has also been entirely marginalized.

As such, neither the issue of corporate agriculture being a major contributor to greenhouse gas emissions, and thereby to climate change, is reported and exposed, nor the potential of localized, biodiversity-based ecological agriculture in addressing the climate change problems properly appreciated.

Underlining the two issues, this handbook seeks to explain in a simple way what is climate change, how it impacts our lives and our food and agriculture. For a majority of the people in the world, climate change is still a new subject. It is a phenomenon that is strongly felt and experienced, but not yet entirely and theoretically understood in its various physical, socio-economic-politico dimensions. As such, this book also outlines the international discourse on climate change, and how it fails to address the genuine concerns of the majority people of the world, in particular the small food producers. I trust this handbook will contribute to further our understanding on climate change and the major issues that surround it.

On the issue of small peasants and biodiversity based ecological agriculture, the handbook cites cases and instances of small peasants, who despite all odds against them, continue to respond to the challenges

of climate change through innovations coming from their inherent local knowledge and vast experiences.

These examples are very heartening and keep alive our hopes in the continued struggles of the people, and strengthen our trust that it is the small peasants who offer the real solutions to the climate crisis. It is they, the UN, other international organizations and institutions and the governments of the world need and must turn to for answers.

Sarojeni V Rengam
Executive Director
PAN AP

INTRODUCTION

> "Mitigation is always the best form of adaptation. There is no way that you can effectively adapt to all the impacts of climate change; it is absolutely impossible. So while we work at adapting, let the main emitters of greenhouse gases work on reducing their emissions."
>
> *--Anthony Nyong, International Development Research Centre, Nairobi, and lead author of African impacts of climate change in the Intergovernmental Panel on Climate Change Report (2007).*

Hadi Eidar, a rice farmer in Penang, Malaysia, had a problem with the pests thriving in his farm and damaging his crop. Ade Saeful Komar, in Subang district, Indonesia, faced erratic rains and increasing water shortages that affected his rice crops. Farmers in the Philippines are worried about the stronger and, of late, more frequent typhoons that destroy their crops. Down under, in Australia, Julia Weston and Frank Giles of Tasmania who grow berries and raise cattle were distressed by a severe drought that hit their crops, pasture and livestock, until they shifted to "biological farming".[1, 2, 3]

Though seemingly unconnected, these events are driven by a common force: climate change. Millions of poor farmers in the tropical developing world have been in fact complaining of erratic and deficient rainfall, droughts, floods and more intense storm surges and cyclones. For subsistence farmers, these weather-related problems, stemming from the changing climate, are now a harsh day-to-day reality.

Already living an ardous life on meagre means and weighed down by increasing cost of inputs, the small farmers now face even greater uncertainties and insecurities – not knowing when it will rain, when to plant and what to plant, or how much of their crop will survive the increasing extreme weather events such as instant heavy rains, flash floods, heat waves and cyclones. Reports from many developing regions show that crop yields have been falling or crops failing because of bad weather; many farmers have even given up planting new crops following repeated failures or crop damages. Poor farmers, fishers and herders, from tropical Latin America to Africa and Asia, face the risk of losing their land, livestock and livelihood because of weather-related calamities and displacement, or of being forced to sell their meagre assets and migrate to cities in search of livelihood. These groups are the hardest hit by climate change, even though they are the least responsible for causing it.

That the climate has been changing worldwide is now undeniable, though many political leaders and decision-makers in the developed world, and more so in the USA, had stubbornly refuted this for long for their own political ends; it was “capitalism’s inconvenient truth”, as Australia’s *Green Left Weekly* put it. The need to let capital and corporations function unfettered and also the reluctance to disturb the “American way of life” took precedence over facing this inconvenient truth.

Today, however, there is a general consensus that the Earth is warming and consequently the climate is changing, but there is no agreement on the solutions to the problem. Bickering still continues on various issues, and international negotiations on global warming have dragged on for years. Instead of genuinely addressing the basic issues such as their unsustainable consumption, resource use and production processes which cause high climate-changing gas emissions, the developed countries, which have a share of 20 per cent of the world’s population but

account for over 60 per cent of the global carbon emissions, have devised some dubious mechanisms (the so-called market-based solutions such as carbon trading) which only help their corporations continue business as usual and financial institutions to make more money. Neither do these solutions promote sustainable development nor do they mitigate the problems of the vulnerable communities around the world - which were to be the broad goals of any such solutions in the first place as set out by the United Nations Framework Convention on Climate Change (UNFCCC). The USA is, in fact, now trying to undermine the UNFCCC's legitimate role in setting such basic principles (including the principle of *common but differentiated responsibilities* in reducing carbon emissions) and steering global climate change negotiations within that framework. However, as the United Nations Development Programme's Human Development Report (2007) noted: "The world's poor and future generations cannot afford the complacency and prevarication that continues to characterise international negotiations on climate change"[4]. Meanwhile, spurred by the prospects of monopoly control and early market gains, corporations are rushing to patent a range of high-cost technological fixes for climate change, including genetically modified 'climate-ready' seeds, agrofuel technologies, carbon storage systems, nanotechnology, and geo-engineering to remove carbon dioxide directly from the atmosphere, *etc*.

People's movements and civil society organizations around the world are concerned about these developments. They think neither technological fixes nor carbon trading can solve the problems (in fact carbon trading has added to the problems of marginal communities in terms of loss of land and resources) whose roots lie elsewhere – in the overconsumption and overexploitation of natural resources by the developed countries, transnational corporations chasing profits, and a small elite across the world (including within developing countries). While many of them have therefore rejected 'market-based mechanisms' as solutions, some have demanded a thorough review of these. Basically, they have called for the developed countries to deeply reduce their carbon emissions and repay their *climate debt* to developing countries and poor communities for having appropriated a disproportionately high share of the global resources, environment and the atmosphere in the course of their industrial development (which has left very little environmental space for development for others) and also compensate poor communities in

developing countries for having caused much harm to them as a result of climate change.

By all accounts, agriculture is most vulnerable to climate change, and hence is the focus of this book. How is changing climate affecting agriculture and food security, deepening the food crisis, pushing the already high food prices further up and causing greater hunger? How is it threatening the livelihood of people in the Asia-Pacific region which hosts 60 per cent of the world's population, mainly small-scale and subsistence farmers and landless workers, fishers and indigenous people? How have poor farmers and others been coping with the problems? How does the current system of corporate-promoted chemical- and energy-intensive agriculture and globalized agricultural trade contribute to climate change? And how can sustainable or ecological agriculture, based on biological diversity and non-chemical inputs, help reduce carbon emissions, improve farm productivity, stability and environmental quality and thus enhance the resilience and livelihood of the farmers and the rural poor? These are the main issues that the book discusses.

Historically, farmers have responded to environmental changes by gradually changing their agricultural practices, developing new varieties of crops and innovating to maintain productivity. Based on this resilience and drawing on their indigenous knowledge and experience, farmers in many parts of Asia are now trying to cope with the problems of climate change – changing crop patterns and timings, using local varieties of seeds better suited to floods, droughts and cyclones, conserving water and soil quality, using natural ways of pest management, *etc*. But given the fact that the climatic changes now occuring are too rapid and too intense, these adaptation measures have limitations. These can help cope up to a point, but resource-poor farmers will find it hard to "continuously cope" with climatic changes and natural disasters occuring at such a pace and scale, as farmers' groups point out.

This again underlines the need for mitigation or cutting down the main sources of climate change. Agriculture directly contributes around 10-14 per cent of the greenhouse gas emissions (and higher, if land use change or deforestation and worldwide food transport are taken into account), mainly from corporate agriculture and industrial animal farming. Considering this, biodiversity-based ecological agriculture, integrating

diverse crops and agro-forestry, traditional animal husbandry and local food markets offer much scope to reduce carbon emissions and enhance carbon storage in agriculture besides providing greater resilience so farmers can better adapt to climate change.

Recent studies in several countries show that biodiversity-based ecological agriculture can lead to substantial reductions in emissions, countering climate change to a considerable extent, and that greater biodiversity (as opposed to the intensive cultivation of single crops – much of the world's food supplies now depend on a narrow base of just 12 crops), by providing greater farm stability in the face of changing climatic conditions and natural disasters, offers a good strategy in adapting to climate change. The studies also show that biodiversity-based ecological agriculture has significant economic and social benefits – higher farm productivity and income, greater food security, and better nutrition, health and environment (as no chemicals are used). Moreover, these systems are particularly favourable to small-scale and marginal farmers who benefited more from these systems than larger farms. Thus, besides mitigating climate change, biodiversity-based ecological agriculture also helps mitigate hunger and poverty. In this context, it is heartening that the number of farming communities adopting biodiversity-based ecological agriculture around the world has been increasing in recent times.

With farm productivity steadily declining the world over and with climate change further threatening agriculture and food production, biodiversity-based ecological agriculture points to the way how we should produce food in the future to raise production without damaging ecosystems. "Small increases in yields on small farms that produce most of the world's staple crops will have far more impact on food availability at the local and regional levels than the doubtful increases predicted for distant and corporate-controlled large monocultures managed with high-tech solutions as genetically modified seeds", says Miguel Altieri, Professor of Agro-ecology at the University of California, Berkeley, in the USA. Such food security issues, so important for the world's poor, both rural and urban, and support to biodiversity-based ecological agriculture, however, find hardly any place in national agricultural and climate policies or international climate negotiations. Because of its multi-functional benefits for a large number of people, particularly the poor and the generally indebted, biodiversity-based ecological agriculture

calls for strong support from governments and public institutions through appropriate policy and financial measures, including thorough agrarian reforms which will facilitate its greater adoption. Meanwhile, poor farmers also need much support from governments to adapt to climate change; instead, governments in the region seem to be busy developing carbon markets for corporations, national as well as transnational.

Chapter One
WHAT IS CLIMATE CHANGE?

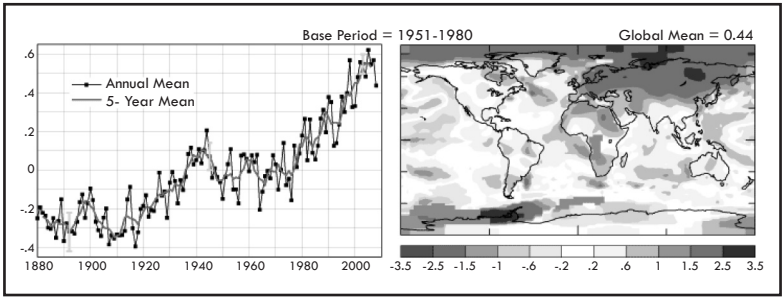
Climate records show that the 30-year period from 1978 to 2007 saw the 27 warmest years since 1850 when global average temperatures began to be reliably measured. The years 1997 to 2008 saw ten of the warmest years recorded over more than a century from 1880 to 2008. The earth warmed by about 0.74^0 Celsius (C) from 1906 to 2005. The rise has been even faster in the recent past - in the short span from 1990 to 2007, the average global temperature rose by 0.33^0 C. Further, the mean global temperature rose from 14.4^0 C during the 1990s to 14.64^0 C in barely eight years from 2000 to 2007 (See Figure 1). A $+0.08^0$ C variance with that of year 2005, the prior warmest year and $+0.06^0$ C compared to 1998 makes the year 2010 the warmest in 131 years (See Figure 1a).

What caused the Earth to warm up to this extent? The Earth of course has been warming to some extent historically because of natural processes – by the balance of the Sun's energy received on the Earth and reflected back or trapped in the atmosphere. The Earth transmits some of the solar energy it receives back *as heat* (or infrared radiation) but much of this heat is trapped by the atmosphere (mainly by water vapour and other gases in the atmosphere) and reflected back to the Earth's surface. This

heat keeps the Earth warm enough to sustain a wide variety of life. Along with other factors, it also drives climate cycles such as the monsoons. Any changes in this heat balance or the Earth's temperature will thus lead to changes in the climate.

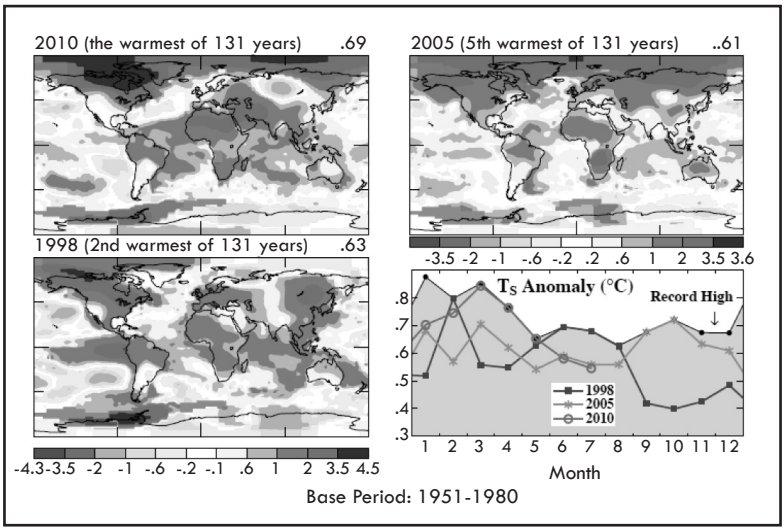
This process of natural warming of the Earth is also known as the 'greenhouse effect' (because the glass or plastic enclosures of a greenhouse trap and retain heat to keep the inside warm), and the gases in the atmosphere that trap the heat are known as greenhouse gases (GHGs). These include carbon dioxide, methane, nitrous oxide, *etc*., and their levels in the atmosphere have been steadily increasing in the past two centuries since the advent of the industrial age. Trapping more heat, they can cause a rise in the Earth's temperature, intensifying the greenhouse effect, which in turn can cause changes in the climate. Both the recent rise in temperature or global warming and climate changes have now been linked to the increase in the levels of atmospheric GHGs caused by human activities, mainly the burning of coal, oil and natural gases (fossil fuels) for various purposes. This is known as *human-induced* or man-made climate change. According to the Intergovernmental Panel on Climate Change (IPCC) report published in 2007, global GHG emissions, "weighted by their global-warming potential", increased by 70 per cent from 1970 to 2004.

Figure 1. Mean global temperatures – (a) Global Land-Ocean Temperature Anomaly (°C) (b) 2008 Surface Temperature Anomaly (°C)



Source: http://data.giss.nasa.gov/gistemp/2008/

Figure 1a. January-July Mean Surface Temperature Anomaly (^{0}C)



Source: http://data.giss.nasa.gov/gistemp/2010july/

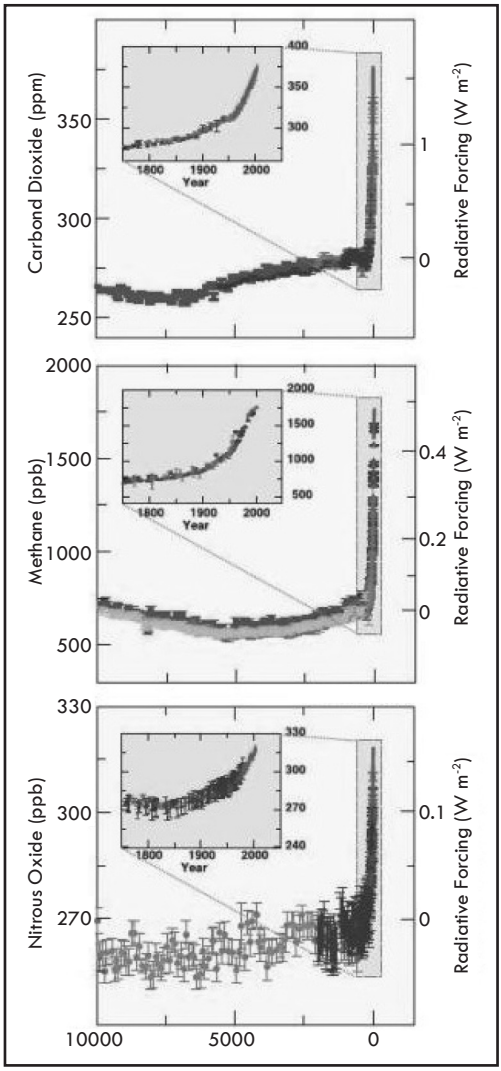
Sources and shares of GHGs

Power generation from fossil fuels and industrial manufacturing processes contribute the highest amount of GHGs, accounting for 45 per cent of the GHGs in the atmosphere in terms of carbon dioxide equivalent. IPCC data (up to 2004) show that the energy sector contributed 26 per cent. Industrial manufacturing processes had a share of 19.4 per cent; the major GHG-emitting industries include metal processing (aluminium, steel, lead, *etc*.), cement, chemical, paper and pulp, and petroleum refining, all of which are highly energy-intensive. This makes both the large-scale use of fossil fuels for power generation and energy-intensive industrial processes environmentally unsustainable.

Among the other sources of GHGs are deforestation and forest degradation which contributed 17.4 per cent (forests absorb and store atmospheric carbon dioxide which is released when they are destroyed), agriculture 13.5 per cent, transport 13 per cent, the buildings sector 7.9 per cent and wastes and waste water 2.8 per cent.

Of the GHGs, carbon dioxide is the most important, now accounting for about 75 per cent of the total human-induced GHG emissions. It is mainly emitted by the use of fossil fuels in industrial processes, power generation and distribution, transport, intensive and heavily mechanized agriculture (which uses fossil fuel), and deforestation. Carbon dioxide concentrations in the atmosphere increased from 280 parts per million (ppm) in the pre-industrial period around the middle of the 18th century to about 384 ppm in 2007 (*See Figure 2*). Some leading scientists, such as James Hansen and his colleagues at NASA's (National Aeronautics and Space Administration, USA) Goddard Institute for Space Studies think that this level is perilous and needs to be quickly brought down to 350 ppm. If unchecked, the carbon dioxide concentration is estimated to go up to 550 ppm by 2050 with disastrous consequences.

Figure 2: Changes in greenhouse gases from ice core and modern data.



Source: http://www.peopleandplanet.net

Methane is released mainly by fossil-fuel use, agriculture (from flooded rice fields and intensive livestock production), decay of wastes, *etc*., and nitrous oxide, again, by agriculture (from the use of nitrogen fertilizers) and burning fossil fuels. Their atmospheric concentrations are rather low compared to carbon dioxide but they can trap much more heat per molecule - 25 times and nearly 300 times more respectively than carbon dioxide.

Then why is it that carbon dioxide is at the centre of much of the debate on global warming and its future impacts on the environment? There are two reasons. One is its relative abundance in the atmosphere. The other is the fact that carbon dioxide survives in the atmosphere much longer than methane and nitrous oxide, causing more damage in the long run (though water vapour which traps heat is also abundant in the atmosphere, it is short-lived). "Carbon dioxide has caused most of the warming (that we see today) ... and its influence is expected to continue", says the Union of Concerned Scientists in the USA. "It takes about a decade for methane emissions to leave the atmosphere, and about a century for nitrous oxide. In the case of carbon dioxide, much of today's emissions will be gone in a century, but about 20 per cent will still remain in the atmosphere approximately 800 years from now .... So, in the same way that carbon dioxide emitted long ago is now contributing to the changes in the climate we are experiencing today, the emissions we are currently releasing will help determine the climate our children and grandchildren will experience." [5]

Once the human-induced emissions cause an initial rise in temperature, various atmospheric processes and a 'self-reinforcing cycle' speed up and intensify the warming. For example, an initial rise in temperature from the carbon dioxide added to the atmosphere leads to higher evaporation of the Earth's surface water and, as a result, to an increase in the water vapour content in the atmosphere. "This in turn causes more warming, which causes an additional increase in water vapour in a self-reinforcing cycle, and this water-vapour feedback may be strong enough to approximately double the increase in the greenhouse effect due to the added carbon dioxide alone". [6]

This relatively rapid pace is what sets the current phase of global warming apart from the earlier natural-warming phases. This rapid warming can

have severe impacts on all human activities and ecosystems. It will worsen the environmental degradation taking place already and affect the productivity of natural resources. And it is the poor farmers and indigenous communities in the tropical developing countries, particularly those living on marginal lands, who will bear the brunt of these adverse impacts.

The IPCC (2007) linked the increase in GHGs in the atmosphere and the temperature rise to increased emissions from human activities. It also estimated that the warming would increase at about 0.2^0 C per decade over the next two decades. On a longer timescale, the Earth's temperature would rise by 1.8^0-4^0 C by the end of the century, under various rates of emission, unless GHG emissions are drastically cut down. Even if the emissions remained unchanged at the year 2000 levels, the Earth would still warm by about 0.1^0 C per decade as a result of the earlier emissions.[7] This emphasizes the seriousness of the problem.

Chapter Two
THE IMPACTS OF CLIMATE CHANGE

Narayana, a small-scale (1.6 hectares) groundnut farmer in Anantpur district of Andhra Pradesh, and Harmohan, a marginal (0.4 hectare) rice farmer in the Mahasamund district of Chhattisgarh (both in India), lost much of their crops in 2008 to bursts of unusually intense rains. Intense rains had destroyed Narayana's groundnut crop the previous year too. In Harmohan's case, the rains were followed by a long dry spell. As erratic and intense rainfalls increase, scientists are advising farmers to change crop cycles and varieties. "But there is no certainty that Narayana will be able to save his crops or Harmohan will harvest 55 sacks of rice (his normal yield) the next season or the one after that", says a report in India's reputed environmental journal, *Down-to-Earth*. "While scientists seek answers in weather patterns, the government needs to change its agricultural policy to deal with the acute shortage of usable water for farmers' fields," said the report.[8] In the eastern state of Orissa, a perception survey of 2,000 farmers by an NGO, Water Initiatives Orissa, in 2007, showed that farmers saw "adverse climatic conditions like delayed monsoon, erratic rainfall and freak weather" as the reasons for a fall in farm productivity in the past five years. [9]

Or, take the case of the Kols, an indigenous community living on small-scale farming and forest products in the Chitrakoot district of India's northern state of Uttar Pradesh. In the past few years, droughts and erratic rains have been badly damaging their crops, forcing some of them to go hungry. Earlier, even when the crops failed, forest products (roots, tubers, vegetables, berries and edible leaves) gave them enough food, and they could also earn some income by selling forest products. But now they hardly get anything to eat or sell from the farms and the forests. The forests are drying up and getting thinner and the quality of the produce poorer. Rising temperatures have damaged the wheat crop, and some have even left their land fallow. And with "an increasing scarcity of fodder, cows yield much less milk."[10]

In the Philippines, on the other hand, most farmers see floods and longer rainy seasons as the biggest problems. In a nation-wide survey by MASIPAG (local acronym for Farmer-Scientist Partnership for Agricultural Development, a network of small-scale farmers, farmers' organizations, scientists and NGOs), farmers said that floods, mainly typhoon-driven, damaged 25-100 per cent of their crops, and farmers in the northern part of the country were even forced to abandon rice cultivation in the typhoon season. Prolonged rainy seasons caused yield losses of about 25 per cent. Farmers also noticed an "aberration" - a sudden change of weather or a quick rise in temperature that lasted for a short while which "they had not seen before". "There are a lot of changes", said a farmer. "In the early 80s, the climate was still normal. Every year, we had two seasons – dry and wet....it was dry for many months and then it rained." But now the weather is unpredictable, and crops are failing.[11]

In Malaysia, indigenous communities are feeling the heat of large-scale deforestation and are finding it difficult to survive. The Kayan community, for example, had lived in the forests of Sungai Keluan in Sarawak for hundreds of years but then the corporations came for logging. "When logging began in these forests, including in the natural water catchment areas, we lost the ability to survive on the forests for food and livelihood," says Juk Eng Jau, a community leader. "The temperature rose because of the lack of trees to keep the place cool. There was a loss of biodiversity, including flora and fauna, and some animal species disappeared." On the other hand, vegetable farmers in the Cameroon Highlands say that the hills are getting warmer with frequent and unpredictable changes

in the weather which is "ruining" their crops. Land clearing on the hills has added to the problem, and vegetable yields and incomes have dropped.[12]

In Nepal, according to official estimates, where a third of the 28 million population is poor, unusually dry winters (affecting winter crops) and erratic rains are "threatening the livelihood of hundreds of desperately poor communities already struggling to produce enough to survive" (according to an Oxfam report), and the UN's World Food Programme says there has been a "sharp and sustained decline in food security" in recent years.[13]

All these offer some examples of how climate change is affecting or will affect poor farmers, forest-dwellers and pastoralists in Asia, though even these reports and statistics do not convey the full picture of the increasing uncertainties and food and livelihood threats they face because of climate change.

Climate change consequences and impacts

Climate change primarily includes changes in norms and patterns of temperature and consequently rainfall. These changes, classified under a direct consequence of the two broad characteristics of climate change – global warming and changing rainfall patterns and distribution, are having significant, wide-ranging geographical, economic, social and political impacts at both the local as well as the global levels. Often these impacts are not isolated but are intricately linked to one another in a ripple effect. Climate change and its impacts need to be looked at and understood as such.

Some of the broad impacts of climate change and their impacts are discussed below, based mainly on the IPCC (2007) report.

Changes in rainfall patterns and distribution

Over the past century (1900-2005), rainfall increased significantly in some regions of the world but decreased in other areas. In general, rainfall increased in regions at higher latitudes (northern regions) and decreased in most sub-tropical (southern) regions. Thus, northern Europe, northern

and central Asia, and North and South America (particularly the eastern parts of South America) saw a significant rise in rainfall while southern Asia, southern Africa and the Mediterranean region saw a decrease.

Two distinct trends are seen in global rainfall patterns. In the 75 years from 1925 to 1999, "the area between 40 and 70 degrees North latitude grew rainier while the area between 0 and 30 degrees North grew drier", reported the National Geographic in its April 2009 issue (based on data from the US National Oceanic and Atmospheric Administration's Geophysical Fluid Dynamics Laboratory). "Climate models generally agree that over the coming century, the polar and sub-polar regions will receive more precipitation and the sub-tropics – the area between the tropical and temperate zones - will receive less."[14]

Bursts of heavy and instant rainfalls (because of the greater evaporation of water due to warming and the heavier water content in the clouds), often leading to sudden floods, have increased in most parts of the world. What is even more worrisome, as far as farmers and agriculture are concerned, is that rainfall is and will be increasingly erratic and unseasonal, affecting crops.

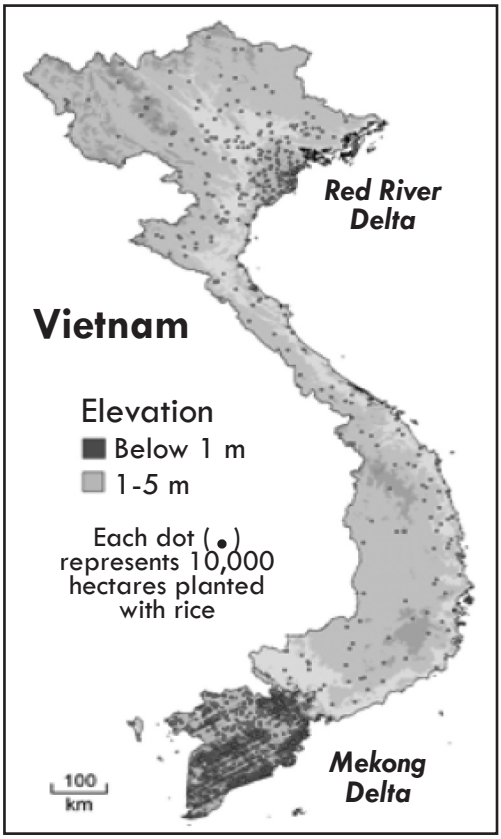
Sea level rise and the threat of coastal flooding

Studies have shown that oceans have absorbed much of the increase in atmospheric heat (over 80 per cent). Consequently, oceans have warmed up to a depth of at least 3,000 metres since 1961, and, with warming, sea water is expanding and sea levels rising. While the sea level rose at an average of 1.8 mm a year from 1961 to 2003, the last decade in this period, 1993-2003, saw the sea rise at a much higher rate – at 3.1 mm a year. On a longer time scale, the sea level rose by 17 cm during the entire 20th century, and is expected to rise by 49 cm by the end of this century, according to IPCC estimates. The rise could be much higher, because this estimate does not take into account an increase in ice melt or "abrupt collapse" of ice sheets in the Greenland and Antarctica regions. Recent evidence of faster ice melting in these regions point to such an eventuality.

Rising sea levels can erode or submerge large tracts of coastal land, jeopardizing the lives and livelihood (agriculture, fishery, *etc*.) of millions

of people living in the large number of small island nations in the South Pacific and low-lying coastal zones in many countries (Egypt, India, Bangladesh, Indonesia, Vietnam, *etc.*). Salt water from the rising sea can seep into farmland and inland water resoures, turning them saline. Both coastal erosion and salinity of coastal land are increasing in many low-lying regions. Low-lying Bangladesh may lose about 18 per cent of the land to erosion, according to a World Bank study. This would also affect agriculture in such coastal areas and lead to displacements and migration of people.

Figure 3: Relatively small increases in sea level could be disastrous for Vietnam's main rice-growing areas in Mekong and Red River deltas.



Source: http://www.irri.org/publications /ricetoday/pdfs/6-3/10-15.pdf

Also threatened in Asia are its large, low-lying delta regions such as the Mekong and Red river deltas in Vietnam, the Ganges delta in India and the Ganges-Brahmaputra-Meghna delta in Bangladesh. These deltas are ecologically rich agricultural lands, and rising sea water can erode or submerge large swathes of these lands.

For instance, according to a study by the International Rice Research Institute (IRRI) which mapped

vulnerable rice-growing coastal areas in Vietnam, even "relatively small increases in sea level could have disastrous consequences" on rice crops in the Mekong and Red River deltas on which Vietnam depends heavily for its food production.[15] (*See Figure 3*) In Malaysia, coastal rice fields are getting flooded because of the rising sea level and storm surges.

While land erosion from coastal flooding is a major problem, salt water infusion from the sea can further affect land and fresh water resources far inland. The threat is particularly serious in South-east Asia, South Asia and East Asia. In Bangladesh, where the sea level has been rising for the past few decades, salt water seepage inland would disrupt the production of rice, the staple food, in its poorest and heavily populated regions, according to the Centre for Environmental and Geographic Information Services (CEGIS)[16]. Salt water infusion from the sea is also a problem in the Ganges delta region of Sunderbans in India. Sea water infusion is often aided by lower sediment deposits in the delta regions and higher groundwater withdrawals inland.

Depleting water resources

Water is critical to human, animal and plant survival. However, in many developing countries water resources are declining because of excessive consumption, wastage and pollution. Global warming and changes in rainfall patterns could worsen this situation. Greater warming, ice melt and lower rainfall would dry up rivers and lakes, reduce groundwater recharge and thus further deplete water resources. As a result, water availability could drop by as much as 10-30 per cent over some dry regions at mid-latitudes and dry tropical regions, and increase at high latitudes and in wet tropical areas. Further, as glaciers and mountain snow covers (such as in the Himalayan mountains in Asia and the Andes in South America) deplete, so too will water in the major rivers and river basins that depend on these glaciers for sustaining their flows in the dry season.

Because they offer easy access to water, large river basins attract and sustain large populations, particularly poor farmers. For example, the three large river basins in Asia – the Ganges-Brahmaputra-Meghna river basin (stretching across China, Bangladesh, Bhutan, India, Nepal and Pakistan), the Indus river basin (across Afghanistan, Pakistan, China, India

and Nepal) and the Helmand river basin (across Iran, Afghanistan and Pakistan) – sustain about 750 million people, among the poorest in the world. "Climate change is likely to lead to severe water shortages in all of these basins in the long term as the Himalayan glaciers are reported to be receding, reducing the glacial run-off which feeds these rivers," says a report by the United Nations Environment Programme (UNEP) and the Asian Institute of Technology in Bangkok. This will put greater stress on groundwater sources, even as "groundwater levels are declining at a rate of 2-4 metres per year in many parts of the Ganga-Brahmaputra-Meghna and Indus basins due to intense pumping ..."[17] Water flow is also expected to reduce in the Yellow and Yangtze rivers, fed by the Himalayan glaciers, in China; these two major rivers support irrigated agriculture and the livelihood of millions of people inhabiting these river basins. Similarly, in South America, the melting Andes glaciers are creating water problems for poor farming communities in Peru, Bolivia and other neighbouring countries.

By reducing water resources, global warming would thus constrain irrigated agriculture in many parts of the world. As the Earth warms up further, water shortages may indeed emerge as a limiting factor in agricultural production in the coming decades, especially in the tropics and the sub-tropics, and that is where most of the world's poor live.

Increase in floods, droughts and cyclones

Another worrying trend is the increasing number and the intensity of climate-related extreme events such as heat waves and droughts, intense rains and flash floods, landslides, cyclones and cyclone-driven floods, particularly in Africa and Asia. Southern Africa, for example, was ravaged by floods for three years in a row recently; floods across West Africa in August-September 2009 displaced 88,000 people, besides destroying crops. In southern China, torrential rains caused heavy floods in 2004, 2007, 2008 and 2009, leaving hundreds of thousands of people homeless and destroying large swathes of crops. A series of floods hit South Asia – India, Bangladesh, Nepal and Bhutan - in 2007, killing over 2,000 people and displacing over 20 million. The number of floods and cyclonic storms in South-east Asia also increased significantly from the 1990s to the period 2000-2008 - from 80 to 115 in the Philippines, from a little over 20 to about 60 in Indonesia, and from about 35 to 60 in Vietnam.[18] According

to IPCC, heavy rainfall events and floods are expected to increase; past trends show that the number of severe *inland floods* worldwide doubled during the decade from 1996 to 2005 compared to the total number of such events during the three decades from 1950 to 1980. Meanwhile, a devastating flood in Pakistan in August 2010 killed 1,500 people, turned 2 million people homeless and damaged about half a million hectares of crops; though firm links are yet to be established, climate scientists think that the flood was "probably" caused by climate change.

The occurrence of tropical cyclones too has been increasing. The most recent was Typhoon Marakot (severe tropical cyclones are called typhoons in East and South-east Asia and hurricanes in the Atlantic region) which hit Taiwan, China and Japan in August 2009, causing landslides and heavy flooding, especially in Taiwan. Other major cyclones in recent times were the series of severe storms and typhoons that killed about 1,500 people, destroyed over a million hectares of farmland and affected over 250 million people in China in 2006; Cyclone Sidr (Bangladesh) which killed over 2,000 people, ruined thousands of acres of crops and affected 27 million people in 2007; Cyclone Nargis in Myanmar in 2008; and Cyclone Aila (Bangladesh and the Sunderbans area of West Bengal, India). Tropical storms and cyclones have become more frequent in South-east Asia. In 2004, a record 21 typhoons hit the region. The Philippines is the worst-affected by typhoons in the region. Meanwhile, scientists say that "rising sea surface temperatures are enhancing the destructiveness of tropical cyclones worldwide."[19]

Droughts and desertification are spreading and intensifying in the tropical regions, destroying crops across tropical Central America, Africa and Asia.[20] Africa is the worst hit, as far as droughts and water scarcity are concerned. Droughts are now spreading from the traditionally drought-prone regions such as Ethiopia, Sudan and Somalia to other parts of the continent. Kenya's long drought a couple of years ago hit its agriculture, depleted its pasture and water resources and affected nearly 4 million people or about a tenth of the country's population. Worst affected by the drought were "the urban and rural poor and, most predominantly, pastoralists", said a report written at the time by the London-based international non-governmental organization Practical Action (formerly, the Intermediate Technology Development Group or ITDG). "Prices for maize, the staple diet of Kenyans, has increased by up to 130 per cent.

Prices for their livestock, most of them emaciated, have been heading in the opposite direction. In the past, the sale of one goat would buy a 90-kilogram bag of maize, now it might require as many as six goats to purchase the same amount of grain." Cattle died and many pastoralists migrated far with "their dwindling herds in a desperate search for pasture". Women had to trek much longer distances in search of water.[21]

Droughts have also turned more severe in northern and north-eastern China where the annual rainfall has been declining, and "the temperate grasslands in northern China are on the verge of degradation and desertification because of drought and environmental deterioration."[22] Thailand, Asia's rice bowl, was hit by droughts in 2005 and again in 2008 when 24,000 hectares of farmland in 55 of the country's 76 provinces was affected. In India, at least a third of the country's 628 districts were drought-affected in 2009, hitting its rice and wheat crops.[23] A seven-year drought, starting in 2002, in the Murray-Darling basin (in southern Australia), the "breadbasket" of the continent, laid bare the once-flourishing region, drying up cropland and fruit orchards; many farmers were forced to give up farming, sell off their land and livestock, and look for jobs elsewhere. Climate change and the drastic changes made in the region's natural ecosystem, including natural water cycles, to introduce intensive agriculture, are said to be the reasons for the drought.[24]

In general, "extreme events are occurring with greater frequency, and in many cases with greater intensity", according to the National Climatic Data Center in the US which tracks such events worldwide.[25]

(*For climate change impacts – See also Table 1)*

Table 1. Five climate threats and 12 countries most at risk

Drought	***Flood***	***Storm***	***Coastal - sea level rise (1 metre)***	***Agriculture***
Malawi	Bangladesh	Philippines	All low lying island states	Sudan
Ethiopia	China	Bangladesh	Vietnam	Senegal

Zimbabwe	India	Madagascar	Egypt	Zimbabwe
India	Cambodia	Vietnam	Tunisia	Mali
Mozambique	Mozambique	Moldova	Indonesia	Zambia
Niger	Laos	Mongolia	Mauritania	Morocco
Mauritania	Pakistan	Haiti	China	Niger
Eritrea	Sri Lanka	Samoa	Mexico	India
Sudan	Thailand	Tonga	Myanmar	Malawi
Chad	Vietnam	China	Bangladesh	Algeria
Kenya	Benin	Honduras	Senegal	Ethiopia
Iran	Rwanda	Fiji	Libya	Pakistan

Low Income Middle Income

(*Source: World Bank*)

Displacement and distress migration

According to the International Red Cross, at least 70 per cent of the natural disasters occurring now are weather-related, and this proportion continues to increase. Over 95 per cent of the people affected by climate disasters are in developing countries. In most such cases, women and children, particularly in rural areas, are the worst hit. During 1995-2005, climate-related natural calamities affected 125 million children every year, according to a report "Legacy of Disasters: The Impact of Climate Change on Children" by Save the Children organization in the UK. "Small-scale disasters, overlooked by the international community, will also intensify, most affecting vulnerable communities living in rural areas on flood plains or on steep slopes at risk of erosion," said the report.[26] Such disasters will lead to greater displacement and migration from rural areas.

Environmental degradation from climate change is another factor that is causing increased migration. "Migration is increasing with climate change and includes traditional static populations who have needed to move because their environment has been adversely affected by climate change," reports Christian Aid, an international NGO. "Climate change

is likely to exacerbate existing challenges around migration, particularly forced migration."[27] Many in small island states such as the South Pacific islands and low-lying areas elsewhere are also trying to migrate because of rising sea levels and floods.

Besides creating greater hunger, lower agricultural growth will have a ripple effect on rural economies in the region, causing more unemployment, impoverishment and social and developmental deprivations among rural populations. Marginalisation and bankruptcies among small-scale farmers, landlessness, rural unemployment and rural-to-urban migration in South and South-east Asia have been increasing in recent times following globalization and the corporate restructuring of agriculture and agricultural trade. According to a recent International Labour Organization report on unemployment in South-east Asia, "people who used to work in the fields are moving to cities to take up jobs but they do not have the skills.''.[28] Climate change would therefore mean greater loss of livelihood, poverty and hunger.

As a result of all these climate-related events and environmental changes, there could be about 200 million climate refugees by 2050, according to a policy paper by the International Organization for Migration.[29] Such migrations will particularly increase women's vulnerabilites; for, when the men migrate, as is often the case, women are left alone to take care of the family's food and other needs, battling a harsh environment, declining land productivity and dwindling natural resources such as water and food sources.

Threat to ecology, ecosystems and biodiversity

Climate change can have a major impact on ecosystems and biodiversity. It can transform ecosystems. As the tropics get hotter, there will be a general northward shift of food crops and other plant species (including grass and pasture land) and also animals and birds to more suitable climatic ranges at higher latitudes, and, in hilly and mountainous regions, a shift towards higher altitudes and cooler locations. Several such migrations are already being reported. For example, apple crops have been shifting to higher and cooler locations in the hills of north India, and moths in Mount Kinabalu in Sabah, Malaysia, have been found to have shifted uphill in response to rising temperatures. A number of such northward

range shifts of birds and animals have also been reported from Europe and the USA. Several plant and animal species may also die out.

Such changes can shift current geographic ranges of crops and agro-economic zones. According to the UN Food and Agriculture Organization (FAO), there could eventually be marked geographical shifts in crop production or agro-economic zones, possibly changing the current geo-political balance in agriculture with a "positive impact" on developed countries in the temperate zone and a "negative impact on tropical developing countries".[30] Another ecological consequence is the changes in the growth rates of food and other plants and the timings of their biological functions such as flowering, leaf sprouting and maturing. This will lead to changes in crop-growing seasons and crop cycles.

Higher temperatures and an increase in GHGs can also change the structure and composition of forest ecosystems, including animal, bird and plant species. Some forest regions may turn drier with forest losses and an increase in the incidence of forest fires, while others could become wetter. There could also be changes in the relative populations of species, depending on the changes in local food availability. A rise in global average temperature beyond 1.5^0-2.5^0 C will change ecosystem structures and habitat ranges of species, and drastically reduce biodiversity. According to IPCC, 20-30 per cent of the large numbers of plant and animal species it had assessed for such changes faced the risk of extinction at this temperature.

These wide-ranging ecological changes will have an impact on the food sources of millions of people around the world who depend on agriculture and forestry, particularly poor farmers and indigenous communities who live on traditional biodiverse or ecological farming and forestry. The diverse range of plants and trees, animals, birds, insects, amphibians and fish, *etc.* in a given area or habitat contribute to the socio-economic well-being of the people. Biological diversity provides a wider variety of food sources (both primary and secondary), better food security, higher productivity, greater stability and sustainability, and helps minimize damage from natural disasters and the impacts of climate change. It is estimated that the poor obtain about 80 per cent of their basic needs from diverse biological sources.

"With food crops and fisheries going out of reach because of shortages and higher prices, and with forests and biodiversity affected, both rural and urban consumers will find it increasingly difficult to meet their food needs, increasing hunger and poverty," says IPCC.

The rise and spread of diseases

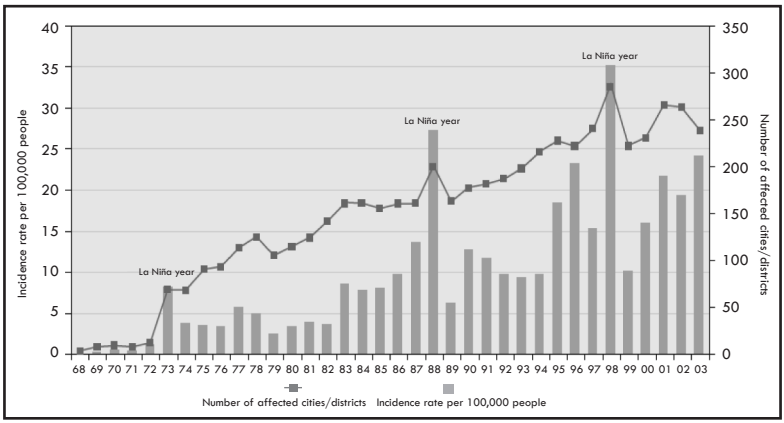
Rising temperatures and humidity will also promote the spread of diseases. For instance, higher temperatures can help the growth and spread of mosquitoes which transmit diseases such as malaria and dengue. As a result, the incidence of these diseases is expected to rise; disease-carrying mosquitoes may also spread to newer areas, including areas at higher altitudes and latitudes. Similarly, water-borne diseases, such as cholera and dysentery, may increase because of the increased contamination of water sources following heavy rainfalls, floods, landslides, cyclones, *etc*. Increasing heat stress will raise the risk of cardiovascular diseases, and forest fires and smog will add to respiratory illnesses, asthma, *etc*.

Several studies indicate that the incidence of dengue and malaria rises during or after extreme weather events such as droughts, heavy or intense rainfalls, and flooding. Dengue cases have been increasing in South-east Asia over the years, and the increase is associated with *La Niña* (when rainfall and flooding increases) and *El Niño* (hotter seasons with droughts and water shortages) years and climate cycles. While *La Niña* years saw a "significant increase" in dengue cases in Indonesia (*See Figure 4*), dengue outbreaks in Vietnam's plains and the central coast are linked with *El Niño* events. In the Philippines, dengue cases rose during the *El Niño* as well as *La Niña* years – overall, the number of dengue cases jumped six-fold from about 5,000 per year in the early 1990s to 30,000 per year in 2003.[31]

Impacts on food and agriculture

As seen earlier, climate change is damaging the wide natural resource base on which millions of people in Asia depend for livelihood – land, water, forests, and also marine resources. Besides curtailing food production, this is undermining the livelihood of small-scale farmers, landless workers, fisherfok, pastoralists and forest-dwellers, and making

Figure 4: Incident of dengue and the number of affected in Indonesia 1968-2003



Note: 1973, 1988 and 1998 were La Niña years.
Data, Department of Health, chart from www.tempointeraktif.com
(Source: The other half of climate change: Why Indonesia must adapt to protect its poorest people; UNDP Indonesia, 2007)

it even more difficult for the increasing number of the urban poor to access food in the face of food shortages and rising prices.

Global warming, in the medium term, has a dual impact on world agricultural production, depending on the location. A 1^0-3^0 C rise in temperature is likely to raise production in relatively cold regions at higher latitudes and reduce production at the warmer lower latitudes, especially the tropical regions, where many of the developing countries are located. Cereal production in many sub-Sahara African and Asian (especially South Asian) countries will be adversely affected. Northern developed countries and Latin American countries at higher latitudes are expected to gain initially until temperatures rise more than 3^0 C when production could fall in those countries too. (*See Table 2*) So while the overall world production may drop by about 1 per cent, developing countries may suffer much higher losses. Some of the developing countries, particularly the poor countries which depend on food imports, may face serious food

Table 2. Expected impacts of climate change on global cereal production

Region	*1990-2080 (% change)*
World	- 0.6 to -0.9
Developed countries	2.7 to 9.0
Developing countries	- 3.3 to -7.2
Southeast Asia	- 2.5 to – 7.8
South Asia	- 18.2 to -22.1
Sub-Saharan Africa	- 3.9 to – 7.5
Latin America	5.2 to 12.5

(*Source: The world food situation : New driving forces and required actions by Joachim von Braun, International Food Policy Research Institute, Washington, 2007; Adapted from Tubiello and Discher 2007*)

problems with a rise in food prices in the global market. These include almost all African countries and many Asian countries where hunger and malnutrition may increase.

"In countries with predominantly agrarian economies, climate change, particularly an increase in temperature and reduction in precipitation ... could dampen economic growth by reducing agricultural productivity," says the IPCC report.[32] Cereal production is expected to decline in over 40 developing countries worldwide by an average of 15 per cent in the long run. Sub-Saharan Africa and South Asia are particularly vulnerable. Several studies have since confirmed these conclusions; if anything, the likely impacts may turn out to be even worse.

Effect on crop yields

How does global warming and climate change actually affect crop growth? This has basically to do with several factors – an increase in carbon dioxide concentration, rise in temperature, increase or decrease in rainfall and the availability of water, and extreme weather-related

events such as floods and droughts. Together they affect crop life and yields, grain quality, and the growth of pests and plant diseases.[33]

While rise in carbon dioxide concentration enhances plant life and growth and slightly improves crop productivity (known as carbon fertilization, this is linked with greater photosynthesis in specific crops), the temperature rise associated with the increase in carbon dioxide reduces or neutralizes this advantage and lowers productivity, depending on the region and the extent of local temperature rise. An increase in temperature makes crops grow faster and mature early which reduces grain production (less grains and smaller grain sizes, or insufficient biomass accumulation) and yield; it also dries up the soil, depriving plants of moisture. In a 2-year study at the IRRI in the Philippines, rice grown at increased carbon dioxide concentrations (and at prevailing or ambient temperature) gave 27 per cent more yield but when combined with a higher temperature much of this gain was lost. Modelling studies showed that in general rice yields rose by 0.5 tonne per hectare for every 75 ppm more of carbon dioxide and dropped by 0.6 tonne per hectare for every 1^0 C rise in temperature.[34]

Average temperatures being higher at lower latitudes (the tropics) and lower at mid (sub-tropics) and higher latitudes (temperate regions), much of the crop losses from any further warming would occur in regions and countries at the lower latitudes (where mainly developing countries are located) and the gains, up to some extent, may happen mostly in northern countries at higher latitudes (mainly developed countries). Even at lower latitudes, say, locations 10 degrees apart in latitude may see varying crop losses with higher losses at the lower latitude. This is why a small temperature rise (1^0-2^0 C) may initially increase crop yields in the northern countries and reduce yields in the southern tropical countries. A further rise in temperature may, however, neutralize this advantage for northern countries and reduce yields there as well.

Poor and erratic rainfall and lack of water affect crop growth and can reduce crop yields. In rain-fed agriculture, the timing of rainfall is important but unpredictable and unseasonal rainfall is becoming a major problem in many Asian countries. Studies show that with every degree of local warming which could lead to lower rainfall and loss of water through higher evaporation, plants would need 10 per cent more

irrigation (in conventional farming systems) in sub-tropical semi-arid regions.[35] Studies have also shown that every 1^0 C rise in temperature in the growing season reduced rice yields by 10 per cent in the Asian region.[36] For rain-fed farming systems in China, rice yields could fall 5-12 per cent for a temperature rise of 2^0 C and , in India, wheat yields could decrease by 2-5 per cent for a temperature rise of 0.5^0-1.5^0C. Yield losses in non-irrigated rice and wheat could be higher.[37] Dryland farmers in Asia face even greater risks from dry spells, droughts and drying water sources. Climate change will further dry up and degrade the land in such areas, as seen in many parts of Asia.

Extreme weather events like droughts can affect the soil, crop growth and yields, and floods and cyclones can destroy standing crops. The incidence of such extreme events and also their severity and the extent of damage and loss they cause have been increasing, particularly in South-east Asian countries.

What will be the impact of all these factors on overall food production? In 2007, *Environmental Research Letters,* UK, reported that climate change had caused an annual loss of 2-3 per cent in global yields of major crops such as wheat, maize and barley; the report said that "almost 30 per cent of the variation in global agricultural yields" over the years could be attributed to higher temperatures.[38] An ADB study in 2009 projected the impact on rice yields in four South-east Asian countries -- Indonesia, Philippines, Thailand and Vietnam. Rice yields in these countries could drop by 50 per cent, relative to 1990 levels, by the end of the century if no measures are taken to counter climate change; corn and soyabean yields would also decline. "Water stress or shortage and decline in agricultural production would pose a serious threat to the region's long-term food security and to lives and livelihood, especially of the poor." Another projection for South Asia points out that several important crops, including rice, wheat, maize, pulses, cotton, sugarcane, tea and coconut, will be affected. (*See Table 3*)

Crop losses from climate change have in fact been reported from many parts of Asia, mainly for wheat, rice and maize. In India, for example, wheat production had fallen over the past several years, and rice production in the Gangetic plains in India had been declining over the past two decades. Warming during early crop life is making wheat crops mature faster with

smaller grain sizes, according to L.S. Rathore of India's National Centre for Medium Range Forecasting.[39] Dr. R.K. Pachauri, who chairs IPCC, says that wheat yields in India have dropped 5-10 per cent following a rise in temperature. Water too is becoming a constraint despite higher national investments in irrigation because of dropping water tables and shrinking water sources (in terms of numbers, size and flow).

In Indonesia, changing rainfall patterns are making it difficult for farmers to decide when to plant, and erratic rainfall is causing crop failures. In Java, a major rice-growing area, farmers have been seeing "abnormal seasons" for several years now. In Sumatra, the wet season now starts 10-20 days later and the dry season 10-60 days earlier. (*See Figure 5*) Such climatic changes have led to increasing crop losses. During the years 1992-2000, every district in Indonesia lost an average of 300,000 tonnes of foodgrains per year compared to a loss of 100,000 tonnes per year a decade earlier. Flows in most rivers have also reduced.[40]

Fishery, forestry and livestock

Fishery and forestry are important sources of food and livelihood for people in the Asia-Pacific region. The region has rich marine and forest ecosystems and large populations of coastal and indigenous communities depend on these systems for both food and livelihood. The region is also the world's largest producer of fish, and fisheries play an important role in the food economy of many countries here, according to the FAO. Climate change is now affecting both fisheries and forest resources.

Climate change can affect fisheries in several ways. Rising seas will, by flooding estuaries and mangroves, disturb the breeding grounds of fish. Warming oceans will affect nutrient supplies to fish and alter their habitats, leading to fish migration. An increase in sea temperature will also destroy coral reefs, affecting a large number of fish species which thrive on coral reefs.

South-east Asia faces the biggest threat in this context. Climate change, combined with sea pollution and overfishing, is destroying its vast coral reefs and the associated diverse marine ecosystems, the richest in the world and on which millions of people depend for livelihood in numerous ways. Spanning the sea from the Philippines to Malaysia, Indonesia,

Table 3. Climate change scenarios and impacts on crops in South Asia

Country	Scenario			Key impacts
	Temperature	*Major crops*	*Rainfall*	
India	0.74°C increase in last century, pronounced warming during post-monsoon	Rice, wheat, maize, pulses, oil crops, sugarcane	Increased frequency of floods during the monsoon and decrease in winter. Fewer rainy days	Fast retreat of Himalayan glaciers, frequent floods in Indo-Gangetic plains. Yield reduction in wheat, rice and maize due to temperature rise.
Nepal	0.09°C rise per year in Himalayan and 0.04°C in Terai regions in winter	Wheat, rice, maize	No distinct long-term trends	Glacier lake outburst, floods due to glacial melt, and soil loss due to floods. Increase in wheat and maize yields due to temperature rise (because of the higher altitude).

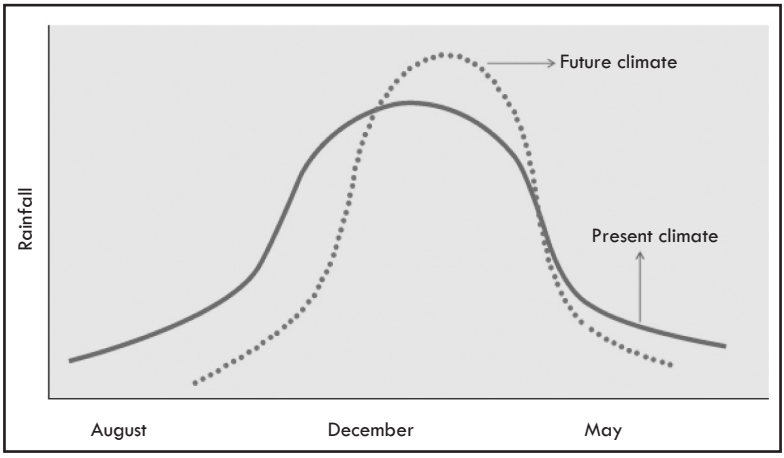
Pakistan	Temperature rise in coastal areas	Rice, wheat, maize, sugar cane	Increase in summer and winter rainfall in northern Pakistan and 10-15% decrease in the coastal belt and arid plains	Decrease in wheat and cotton production due to increased temperature and decreased water availability.
Sri Lanka	0.2°C per year increase in central highlands	Rice, tea rubber, coconut	Increasing trend in February and decreasing trend in June	More intense floods, increased temperature and prolonged droughts, decreased coarse grains, tea & coconut production.
Bangladesh	Increasing trend, more in summer than in winter	Rice, jute, maize	Annual rainfall increase with frequent floods and cyclones	Coastal region inundation, intrusion of sea water, loss of cultivated area. Rice yields to be affected by extreme weather events and salt water.

Source: Options for Crop Production for Coping with Climate Change in South Asia, Anil Kumar Singh. Original source: Kelkar and Bhadwal 2007; Xianfu Lu, 2007

Papua New Guinea, Solomon Islands and Timor Leste, the Coral Triangle houses 75 per cent of the world's coral species and over 3,000 species of fish. Coral reefs are sensitive to rise in temperature and acidity (caused by increasing carbon dioxide concentration in the sea). These factors have destroyed about 40 per cent of the coral reefs and put another 45 per cent under threat, reducing the "ability of coastal ecosystems to provide food and other benefits to coastal communities", concludes a recent study by the World Wildlife Fund.[41] "Coastal ecosystems in this region are critically important for human livelihood, providing food and resources to over 100 million people", says the study. " Many people in the region forage on coral reefs and coastal ecosystems such as mangroves to collect their food and income."

Elsewhere, coastal flooding and changes in weather patterns and seasons are affecting fishing. In the lower Mekong River region, for example, coastal flooding will jeopardize the livelihood of a large number of rural poor who depend mainly on fishery. In Indonesia, fishers in many regions say "they can no longer predict the right time or places to catch fish" because of the erratic weather; others find fishing more difficult because the seasonal signals on which they depended are changing, and also

Figure 5 : Likely future rainfall pattern in Java and Bali



(*Based on Naylor et al, 2007. Source: The other half of climate change: Why Indonesia must adapt to protect its poorest people; UNDP Indonesia, 2007*)

because high waves now "threaten even the largest boats".[42] Meanwhile, climate change in the region is rapidly driving 'commercially exploited' fishes northward from tropical seas into the polar seas.[43]

Forests are a source of round-the-year food (fruit, tubers, edible leaves, *etc*.) and income (from selling forest produce) for the poor. But higher temperatures and reduced rainfall are affecting forest areas and forest productivity. In many regions, forests are getting drier. Rising temperatures and prolonged dry spells (combined with land use changes) have also increased forest fires in North and South-east Asia (particularly in Mongolia and Indonesia), destroying forests. According to IPCC, "the intensity and the spread of forest fires in North and South-east Asia have increased in the past 20 years, and this was largely related to temperature rises, declines in rainfall and the increasing intensity of land use." This will harm indigenous communities who live in the forests and its periphery.

As for livestock, herders are finding it difficult to maintain livestock production and productivity because of water shortages and decreasing pasture in arid regions. Pastoralists in regions such as Mongolia may suffer "large losses" in livestock, notes the IPCC. Lack of water and pasture will also reduce milk yields in livestock, and a drop in milk yield has been reported from some parts of Asia.

Economic costs of climate change

The destruction caused by extreme weather events, deterioration of natural resources and ecosystems, loss of agricultural productivity and morbidity induced by climate change would also mean huge economic losses in terms of production. What are the economic costs of climate change? A study of the economic impact of climate change, the Stern Review, done by the British economist, Nicolas Stern, for the UK government in 2006, concluded that a rise of 2^0-3^0C in global temperature over the next 50 years could reduce global economic output by 3 per cent, with the losses being disproportionately higher in poorer countries. The Review pointed out that the cost of stabilizing carbon emissions is lower than this economic cost of production losses. IPCC put the average economic loss at 1-5 per cent of the global GDP if the Earth warms up by 4^0 C but regional losses could be much higher. Because of its heavy

dependence on agriculture and natural resources, long coastlines and tropical climate, South-east Asia may suffer greater losses than these global averages, estimates the ADB study.[44]

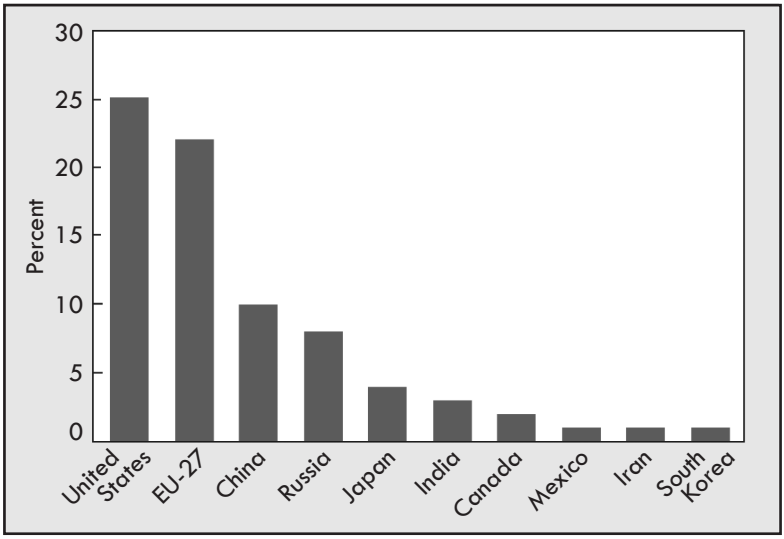
Obviously, it is the poorest living on marginal and low-lying lands, with their lives and livelihood depending entirely on natural resources and the local ecology, who stand to suffer the most. The rural and urban poor are also vulnerable to high food prices resulting from droughts and crop failures and the destruction of crops by extreme weather events. But governments around the world have not adequately responded to this basic truth (or have ignored it) nor have they fully grasped the wide-ranging implications of climate change. There is therefore a lack of serious efforts in addressing the problem – in terms of mitigating climate change or helping the poor to cope with it and protect their livelihood.

Chapter Three
INTERNATIONAL DISCOURSE AND NEGOTIATIONS

Though the poorer countries and, within these, the poorest people bear the worst impacts of global climate change, paradoxically, they are the least responsible for climate change as they emit the least amount of GHGs. Industrialized countries who are currently the least affected by climate change are historically the biggest emitters of GHGs, or are the worst environmental polluters. This has been intrinsic to the unsustainable ways of growth, production and consumption that they have followed for long.

Since1950, the industrialized countries have contributed around 80 per cent of the carbon dioxide accumulated in the atmosphere. The US has been the biggest emitter, accounting for about 25 per cent of the cumulative emissions. (*See Figure 6*) The European Union (EU) accounts for about 23 per cent. Even today, with a share of only 20 per cent of the world's population, the developed countries account for over 60 per cent of the current industrial carbon dioxide emissions.

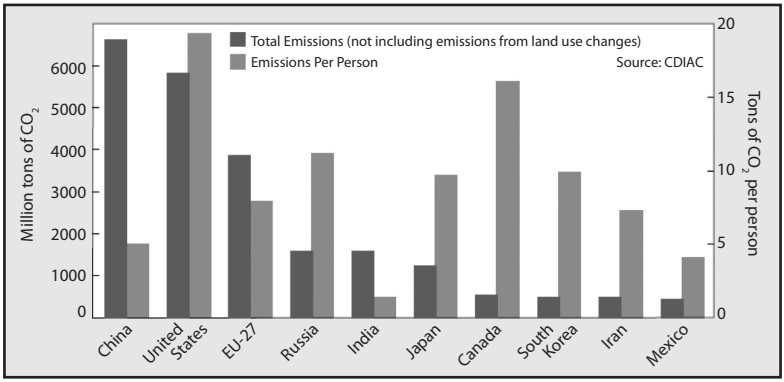
Figure 6: Top 10 carbon-dioxide-emitting nations and their shares, 1950-2007



(*From*: CDIAC; Shares based on CO_2 emissions data, not including emissions from land use changes.)
(*Source :* McKeown, A., Gardner, G., "Top 10 CO_2 Emitting Nations' Share of Global CO_2 Emissions, 1950-2007", *Climate Change Reference Guide,* Worldwatch Institute www.worldwatch.org)

In 2007, China, with its fast pace of development, emerged as the largest current carbon dioxide emitter. It emitted about 6.5 billion tonnes of carbon dioxide while the US emitted a little less than 6 billion tonnes and the EU nearly 4 billion tonnes. To go by this absolute figure would be misleading, though, because China has a far larger population and also far greater developmental needs. A better and fairer indicator would be the carbon dioxide emission per person or per capita. By this yardstick, China ranks far lower than many other countries. It currently emits about 5.5 tonnes of carbon dioxide per person. The US emits about 19 tonnes per person (about 12 times more per person than the entire developing world of over 60 countries – with a population of 2.7 billion - put together), Canada about 16 tonnes, Russia nearly 12 tonnes, Japan and South Korea a little less than 10 tonnes each, and the EU about 7.5

Figure 7 : Top 10 carbon-dioxide-emitting nations, total and per person, 2007



(*Source :* McKeown, A., Gardner, G., "Top 10 CO2-Emitting Nations, Total and Per Person, 2007," *Climate Change Reference Guide,* Worldwatch Institute www.worldwatch.org)

tonnes. A large and fast-developing country such as India still emits only around 1.3 tonnes per person (*See Figure 7*).

The current global average carbon dioxide emission per person is about five tonnes. If the world is to limit global temperature rise to 2^0 C and the average global GHG concentration to 450 ppm (as is being generally proposed), the global average emission per person needs to be brought down to 2.5 tonnes. (As discussed earlier, some leading climate scientists think that even this level of GHG emission is too high to avert damage.)

Developed countries' climate debt

Apparently, there is a gross distortion in the carbon dioxide emission patterns of developed and developing countries (and similarly among various economic classes within countries). In the course first of their industrial development, and then the relentless pursuit of affluence and a lifestyle of excessive consumption, the developed countries and their transnational corporations have not only exploited and appropriated a disproportionately large share of natural resources around the world, but they have also appropriated a grossly disproportionate share of the global atmospheric space, which, it needs to be emphasized, is a common

resource that is to be equitably shared by all. This the developed countries have done using their colonial and then free-market global economic and trade policies and agreements, helped by global financial and trade organizations such as the World Bank, the International Monetary Fund and the World Trade Organization geared towards this end.

By already using up a major proportion of the atmospheric space, the developed countries have left hardly any environmental space for the developmental needs of the rest of the world. Unless the current skewed global consumption and production patterns are corrected, the developmental needs (in terms of energy use, consumption of resources, *etc*.) and the provision of basic needs for the vast majority of the world's poor are likely to be compromised by the imposition of unfair or unilateral environmental standards on them.

"This basic and undeniable truth forms the foundation of the global climate justice movement," says the Third World Network (TWN).[45] The fact that the developed countries have contributed much to the atmospheric carbon dioxide accumulation, and thus to climate change, has led to the concept of a climate debt that the developed countries owe the rest of the world. A number of developing countries, NGOs and social movements worldwide have been advancing this argument in world forums on climate change. "For their disproportionate contribution to the causes of climate change and its adverse effects, developed countries owe a two-fold climate debt: first, for overusing and substantially diminishing the Earth's capacity to absorb greenhouse gases (and denying more environmental space to the developing countries that need it most for their development), the developed countries have run up an *emissions debt* to developing countries; and, second, for the adverse effects of these excessive emissions (contributing to the escalating losses, damages and lost development opportunities facing developing countries), the developed countries have run up an *adaptation debt* to developing countries. The sum of these debts constitutes the climate debt of developed countries," notes TWN. (Similarly, the richer classes within developed as well as developing countries are responsible for more GHG emissions because of their higher resource and material consumption than the poorer classes.)

From the perspective of the developing countries, this ethical concept of the developed world's historical climate debt and hence its greater responsibility (or *differentiated responsibility*) in mitigating climate change underpin the current international negotiations on climate change. This requires the developed countries to take on a much bigger share of the required reductions in global carbon dioxide emissions if the global temperature rise is to be limited to 2^0 C. Also, having largely created the problem and benefited from it, they should also bear the responsibility of helping resource-poor countries and communities to cope with, or adapt to, the numerous climate problems they face and provide carbon-efficient technologies (which the developing countries would not have the resources to develop on their own) as well to mitigate global warming.

The developed countries of course do not share this perspective. They have tended to deny this historical responsibility and the debt that goes with it, still trying to retain a large share of the atmospheric space for themselves. This has given rise to a range of contentious issues which have dogged the long drawn-out international climate talks.

UNFCCC and the Kyoto Protocol

Following the setting up of the United Nations Framework Convention on Climate Change (UNFCCC) in 1992, the Kyoto Protocol, finalized in Kyoto, Japan in 1997, was the first major step in international climate negotiations. "Recognizing that developed countries are principally responsible for the current high levels of GHG emissions", the Kyoto Protocol set a binding target for the reduction of GHG emissions by 37 industrialized countries and the European Community (including countries in transition to a market economy such as in central Europe). These countries (known as Annex-1 countries) were to cut their emissions by 5.2 per cent, relative to 1990 levels, by 2012, when this first commitment period ends and by which time bigger reductions would be negotiated and finalized for the second phase or the second commitment period. Developing countries were not required to take on any reduction commitments. (The Kyoto Protocol came into force in 2005. The US did not accept the Kyoto Protocol on the plea that developing countries too should cut their emissions.)

The emission reductions under the Kyoto Protocol were to come mainly from domestic measures but developed countries, under pressure from its corporations, managed to inject some *flexible mechanisms* into the Protocol – which allowed them to use market-based mechanisms in addition to the domestic measures to meet their reduction targets. These mechanisms included carbon emission trading (carbon market), clean development mechanism (CDM) and joint implementation. Emission trading allows countries with excess emissions to set these off without having to cut their own emissions by buying carbon credits from countries which have low emissions. CDM allows industrialized countries to claim carbon credits by financing any project (such as the use of more energy-efficient industrial equipment and processes or alternative energy sources, and forest protection) which reduces carbon emissions in a developing country. Under joint implementation, an Annex-1 country can acquire carbon reduction units for meeting its carbon reduction targets by investing in emission-reducing projects in another Annex-1 country.

Essentially, developed countries found it cheaper to buy carbon credits elsewhere than cut emissions at home; the developing countries, on the other hand, saw carbon credits as a means of earning some money, attracting foreign funds and environment-friendly technologies, despite the fact that it would limit their future growth options. Flexibility also gave corporations a much bigger role in formulating and implementing emission reduction plans through the market.[46] In fact, since the Kyoto Protocol, corporations have been influencing the agenda even more and driving the course of the international negotiations on climate change.

The Kyoto Protocol also required developed countries to provide adequate funds and technology to developing countries to take measures to adapt to and mitigate climate change. Funds were to be transferred mainly through the Global Environment Facility (GEF), carbon trading through CDM, and two World Bank-managed funds – the Clean Technology Fund and the Strategic Climate Fund, the two together called the Climate Investment Funds.

However, on both emission cuts as well as funding, analysts have noted that the response of the developed countries has been very poor. On the emission reduction count, far from a reduction, industrialized countries' emissions have been actually increasing; from 1990 to 2006,

GHG emissions from industrialized countries rose by 10 per cent (only some European countries such as Germany and the UK had cut their emissions), according to UNFCCC. As for financial support for adaptation and mitigation, the Stern Review, for instance, had estimated that the requirement would be $550 billion per year for 2007 (1 per cent of the world's GDP for that year) but the actual funds that all the developed countries put together spent on mitigation in developing countries was only US $13.3 billion per year which was less than 2.5 per cent of the funds required; adaptation hardly drew any action or attention.[47]

Meanwhile, instead of being supplemental to domestic efforts, carbon trading is being used as the main means of meeting emission reduction targets in developed countries, and carbon credits as a profitable commodity to be traded in the market. CDM projects were to further the environmental and social goals of the host developing countries, that is, they were to promote sustainable development in developing countries and also reduce the vulnerabilities of the poor to climate change. Instead, most such projects are being used for private gains. Many CDM projects "are defeating the very purpose of CDMs as tools for ensuring sustainable development, ... particularly projects being implemented in tribal areas", says the Indian Network on Ethics and Climate Change, a network of organizations and individuals concerned with climate change. "Carbon sink projects and biodiesel plantation projects are resulting in displacement and deforestation in the tribal areas. Giant firms are diverting food crops/forest land for monoculture and fast-growing trees like eucalyptus and earn carbon credits without sharing the benefits with farmers. Such projects impact land use pattern and also lead to loss of ownership and control of common property resources of the tribal communities."[48] The international carbon market doubled from $64 billion in 2007 to $126 billion in 2008, and the US Commodities Futures Trading Commission says that the carbon market may eventually turn out to be the biggest futures trading market.

For similar environmental and social reasons, projects under the World Bank's Climate Investment Funds have also come under criticism from people's movements. The World Bank, they point out, is known for its corporate- and market-friendly policies and projects which do not help the poor or rather undermine their right to or control over natural resources. Besides, by "creating a parallel structure for financing climate

change adaptation and mitigation", the World Bank "undermines the multilateral framework of the UNFCCC", which was to mediate such funding and projects guided by their potential contribution to sustainable development and benefits to vulnerable groups.[49]

Post-Kyoto developments and issues

Even as developed countries were dragging feet on the implementation of the measures under the first phase of the Kyoto Protocol, several rounds of discussions and conferences sought to lay the ground for the post-2012 second commitment period. The Bali (Indonesia) conference in 2007 set a 2-year road map for negotiations under two tracks (the dual-track mechanism) – the Ad Hoc Working Group for Long-term Cooperative Action (AWG-LCA) to focus on issues such as mitigation, adaptation, funding and technology transfer for the long term, and the Ad Hoc Working Group-Kyoto Protocol (AWG-KP) to focus on further emission reduction commitments after 2012. Over two years, these groups were to prepare texts for final negotiations at the climate conference (Conference of Parties or COP) in Copenhagen (Denmark) in December 2009.

The main issues, as far as the developing countries were concerned, were: (i) the acceptance of the *historical responsibility* by developed countries and the need for much bigger and binding emission cuts (at least 40 per cent below the 1990 levels by 2020); and (ii) provision of larger funding and technological resources for adaptation and mitigation measures in developing countries, including the transfer of low-carbon and renewable energy technologies free of patents.[50]

Not willing to accept their historical responsibility, developed countries, led by the USA, have been resisting these moves and any *meaningful* emission cuts under pressure from their corporations (especially oil and coal industries which think that big emission cuts may hurt their businesses) and the fear of a constraint on their growth and lifestyles (of the rich and the middle classes). They have also been increasingly stressing on market mechanisms to offset their carbon emissions.

At the G-8 Group (the USA, UK, France, Germany, Italy, Japan, Canada and Russia) meeting in Italy in July 2009, for example, agreeing that

global warming should be limited to 2^0 C above the pre-industrial levels and that global emissions should be reduced by 50 per cent by 2050, these countries said they would cut their emissions by 80 per cent by the year 2050 but refused to have any specific mid-term targets; they also wanted reduction "commitments" from some of the developing countries such as China and India, on the ground that their emissions were increasing and were likely to increase further as their economies grew. (These developing countries, who have low per-capita emissions, prefer voluntary caps on their emissions and no binding reductions). Much of the proposed 80 per cent emission reduction was to come from market mechanisms and carbon trading and not from domestic reductions. The G-8 Group preferred to work through the private sector and the carbon market rather than inter-governmental transfers of funds under the UNFCCC structure. The Group also stressed the role of the World Bank's 'Climate Investment Funds' for financing adaptation and mitigation measures and projects in developing countries, and the need for patents and intellectual property rights (IPRs) to "foster innovation" in technology. This meant the transfer of low-carbon technologies to developing countries would continue to remain under the IPR regime.

IPCC had estimated that developed country emissions needed to be cut by 25-40 per cent below the 1990 levels by 2020 and by 80-95 per cent by 2050 if temperature rise was to be limited to 2^o C and emissions to 450 ppm. Developing countries too have been demanding a 40 per cent cut in developed country emissions by 2020 for any impact on mitigation. The G-8 Group's refusal to set a meaningful mid-term target drew much criticism from several quarters. Even the UN Secretary-General, Ban Ki-moon, was compelled to criticize the Group for "failing to make deeper commitments….and set a strong and ambitious mid-term target for 2020." Such a target was "politically and morally imperative and a historical responsibility", he pointed out.[51]

By shifting the focus from their *historical emissions* to developing countries' *current and future emissions*, the developed countries were in effect trying to write-off their accumulated emissions and climate debts. And going by more recent developments in climate talks, the USA is now trying to subvert all the basic principles and guidelines for mitigation and adaptation established earlier by the UNFCCC and prepare the ground for a new set of rules favouring itself and other developed countries.

Towards this end, it seeks to sidetrack the accepted (dual-track) negotiating processes under the UNFCCC (using, for example, its own forums such as the Major Economies Meeting on Climate Change and Major Economies Forum for Energy and Climate).

This was evident at Copenhagen.

Copenhagen and after

The whole world was looking to Copenhagen to not just chart out the post-2012 path for emission reductions, but pave the way for a climatically safer world. It was hoped that the developed countries would see the scientific evidence of global warming impacts and their socio-economic and ethical implications, and work towards deeper emission cuts and funding commitments. As it turned out, though the two ad hoc working groups, set up in Bali, had submitted their texts to the conference for final negotiations, a general agreement, based on these texts, could not be arrived at quickly enough.

This presented an opportunity for rich countries (mainly the USA, UK and the host country Denmark) to run their prepared plot "to ditch the Kyoto treaty, which legally committed industrialized countries to emission cuts", as The Guardian, of London, put it. In its place, they "sought to impose a new global agreement which would allow them to set their own targets and timetables, develop carbon markets, rework forestry rules, and spur green technology"[52] (to be possibly patented and marketed in developing countries under patent terms).

But the leakage of the "Danish text" – prepared behind the scene and outside the UNFCCC negotiating process – created an atmosphere of mistrust. There were then alternative drafts prepared by BASIC countries (Brazil, South Africa, India and China), followed by additional proposals from the African Group and the Alliance of Small Island States (AOSIS). On the last day, as a compromise, the USA, China, India, Brazil, and South Africa together drew up a text which was discussed in isolation by only 25 heads of state (out of the 192 attending the conference), turned into the Copenhagen Accord, and then tabled before all other countries as a general agreement. Considering the objections raised by many developing countries, the conference could not "adopt" the

Accord but merely took "note of" it. The conference, however, extended the terms of the two ad hoc working groups, and their texts, adopted by all countries at Copenhagen, would be the basis for further negotiations, leading up to the next COP in November-December 2010 in Cancun, Mexico, though there were some efforts by the rich countries to keep the Copenhagen Accord, which is not legally binding, as the basis for further negotiations.

The Copenhagen Accord recognized the need to limit global temperature rise to 2° C but required no "binding commitments" from individual countries nor "aggregate targets" for emission reductions to achieve this goal. Emission reductions were voluntary, with each country setting its own targets. The USA offered to cut its emissions by 17 per cent below the 2005 level by 2020, which works out to only 5 per cent below the 1990 level. The EU collectively offered a 30 per cent cut provided other rich countries too did so, otherwise it would be 20 per cent. All such voluntary reductions proposed by the developed countries add up to only 12-18 per cent below the 1990 level by 2020 (according to studies by several organizations). This is much below the 25-40 per cent reduction needed by 2020, as estimated by IPCC. The total reductions now proposed by the developed countries is equated with a 3° C temperature rise. Similarly, the proposed funding of US $30 billion for the period 2010-2012 and US $100 billion a year (including from market sources) by 2020 for mitigation and adaptation in developing countries in the Copenhagen Accord is far too inadequate.

More importantly, the approach and positions taken by the developed countries at Copenhagen undermined the principles of climate equity and justice and the multilateral negotiating processes under the UNFCCC, and sought to write off developed countries' historical responsibility and climate debt. So developing countries are now stressing the "centrality" of the UNFCCC processes in climate negotiations, though the rich countries have been pressuring developing countries to "associate" themselves with the Copenhagen Accord and also threatening to cut aid if they failed to do so. Consequently, 137 countries had associated themselves with the Accord as of July 2010. Several groups of developing and poor countries have meanwhile also submitted their own proposals, relating to emission cuts, carbon trading mechanisms, land-use change, forestry, *etc*., to be discussed at Cancun; these include the Group of 77

(or G 77) and China, the African Group, the Least Developed Countries and AOSIS. Interestingly, 107 countries have proposed that, considering the damage climate change is already causing them and is likely to cause (with greater intensity) in the future, global temperature rise be limited to below 1.5° C, instead of 2° C, and that developed countries cut their emissions to meet this target.

Emergence of People's Movements

A noteworthy development meanwhile is the emergence of worldwide people's movements, articulating the problems and perspectives of the poor and vulnerable communities such as small-scale and marginal farmers and indigenous communities. In the run-up to Copenhagen, people's movements had pointed out the increasing damage climate change was causing to natural resources, food production and the livelihood of the poor and the vulnerable in the tropical developing countries. They had called on developed countries to accept their historical responsibility for emissions, reduce emissions drastically and adequately compensate poor countries and communities for the damage climate change has caused. Many of these groups had also rejected market mechanisms like carbon trading in addressing the problem while some had sought a thorough review of these mechanisms which adversely affected them. The Copenhagen Accord did not meet any of these expectations.

There is also a larger question which the climate negotiations failed to address. People's movements look at the climate problem not just as an environmental issue but as an issue of social justice and human rights. Market mechanisms and market-led growth will not solve the problem nor will technological fixes help address it if the developed countries continue to over-consume resources, both industrial and agricultural. The larger solution calls for sustainable development based on the "equitable access to sufficient natural resources" for people; and, for this, people must have *real* access and control of or sovereignty over natural resources. Agricultural and industrial development must be oriented to the welfare of the people and not just to the benefit of corporations and the elite, including within developing countries. Principles of equity and social justice in sharing natural resources should extend right up to the poor and vulnerable sections within developing and poorer countries.[53] *(See Annexure 1 – People's Protocol and People's Movement on Climate Change.)*

But the climate negotiations do not reflect these views of the people or the voices of the most affected communities. For example, indigenous peoples are one of the most affected communities, hit both by climate change as well as now by the market-based carbon-offset solutions being pursued. "Melting ice sheets in the Arctic makes hunting sea mammals and fishing difficult and risky, erratic rainfalls reduce productivity of fields and pastures, storms and floods destroy crops and homes ... and (now) many of the climate change mitigation policies and schemes currently being developed have severe impacts on indigenous peoples," said a statement issued by indigenous people's organizations in September 2009 at an inter-session of a meeting at the UNFCCC climate talks held in Bangkok preparatory to the Copenhagen Conference. "Indigenous peoples are also opposed to many of these schemes because they do not address the real causes of climate change: the over consumption of the world's resources by the few... (But) indigenous people have found it very difficult to get their voices heard and their concerns taken into consideration in national, regional and international negotiations...".[54]

Following the failure of the Copenhagen Conference, in April 2010, about 35,000 representatives from various grass-roots organizations and indigenous communities from around the world met at Cochabamba, in Bolivia, to chalk out their own proposals for tackling climate change; governments, they said, could not tackle these problems or they promoted "false solutions" which would not help. The World People's Conference and Rights of Mother Earth emphasized the basic need for people to "maintain harmony with nature", balancing the needs of the current generation and of future generations and not overexploiting the Earth's resources. Because of overexploitation, the Earth has now exceeded its "regenerative capacity" by over 30 per cent, with the richest countries having "an ecological footprint five times bigger than what the planet is able to support". There was a need for "people's solutions" to environmental problems, evolved from their experience and myriad innovations, as opposed to corporate solutions. ''All environmental problems cannot be solved with technological solutions", and it is necessary to make deep changes in consumption and production patterns, and to create a "sustainable model for production, consumption and the economy as a whole since the Earth has limited resources…", noted the Conference. Accordingly, while calling for much deeper cuts in developed country emissions, climate negotiations should not

reduce the UNFCCC's "shared vision for long-term cooperative action" to "defining the limit on temperature increases and GHG concentrations in the atmosphere" but must incorporate measures to radically change production and consumption patterns, build up the Earth's capacity and establish harmony with nature.[55]

Based on these general principles, the World People's Conference and other social movements have put forth several proposals related to emission cuts, funding, market mechanisms, land use and forestry, technological solutions to climate change, *etc.* These include [56] :

- The developed countries must cut domestic carbon emissions by at least 50 per cent below 1990 levels, not using carbon markets "which mask the failure of actual reductions in GHG emissions"; instead of reducing emissions, carbon trading promotes more emissions in developed countries, and therefore emission reductions must come from domestic efforts.

- Annual funding from developed countries for mitigation and adaptation measures in developing countries should be raised to a minimum of 6 per cent of their GDP with a new funding mechanism under UNFCCC (and not under the World Bank).

- Peasants' and indigenous people's land and forest rights should not be violated in the name of protecting forests and reforesting degraded forests (under the plan for Reducing Emissions from Deforestation and Degradation or REDD +) ; such schemes should have the "free and informed consent" of the people.

- A "multilateral and multidisciplinary mechanism" should be created for the "participatory control, management and evaluation" of transfer of useful and socially relevant green technologies, free of IPRs, to developing countries (patents, if any, should be in the public domain); and an inventory of such technologies should be built up.

- Developed countries must "assume responsibility" for the millions of people forced to migrate because of climate change.

- Reject all “false solutions” such as biofuels, geo-engineering, and nano technology.

- Reject “technological packages” such as agrochemicals and genetically modified crops, which corporations claim, help reduce GHG emissions in agriculture. Similarly, forest monocultures, agrofuels and industrial animal farming are being promoted on such “false arguments”.

Climate change has had “profound impacts” particularly on agriculture and hence on the lives of farmers and indigenous peoples worldwide, and these impacts will “worsen in the future”. Agriculture therefore needs to be shifted to a “sustainable model” based on people’s solutions., say people’s movements. For example, global carbon emissions can be cut down substantially by “increasing biodiversity, recuperating soil organic matter, replacing industrial meat production with small-scale diversified food production, integrated forest management, and expanding local markets”.

People’s movements and other organizations are now mobilizing people worldwide towards these ends. They will also be holding the Alternative Global Forum - For Life, and Environmental and Social Justice - at Cancun.

Chapter 4
CORPORATE AGRICULTURE AND CLIMATE CHANGE

Just as climate change has a strong impact on agriculture, the latter, particularly corporate agriculture - intensively chemical-based - and industrial animal farming, contributes substantially to climate change by the emission of GHGs.

According to IPCC, in 2005, agriculture directly contributed 10-12 per cent of the global human-induced GHG emissions. The Stern Review put it at 14 per cent. A Greenpeace-commissioned study on the climate impacts of agriculture in 2008[57] found that agriculture's share in the total emissions went up to 17-32 per cent when emissions from land use change (clearing land of native vegetation and forests, thereby releasing carbon locked up in the vegetation and land as carbon dioxide) were taken into account. This share goes as high as 40 per cent when emissions from "transporting agricultural commodities around the world" are included, according to an estimate by the International Federation of Organic Agriculture Movements (IFOAM).

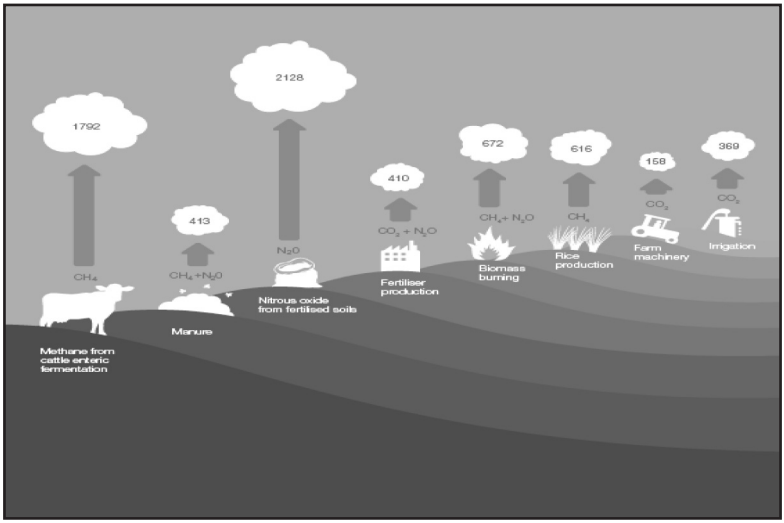
Agricultural emissions that contribute to global warming include, as discussed earlier, nitrous oxide, methane and carbon dioxide, mainly

the first two. According to IPCC, agriculture accounts for 58 per cent of all the nitrous oxide and 47 per cent of all the methane emissions into the atmosphere. Nitrous oxide is produced from residual nitrogen from chemical fertilizers and manure used in the soil and partly from burning biomass (crop residues and litter). Methane comes mainly from livestock - from their digestive process, more so because animals in large-scale intensive animal farming are fed grains, like corn, wheat and soyabean instead of grass and other natural vegetation. It also comes from stored animal manure, flooded rice cultivation systems (as microbes break down the organic matter in the soil), and burning biomass. Carbon dioxide is released when land is cleared of plants and forests and from intensive and mechanized farming (from heavy ploughing and the burning of fossil fuels in farm machinery). Besides these, there are indirect GHG emissions from related processes - mainly carbon dioxide from fossil fuels used in the production of fertilizer (which is highly energy-intensive) and other agrochemicals, from the energy used in pumping large amounts of irrigation water, and various other farming operations. (*See Figure 8*)

Nitrous oxide from fertilized soil is the main source of GHG emissions from agriculture excluding emissions from land use change in almost all parts of the world, as per the IPCC report. Exceptions are Latin America, countries in Eastern Europe and Central Asia, and the Pacific regions of Australia, New Zealand, Japan and Korea where methane from livestock is the main source. As can be expected, developing countries in Asia account for the bulk (80 per cent) of the methane emissions from flooded rice cultivation. Developing countries in sub-Saharan Africa and Latin America contributed much (74 per cent) of the methane emissions from biomass burning, and developed countries had higher (52 per cent) methane emissions from animal manure than developing countries.[58]

As fertilizer use and animal manure production continues to grow, nitrous oxide emissions from agriculture is expected to increase by 35-60 per cent in the next two decades. With the total rice-growing area estimated to grow by only 4.5 per cent by 2030 (according to FAO), it is unlikely that methane emissions from flooded rice farms would increase much. However, the trend of increasing meat consumption may increase livestock production and hence methane emissions from livestock may rise by over 50 per cent by 2030.[59]

Figure 8 : Source of agricultural greenhouse gases, excluding land use change



Source: Greenpeace Report "Cool Farming" (Ref. 57)

Thus, chemical- and energy-intensive farming, including industrial animal farming, have led to increasing GHG emissions from agriculture.

Green Revolution and intensive chemical farming

Agriculture turned to intensive chemical farming in a big way with the promotion of the Green Revolution in the 1960s by international agencies and transnational corporations in the business of manufacturing chemical fertilizers and pesticides. Under pressure from these agencies and corporations, governments in developing countries made farmers replace their traditional farming systems, based on local resources, local ecology and diversity, with 'modern' farming. The new system used varieties of seed that depended on high inputs of water, chemical fertilizers and pesticides for good yields. It also used heavy farm machinery. Mono-cropping replaced diverse cropping and native forestry to facilitate intensive farming, and small-scale farmers were marginalized and displaced. Corporations and large-scale commercial farmers came to dominate agriculture.

Further, as IPCC notes, "some macroeconomic changes, such as the burden of high external debt in Latin America triggered the adoption, in the 1970s, of policies designed for improving the trade balance, mainly by promoting agricultural exports. This resulted in changes in land use and management (clearing land, vegetation and forests for intensive farming), which are still causing increases in annual GHG emissions today." In addition, "the increase in international flow of agricultural products which may result from trade liberalization could cause higher GHG emissions from the use of transport fuels."[60]

Latin America is now a major exporter of agricultural products, particularly soyabean to feed cattle, and more recently agrofuels made from agricultural crops. Swathes of forests have been cut to grow transgenic soyabean and agrofuel crops. The new trend of clearing prime forests for agrofuel crops for exports is catching on in other parts of the world too, especially in Asia. Consequently, much of the world's farmland is now devoted to the intensive cultivation of export crops for food, feed and agrofuels, and this has serious implications for GHG emissions.

Corporations aggressively promoted fertilizers and pesticides in the name of boosting agricultural production, food security and food exports. Fertilizer use jumped by 800 per cent between 1960 and 2005; however, after an initial rise in productivity, crop yields began to decline by the 1990s as the chemicals degraded the land and groundwater tables fell following the intensive use of water. With hybrid seeds, there were declining harvests, and after a certain point, crops were simply not responding to the increasing fertilizer input. Furthermore, crops do not use all of the nitrogen in the fertilizers fed to them. About 50 per cent passes on to the soil where it accumulates and is released into the atmosphere as nitrous oxide or into water. When it reaches the oceans, it creates "dead zones," zones of oxygen deficiency, which kill fish and other marine life over large areas. Nitrous oxide and methane emissions from agriculture increased by 17 per cent from 1990 to 2005. The number of ocean dead zones increased from barely 50 in the 1960s to 405 now, and they are fast spreading.[61]

"The Green Revolution resulted in the ascendancy of hybrid seeds and high-input agriculture (chemicals, energy and water), posing a serious threat to natural agro-biodiversity," says Oswald Quintal of Low External

Input Sustainable Agriculture (LEISA) in India. The introduction of hybrid seeds further pushed up the demand for fertilizers as these seeds need even more fertilizers for good yields. Thus, in effect, these seeds were not high-yielding varieties as they were termed, but actually high-responsive varieties, because they only responded to more intensive use of chemicals and water, and could not do well without them.

Though fertilizer use has plateaued in developed countries following environmental regulations, it has picked up in Asian countries. With the intensification of agriculture (particularly by large corporations) in South East Asia for the production of food grains, industrial and plantation crops and animal feed (much of these for exports), the use of nitrogen fertilizer has increased - from 1995 to 2005, it rose by 44 per cent in Thailand, 41 per cent in the Philippines, 37 per cent in Indonesia, and 35 per cent in Vietnam. This rapid expansion of agriculture has also led to increasing conversion of forest, grass and wetlands.

Besides direct fertilizer use, fertilizer production, being highly energy-intensive, leads to GHG emissions. The manufacture of commonly used nitrogen fertilizers consumes much more energy than other forms of fertilizers and hence emits more GHGs -- 3.3-6.6 kg carbon-dioxide equivalent annually per kg of fertilizer produced (including transport and storage) against 0.36-1.1 kg and 0.36-0.73 kg respectively for phosphates and potassium fertilizers.[62] Nitrogen fertilizer today accounts for 57.5 per cent of all fertilizers sold globally. The storage, transport and wide distribution of fertilizers further add to the emissions. Fertilizer production and distribution now contributes about 1 per cent of the total global GHG emissions. In sum, increased fertilizer use has led to greater GHG emissions, contaminated land and water sources, and killed off much marine life.

Intensive agriculture, particularly the rapidly spreading export-oriented monoculture crop systems, has also intensified the use of scarce water resources. Today, 40 per cent of the world's food is grown in irrigated farms which use up nearly 70 per cent of all water withdrawn. Pumping and delivering this water, often to distant farms, uses up energy, adding to carbon dioxide emissions.

As noted earlier, climate and water sources affect each other in various ways. While global warming and climate change affect agriculture and water systems, the intensive use of water in agriculture can in turn contribute to climate change. Governments and corporations, however, continue to promote and support water- and energy-intensive agriculture. In the light of the climate crisis, agricultural policies promoting such practices need to be re-evaluated, and agriculture based on the sustainable use of water should be "part of the climate solution".[63] (*See Box - Agriculture, water and climate change*) In this context, it is significant to note that several studies have now shown that traditional farming systems and systems such as the System of Rice Intensification (SRI) being used by small-scale rice farmers in many Asian countries use much less water and energy per unit of production and generally also produce more food per unit of land than intensive farming systems. Traditional farmers around the world have also been successfully using a range of water-conserving techniques in response to water shortages, droughts and other changed climatic conditions.

Problems of industrial animal farming

Rearing animals and birds has always been part of agriculture, but in the past several decades, animal farming or animal agriculture has emerged as a major industry under the dominance of transnational corporations. In the name of efficiency, economy of scale and high yields, large numbers of animals – cattle, pigs, chickens, *etc*. - are raised intensively on concentrated feed in confined spaces for meat, milk and eggs. These animals are generally fed on corn- and soyabean-based feed sourced from around the world. The crops, particularly corn, are grown with intensive application of chemical fertilizer, and their transport over thousands of kilometres consumes large amounts of fossil fuel. The magnitude of this problem is seen from the fact that corn requires more nitrogen fertilizers than any other feed crop, and more than half of the global corn crop now goes for animal feed. The enormous amounts of manure these farms produce are stored in landfills where they decay and produce methane.

This industrial animal farming sector accounts for approximately 9 per cent of the global carbon dioxide emissions (from fertilizer production for and use in feed crops, energy used in producing feed crops, feed transport, animal product processing and transport, and land use changes), 35-40

per cent of the methane emissions (from the animals and stored manure), and nearly 65 per cent of the nitrous oxide emissions, says a recent study published in the journal *Environmental Health Perspectives.*[64] Though this intensive animal farming is now practiced mainly in the developed countries (among them, the US accounts for the highest emissions of methane from animal manure), Latin America and Asia are increasingly adopting these intensive systems, replacing their "more sustainable and more animal-welfare-friendly practices". "Although extensive or pasture-based farming methods still remain the norm in Africa and some parts of Asia, in recent years, industrial livestock production has grown at twice the rate of more traditional mixed farming systems and at more than six times the rate of production based on grazing", notes the study.

Pasture-based cattle-rearing systems integrated into the general agricultural systems are more sustainable and cause far less GHG emissions. Instead, the animal farming industry is merely tinkering with technical solutions such as reformulating animal diets to reduce methane emissions.

Deforestation and land use conversion

Deforestation and land use conversion contribute significantly to GHGs and climate change. Forests are increasingly being destroyed for logging, mining and agrofuel crops, and by forest fires. The increasing emphasis on global trade in agriculture has, as mentioned earlier, led to the destruction of tropical rainforests for crop lands. Vast expanses of South American rainforests have been lost to soyabean-growing and cattle ranching, according to the Greenpeace study cited above. (*Please see, Ref. 57)* In South East Asia, tropical forests are being lost at a rapid rate to logging, mining, plantation crops and now to oil palm plantations in response to the increasing global demand for agrofuels. Oil palm plantations are, in fact, driving deforestation in some Asian countries.

While global forest losses have been declining over the past decade (including in Asia), in South East Asia, deforestation gained pace with the loss of 27 per cent of its primary forests over the 15 years from 1990 to 2005; the rate of loss increased from -1.2 per cent a year during 1900-2000 to -1.3 per cent a year during 2000-2005 (except in Vietnam where forest areas have increased). Indonesia was the biggest loser, followed

Agriculture, Water and Climate Change

It is not only that climate change-related water stress will affect agriculture; the converse is also true. Current water use patterns and associated practices contribute to climate change. It is noteworthy that the two sectors in the world that use the most water, chemical-intensive agriculture and fossil-fuel-based energy production, are also the biggest contributors to global warming. This increases water stress in many sectors and regions.

There are a number of ways in which national agricultural, trade and energy policies affect both water resources of a nation and *climate change at the global level*. Let us take a brief look at irrigated agriculture.

Irrigation water use increased dramatically in most parts of the world in the second half of the 20th century with the unprecedented expansion of chemical-intensive agriculture. This was followed by the building of massive water systems including dams, reservoirs, aqueducts, pipelines and canals that brought water to otherwise water-scarce regions.

The pursuit of export-led growth in agriculture has also been dependent on intensive use of fossil-fuel-based chemical inputs, contributing greatly to climate change. In addition, the transport of agricultural commodities around the world and intensive agricultural practices (such as confined animal feedlots and indiscriminate fertilizer use) also contribute to GHG emissions. According to the World Bank's 2008 report on agriculture, intensive agriculture directly contributes about half of the global emissions of two of the most potent non-carbon dioxide GHGs - "nitrous oxide emissions from soils (from fertilizer application and manures) and methane from enteric (intestinal) fermentation in livestock production". Each accounts for about one-third of the farm sector's total non-carbon dioxide emissions, and these emissions are projected to rise with the trend of increased meat consumption in emerging economies.

Agricultural practices geared to growing export-oriented monoculture crops have also resulted in high levels of pollution in local systems. In addition, nitrogen used in fertilizers leaches into water courses increasing indirect nitrous oxide emissions downstream. This model of production has intensified water use.

Protecting our waters in local watersheds and wetlands and using them judiciously in support of local agricultural systems and livelihood practices, rather than continuing with the current strategy of promoting export-oriented, monoculture, industrial, water-guzzling agricultural systems, is key to reducing the water sector's direct contributions to climate change. Moreover, local practices that conserve and enhance local water availability to ensure resilience of rain-fed agricultural systems are necessary as an adaptation mechanism to meet climate challenges and to help meet food security goals, two of the biggest challenges for developing countries today. It is time to re-evaluate our agricultural policies that promote water- and energy-intensive agriculture. Effective and sustainable water management in agriculture in support of healthy food systems needs to be part of the climate solution.

(By Shiney Verghese, The Institute for Agriculture and Trade Policy, USA)

by Myanmar, Cambodia, the Philippines and Malaysia. Similar trends are also seen in Latin America and Africa.

"The continuing decline in primary forests in most tropical countries is a matter of serious concern," notes FAO in its report, *State of the World's Forests, 2007*. UNEP estimates that the conversion of peat forests in South East Asia accounts for 6-7 per cent of the total global carbon dioxide emissions. Such massive deforestation also intensifies the impacts of climate change, particularly floods and landslides, leads to widespread land erosion, loss of biodiversity and loss of livelihood among forest-dwellers and farmers. This emphasizes the need to restore degraded land and conserve forests which function as carbon sinks or natural carbon storage systems and to integrate forestry into agricultural systems.

Ecological agriculture as a mitigation factor

Clearly, industrial or corporate chemical-intensive agriculture is a major contributor to GHG emissions. "Increasing releases of GHGs from the green sector have made agriculture a producer of global warming rather than a mitigating factor."[65] Meanwhile, agribusiness corporations are also cashing in on the new market opportunities offered by climate change

by rushing into the development of the so-called climate-ready seeds, agrofuels, *etc*. Climate-ready seeds are seeds genetically modified to tolerate drought, floods, salinity, warmer weather, *etc*., and corporations have been rushing to patent such seeds, with only a few corporations claiming the bulk of the over 500 such patents filed. Corporations claim that, with the changing climate, such seeds are needed to raise yields and solve world hunger but past experience with genetically modified seeds does not support this claim. Not only have these seeds not helped to increase yields but they have also led to the rapid expansion of large-scale monoculture farming, reducing genetic diversity. They are also too expensive to be used by small-scale and marginal farmers, and carry environmental risks. Similarly, agrofuels have not helped reduce carbon emissions because they consume more energy (and much water) to produce than they eventually save - cutting into food production through land use changes and causing destruction of prime forests.

However, agriculture itself offers much scope for the mitigation or reduction of these emissions - by using appropriate non-chemical, biodiversity-based ecological agricultural practices and land management to minimize GHG emissions and to retain and store carbon in the soil, plants and trees. While intensive chemical agriculture leads to the loss of soil organic matter and soil carbon, non-chemical sustainable agricultural practices help increase both. With the right practices, agriculture can help accumulate carbon, instead of emitting it.

Instead of moving in this direction, “mainstream agriculture is moving in an opposite direction,” points out IFOAM.

Chapter Five
FARMERS' RESPONSES: TOWARDS BIODIVERSITY-BASED ECOLOGICAL AGRICULTURE

In the past, when climate changes were largely gradual, people could see and generally understand how they changed their ecology and environment. With weather and climate changes now occurring at a much faster pace, these are becoming entirely uncertain. How have people, and particularly small peasants, been coping with such changes? What are the adaptive measures they have been using, in Asia as well as worldwide? And, even more important, given the current situation, how can agriculture help mitigate climate change and improve farmers' livelihood? This chapter looks at these issues.

Farmers have traditionally responded to gradual variations in local climatic conditions by evolving, innovating and often fine-tuning their farm and resource management practices to suit the changing conditions. This also helped them develop a wide repository of knowledge and practices to suit diverse geographic, climatic, soil and water conditions. Today, with the massive problems that climate change poses, Asian farmers are responding by delving deep into their inherent knowledge and innovative

skills through a range of adaptive measures - changing crop cycles, crop patterns and varieties, and adapting farming practices (diversifying and mixing crops, *etc*.) and soil and water conservation measures to optimize the use of depleting natural resources. In many areas, farmers are adopting and adapting measures to control floods (low embankments and check dams using local materials), harvesting and storing water, and growing native trees in deforested and degraded land.

The South East Asian scene

In the South East Asian region, the most common adaptation measures seen are changes in cropping calendars and crop patterns (for example, from growing two rice crops to rice and maize), use of drought-resistant and heat-resilient varieties, inter-cropping and crop rotation, and changes in farm management practices, according to the ADB study. For example, in Thailand (the world's largest rice exporter) where rice crops are threatened by higher temperatures, droughts and floods, some farmers have changed rice planting time, and now also plant other crops between seasons to protect their incomes. In Vietnam's Mekong River Delta, farmers have not only built new, and revived old, small-scale irrigation facilities and embankments to prevent flood damage to farmlands but have tried to take advantage of flood-borne soil nutrients by planting appropriate crops and seed varieties. [66]

In the Philippines, farmers have developed a variety of local seeds to suit local conditions such as droughts, floods and typhoons. Farmers in the MASIPAG network, for example, have developed early-maturing rice varieties which are harvested before the main typhoon season starts, and they do staggered planting and use diverse crops to help reduce crop failure risks. According to MASIPAG, whose agricultural development programmes always take into account "local climate variability", resilience and adaptability will now become even more important. (*See Box – Farmer-led sustainable agriculture)*

In Indonesia, Farmer Field Schools have encouraged farmers to build up their knowledge, skills and climate response by making close observations and experimenting on the farm on various aspects of agriculture – crop response to various types of nutrients and amounts of water, soil and water management (including water-holding capacity of

Farmer-led Sustainable Agriculture for More Diversity in Farming Systems

An important concept in MASIPAG's farmer-led sustainable agriculture is to create more diversity in farming systems, particularly integrating agro-forestry which offers multi-functional benefits – as fodder, green manure, firewood, windbreak, erosion control, wildlife habitat and so on.

The following are some of the measures formulated by farmers in response to two major climate-related problems – typhoons and flooding, and droughts.

Typhoons and flooding: In this case, much of the damage occurs in the period close to rice harvest. So, farmers are planting a large number of varieties with different harvest time to minimize the risk of total crop failure. Staggered planting and inter-cropping help to further reduce the risk. In areas of strong winds and typhoons, farmers are using shorter plants with bigger stalks and erect leaves, and, in flooded areas, medium and tall varieties with strong stalks. Planting additional trees offers some protection from strong typhoon winds. Upland farms can also diversify into livestock as fodder is abundant there.

Drought: Diversification of crops is also a good strategy for drought. Perennial crops such as banana and many root crops are more drought-resistant than rice and corn. Plant breeding can identify more drought-resistant varieties. Agro-forestry mobilises water from deeper soil layers and helps create a moist microclimate. Organic farming aims at increasing the soil humus content. Humus has a very high water-holding capacity and thus plants can bear water stress for a longer period. Building terraces, or water-retention systems, can improve water availability for crops. Irrigation systems can help reduce the effects of drought. A shift to crops which consume less water can be important.

In addition to these technical measures, people's organisations and provincial coordinating bodies along with a participatory process help farmers adapt to the multiple stresses of their environment. Greater empowerment and the emphasis on building on farmers' knowledge and experience spur them to collectively work out appropriate adaptive measures.

These social aspects are important. "There is openness and sharing within the group, and active group participation," says farmer Eddie Panes. "We share whatever we learn at the meeting and also the technologies we have, like which varieties are more adapted to our place, which technologies are best suited to strong wind, rain or drought and such situations. We don't know what climate change will bring tomorrow, what really will be our situation. It changes all the time."

(Adapted from: MASIPAG, Food Security and Farmer Empowerment – A Study of the Impacts of Farmer-led Sustainable Agriculture in the Philippines, 2009)

and water losses on various types of soil and land topography), how to build up organic matter in the soil, pest-predator relationship and growth cycles for ecological pest control, *etc*. With the weather, especially rainfall, turning more erratic and unpredictable and official weather forecasts more unreliable, farmers now want to make their own weather observations and use these and other agro-meteorological information in taking farming decisions. This has led to the development of Climate Field Schools, on the lines of Farmer Field Schools, where farmers seek to enhance the resilience of their farming systems. In Indramanyu, in West Java, for example, lowland rice farmers, facing erratic rainfall, are reported to have developed "diverse agricultural systems in response to the different water regimes"; in the dry rain-fed hilly areas of Gunung Kudul in central Java, where only one rice crop could be raised in a year, farmers have been experimenting with "local practices of dry multiple cropping of rice, corn, cassava, sorghum, tobacco and vegetables". And, in general, "farmers are now more aware of how to use climate information in managing their soil, water and crop resources for best effects."[67]

In Malaysia, where deforestation, storm surges and coastal flooding are threatening the livelihood of forest and fishing communities, some among them are using indigenous practices to restore forests and mangroves. The Kayan indigenous community of Sarawak, whose local biodiversity and hence survival was threatened by forest-logging and climate change, is massively reforesting the area with *local trees.* Penang's inshore fisher communities, facing a threat to their livelihood from the clearance of thick mangrove forests (which harbour varieties of fish) and flooding,

have been replanting mangroves in the cleared and also new areas; the mangroves have helped reduce flooding.[68]

Farmers' responses in South Asia

With its vast geographical spread and varied agro-climatic zones, India faces varied climatic impacts - intense rainfall and floods in some parts, lower rainfall in others, increasing aridity in the dry areas, and warming in hilly and forest zones. This has drawn varied responses and adaptive measures in various parts of the country.

In eastern India, for example, rice farmers grow several varieties to reduce the risk from unstable rains and droughts. When the rains come late, they grow more of early-maturing rice which can be harvested before any drought conditions set in, and are also directly (dry) seeding rice instead of transplanting seedlings. The farmers have also generally diversified crops and varieties (early-maturing, drought-resistant, *etc.*) to maintain a stable farm output, and have also sought to diversify their sources of income.[69] In some areas of the northern mountain state of Uttarakhand, farmers associated with *Beej Bachao Andolan* (Save Seeds Movement) have sought to revive the traditional *Baranaja*, a multi-cropping system that provides both food and fodder security even in climate change and failed weather situations. In the southern state of Andhra Pradesh, where intense rainfall is increasing, farmers are trying out fruits (in place of groundnut, millets, sorghum, *etc.*), while in Chhattisgarh, a traditionally rich rice-growing area where rainfall is now declining, they are experimenting with growing pulses and sorghum (in place of rice) which consume less water.[70] Lower rainfall in the hilly and forest areas of Meghalaya in the north-east has prompted farmers there to "scale up non-water-intensive crops, maintain pools of different seed varieties, build bunds and terraces to conserve water, and practice mixed cropping and crop sequencing, which were not prevalent in these places earlier"; farmers here say they have been seeing faster changes in climate than before.[71]

Floods have increased in eastern parts of Uttar Pradesh in India in the past few decades. In response, based mainly on indigenous knowledge and practices, people have developed numerous ways of coping with the problem and protecting their livelihood. Primarily, they have adopted

a crop cycle that helps minimize crop losses. The cycle consists of a variety of (i) pre-flood crops that can be harvested before the floods (early-maturing and short-duration paddy, maize, millets, and fruit and vegetables such as watermelon, okra and gourd which grow well on sand and silt left behind by the floods); (ii) crops grown during floods (such as deep-water rice varieties, fruits such as guava, bamboo and lotus); and (iii) post-flood crops (crops which grow well in water-logged conditions, such as rice that can be sown late, alfalfa, mustard, coriander, and quick-growing *arkil*, a variety of pea). The region being rich in biodiversity, farmers have also diversified (with diverse crops, trees, plants, grass, and animal-rearing) and intensified their agriculture (growing hemp and vegetables with sugarcane, for example) to reduce flood losses or recover part of the flood-hit crops. Other protective measures include setting up grain and seed banks to cope with disasters, and seed production to preserve local seeds and for additional income. Fish culture, livestock-rearing and fodder production and storage systems (for the flooding season) help enhance people's livelihood or make them more resilient. Further, women engage in adding value to the produce by processing paddy, milk, sugarcane and vegetables. To disseminate the knowledge, skills and experience gained in these processes wider, farmers and NGOs have got together and documented nearly 100 such adaptive practices being used in this region.[72]

Floods are also a problem in low-lying Bangladesh where farmlands in many areas remain water-logged for long periods through the year. With water hyacinths growing thick on these waters, farmers have adapted a technique, popularly known as floating gardens (*dap chas*), of growing vegetables, spices, herbs, *etc.,* on the floating hyacinth beds without chemicals as the hyacinths provide an organic base to the crops. This has restored part of the lost income for many families, which they supplement with other gainful work such as raising ducks, fishing, and growing vegetables and flood-tolerant plants on raised soil beds.[73]

Facing glacial floods, farmers in Nepal have developed 'hanging nurseries', and also grow plants on heaped soil rather than on flat ground to reduce losses during floods. To protect seeds from floods, seed storage systems are built on elevated ground. Diversified crops now include "stress-tolerant" wild varieties of vegetable, and maize, tomato, pepper, *etc.,* inter-cropped with rice.[74] In Sri Lanka, sea water infusion (resulting in

salinity of farmland) and land erosion have been causing crop losses in coastal areas. In the southern coastal district of Hambantota, for example, salinity has emerged as "a key problem", and rice farmers have been losing 30-40 per cent of the yields; this and the increase in pests and plant diseases have pushed up the use of chemical fertilizers and pesticides, raising costs and degrading the soil. Working together, farmers and NGOs tested and selected varieties of traditional salt-resistant rice which were then grown organically with low external inputs and biopesticides. This has especially "helped marginalized salinity-affected farmers to cope".[75]

Meanwhile, dryland farmers in many parts of Asia which are getting drier are changing their irrigation practices, shifting to crops and varieties that maintain yields with less water, and are also developing community-based water-harvesting systems to optimize the availability and use of water.

Climate change, women and response

Climate change has a particularly severe impact on women. In the wake of crop losses and food shortages, it is women and girl children in the family who, going by prevailing social norms, are expected to eat less or forego food. If there is a water shortage because of less rainfall and drought or a fuelwood shortage because of deforestation, it is rural women who have to trek far longer and spend much more time to search for and fetch these daily domestic requirements. Thus climate change is increasing hunger, the burden of work and other hardships among women. And it is women who suffer more following natural disasters such as floods, landslides, typhoons and loss of land, home and livelihood. Because of their social constraints, they suffer greater casualties and stress, and also greater discrimination (especially women who head families) in receiving public assistance and compensation as their individual rights to land, homestead and government assistance are not clearly recognized. This was evident in the cases of many women victims of the Asian Tsunami in 2004.

Water shortages are a problem women in arid zones are increasingly facing. In this context, a community initiative by marginalized people in the arid Mewar region of Rajasthan in India holds much significance.

Spreading aridity and depletion of ground water prompted communities in some parts of this region to "revive their traditional rain-harvesting and usage systems" such as ponds and canals and also build new tanks and canals, according to a UNDP report;[76] following this, they set up *jal sabhas* (water committees) in the villages to protect and manage the water resources. As a result, "190 villages have seen significant improvement in water security," benefiting nearly 180,000 people (mainly Dalits, tribals and other socially backward groups). A survey later showed that, in 85 per cent of the sampled households, the new system had reduced women's "burden of traversing long distances to water sources", as noted in the report. (*See also Box- Traditional knowledge and local coping strategies worldwide).*

Limits to adaptive measures

All such adaptive measures basically seek to reduce the impacts, damage and vulnerability to climate change and to protect livelihoods of poor communities. However, the adaptive measures have some limitations in the context of the current phase of rapid climatic changes, recurrent extreme weather events and disasters, their increasing intensity, and the lack of resources available to poor farmers and landless workers. Beyond these adaptive measures, therefore, there is an urgent need for measures which help mitigate climate change.

"Small-scale farmers, regardless of how knowledgeable, resilient and empowered they may be, cannot be expected to respond continuously to disasters", observes MASIPAG. They need support systems such as "solidarity funds, early warning systems and other appropriate infrastructure". But above all, "the adaptive systems need to be seen in the broader context of climate change worldwide ... which calls for urgent mitigation measures in sectors and countries which contribute the most to climate change."

Viable options in mitigating climate change and hunger

Agriculture offers much potential for the mitigation of climate change through sustainable agricultural practices. Mitigation tackles climate change at the source, *i.e.* it seeks to reduce the sources of GHGs and hence GHG emissions. These practices include: doing away with the

Traditional Knowledge and Local Coping Strategies Worldwide

Traditional knowledge can help to provide efficient, appropriate and time-tested ways of adaptation to climate change. Several examples of local coping strategies can be cited.

In Africa, rural farmers have been practicing a range of agricultural techniques as coping strategies and tactics to enable sustainable food production and to deal with extreme events. These include intercropping and crop diversification; use of home gardens; pruning and fertilizing to double tree densities and prevent soil erosion in semi-arid areas such as in Senegal, Burkina Faso, Madagascar and Zimbabwe; and water-conservation techniques to cope with arid conditions such as the *Zaï* technique in Burkina Faso. In the latter system, farmers dig pits in the soil to collect wind-carried organic material in the dry season, and at the start of the rainy season, they add organic matter from animals which attracts termites resulting in termite tunnels that collect rain deep enough that it does not evaporate, thus increasing soil fertility.

In Latin America, these strategies include a variety of agricultural practices, ecosystem protection and methods to adapt to extreme events. Farmers in Peru have been using an ancient irrigation and drainage system, *waru waru*, or raised field agriculture which allows farming in the low-lying, flood-prone, poorly drained lands found all over the Altiplano. Shallow canals provide moisture during droughts and drainage during the rainy season. When filled with water, these also create a microclimate that acts as a buffer against night-time frosts. The *waru waru* system provides farmers with greater harvest security and reduces the risks associated with frosts and drought.

In Mexico, the Cajete Terrace agro-ecosystems have been in place for 3000 years in the hillside regions in Tlaxcala. In these rain-fed corn-bean-squash agro-ecosystems, food is grown on steep erosion-prone slopes. Rainfall here is concentrated between May and September and often occurs in sudden downpours. The sloping terraces feed excess water into tanks (*cajetes*). The water, which would otherwise not be absorbed into the soil, collects inside the *cajetes* and slowly percolates into the surrounding soil after the rain has stopped. Eroded soils are also trapped inside the *cajetes*, preventing soil loss down the slope. The nutrient-rich soils inside the *cajetes* are later gathered and distributed onto the

fields. The Aymaran indigenous people of Bolivia have been coping with droughts through the construction of small dams or *qhuthañas*. These dams collect and store rainwater up to 50 to 10,000 cubic metres.

In small-island developing states, communities have developed coping strategies for agriculture, coral reef protection and climate extremes. For example, on Timor Island, farmers have developed their own varieties of major staple crops to adapt to erratic rainfall and cyclones and to ensure food security. Reconstructing *groynes* (low walls built into the sea to prevent erosion), building sand dune fences, and planting trees along the coast reduce the impact of coastal erosion following a rise in the sea level.

The United Nations Framework Convention on Climate Change database on local coping strategies provides a collection of long-standing coping strategies, mechanisms, knowledge and experience from communities in developing countries that have had to adapt to specific hazards or climatic conditions. Please see http://maindb.unfccc.int/public/adaptation.

(Source: United Nations Framework Convention on Climate Change (UNFCCC). *Climate Change: Impacts, Vulnerabilities and Adaptation in Developing Countries*, 2007)

use of chemical fertilizers and other chemicals or minimizing their use which cuts down GHG emissions; reduction in fossil-fuel-based energy use; good land and crop management to improve soil fertility and store carbon in the soil; agro-forestry and animal husbandry (integrating native trees and animals into the farming system); expansion of biodiversity; and promotion of local food systems and markets to avoid long-distance transport of food. These practices are variously known as organic systems, ecological agriculture or biodiversity-based ecological agriculture (BEA). *(See Boxes - How organic farming counters climate change).*

Besides mitigation of (and also helping adaptation to) climate change to a significant extent, biodiversity-based ecological agriculture can, in most cases, substantially raise crop yields and offer greater food security, increase farmers' income and improve their livelihood and health without damaging the environment. In other words, such a system can also help mitigate hunger and poverty among the rural poor, build

up their resilience, address people's health and nutrition concerns, improve the environment and enhance the quality and safety of food for urban consumers. Biodiversity-based agriculture thus combines several environmental, economic and social benefits.

Diversity, resilience and *local innovation* are the keys to such agricultural systems. Being thus knowledge (and not capital)-based, these systems are particularly suitable for small-scale farmers who form the majority in agriculture in developing countries. By encouraging farmers to share knowledge and experience through collective discussions and decision-making, biodiversity-based ecological agriculture promotes participatory development and social and gender equity among communities. Catering to local markets can foster close interactions with communities in the neighbourhood, helping to develop local food systems. Biodiversity-based ecological agriculture in fact promotes food sovereignty at the community level; that is, it empowers farming communities to decide what food they want to grow and how best to grow it.

BEA is multi-functional

Several recent studies have highlighted the multiple benefits of biodiversity-based ecological agriculture. A comprehensive review (published in 2008) of sustainable agriculture and food production and distribution systems worldwide by Prof. Mae-Wan Ho, of The Institute of Science in Society, UK, and her colleagues shows that "organic agriculture and localized food systems can mitigate 30 per cent of the world's GHG emissions and save 16.5 per cent or one-sixth of the global energy use". The biggest reductions in GHG emissions come from carbon storage in organic soil (11.5 per cent) and "localizing food systems" (10 per cent); reduction in the use of nitrogen fertilizer can reduce GHG emissions by 7 per cent. Furthermore, biodiversity-based ecological agriculture systems can give much higher yields even without the use of chemical fertilizer and offer greater employment opportunities. The energy savings from localizing food systems come mainly from reduced transport of agricultural inputs and food. If farm and food wastes are used to produce energy, up to 54 per cent of the GHG emissions could be reduced and nearly 50 per cent of the energy saved. However, the review noted that the "organic food system is being taken over by food corporations", undermining its traditional values.[77] Corporations are promoting genetically modified

crops (which pose new threats to biodiversity, local seed varieties and farm practices) as part of the organic system and also 'costly and complex' certification systems which poor farmers cannot afford.

Another worldwide study, covering 287 sustainable agriculture projects in 57 poor countries by Jules Pretty from the Centre for Environment and Society, University of Essex, in the UK, and other scientists in Thailand, Sri Lanka, China and Mexico, showed to what extent such projects can mitigate climate change under varied farming conditions and also raise yields and improve farmers' livelihood. The study, published in *Environmental Science and Technology* (USA) in 2006, evaluated projects that had used "a variety of resource-conserving technologies and practices". [78] These included: integrated nutrient management; conservation or reduced tillage to conserve soil and make more efficient use of soil moisture; integrated pest management based on ecological methods; agro-forestry or growing multi-functional trees in the farms; aquaculture with fish, shrimps, *etc*. grown in rice fields and ponds; water harvesting in dryland areas and degraded lands to grow crops; and integrating livestock such as dairy cattle and poultry into the farming systems. The study showed the following benefits from these projects.

- The projects helped store 0.35 tonne of carbon per hectare per year in soils and trees. If 25 per cent of the global farming systems adopted these sustainable agricultural practices, it would store 100 million tonnes of carbon per year.

- Average crop yields increased by 79 per cent.

- Food production per cubic metre of water used rose by 15.5 per cent for irrigated rice, 70 per cent for rain-fed cereals, 102 per cent for legumes and 107.5 per cent for roots and tubers. This efficiency resulted from reduced tillage which reduces evaporation, the use of more water-efficient crop varieties, cutting down water losses, and "inducing micro-climatic changes to reduce water requirements".

Another study, spanning 20 years from 1978 to 1998, on the mitigation potential of organic farming conducted in Switzerland showed that it

can reduce GHG emissions by 31 per cent compared to chemical-based agricultural systems.[79]

In the Philippines, as discussed earlier, MASIPAG promotes non-chemical and largely non-mechanized agriculture (to reduce energy use), and emphasizes crop diversity, breeding local seed varieties and the production of food for local markets. MASIPAG's biodiversity-based organic ecological agriculture produces much less GHG emissions than highly mechanized (more fuel-consuming) and export-oriented agriculture practiced in the Philippines. The farmers in the network, most of whom are among the poorest in the country, now "have better food security, better incomes, better health, and a positive view of their future" compared to conventional farmers, according to a study published in May 2009.[80]

The study covered 840 small-scale farmers (with average land-holding of 1.5 hectares) across the country – 280 practicing full organic farming, 280 in transition to organic farming and 280 conventional farmers using chemicals as a reference group. Apart from better environmental quality and health, the survey showed that organic farmers had higher productivity and earned 50 per cent higher net income per hectare (for fully organic farmers) than conventional farmers whose incomes had in fact been falling or had remained stagnant over the years. The organic farmers also had 50 per cent more crop diversity, "better soil fertility, less soil erosion, increased tolerance of crops to pests and diseases, and better farm management skills". Because of the higher productivity and diverse crops, the organic farmers ate more diverse and nutritious food and so had better food security. The results were particularly favourable to the poorest among the organic farmers.

Other studies too show that besides mitigating climate change, sustainable farming can help reduce hunger and poverty and provide greater food security, especially among small-scale farmers. (*See Box - Biodiversity-based ecological agriculture, incomes and food security*) This has great significance for the majority of farmers in developing countries who are generally poor, malnourished or hungry.

Biodiversity, agro-forestry and small farms

Diversified organic farms mitigate GHG emissions by increasing the carbon stock in the soil, and are also less vulnerable to the impacts of climate change. Besides, recent research has shown that small farms with mixed crops improve productivity per unit area when total production on a farm and not just the yield from a single crop is counted. Diversified farms maintain good soil quality, retain soil moisture and are less prone to soil erosion, which means they also suffer less damage in climate-induced calamities. For these reasons, small-scale and indigenous farmers often maintain diversity "as insurance against future environmental change or social and economic needs." (*See Annexure 7 – Small traditional biodiverse farms are more resilient and sustainable*)

Several studies around the world have shown the advantages of biodiversity and of using different varieties even within a crop. To cite some examples, corn grown with three other food crops and three cover crops doubled yields over three years and maintained better soil fertility, in the USA; in Italy different wheat varieties grown in non-irrigated wheat farms reduced crop losses in dry conditions; and in China a mixture of rice varieties, some susceptible and others resistant to rice blast disease, reduced the impact of the disease and gave consistently higher yields than monoculture rice farms. "While oversimplified farming systems, such as monocultures of genetically identical plants, would not be able to cope with a changing climate, increasing the biodiversity of an agro-ecosystem can help maintain its long-term productivity and contribute significantly to food security", conclude the authors, Janet Cotter and Reyes Tirado of the Greenpeace Research Laboratories at the University of Exeter, UK, in their recent study of the role of biodiversity in agriculture in the face of climate change. "Genetic diversity within a field provides a buffer against losses caused by environmental change, pests and diseases," the report stated."[81]

Such diverse farms can be integrated with agro-forestry (in which a variety of trees are grown along with food crops) to further enhance their potential to mitigate carbon emissions, enhance carbon storage and improve productivity. Agro-forestry includes growing trees for timber, fruits or other purposes, and shelter and buffer trees to protect food crops and provide windbreaks. Diverse agriculture and agro-forestry has been traditionally practiced by indigenous communities.

Studies show that sustainable agricultural systems, in general, can store 0.3-0.6 tonne of carbon per hectare annually and this can go up to several tonnes per hectare "when trees are intercropped in cropping and grazing systems"; thus, sustainable agro-forestry offers the biggest advantage for carbon storage.[82] Recognizing this role of biodiversity in mitigating climate change, the United Nations Convention on Biological Diversity (CBD) has declared 2010 as the International Year of Biodiversity.

Localizing food systems

Localizing food trade is an important component of reducing global GHG emissions from agriculture and could reduce GHG emissions by about 10 per cent. The increasing trend of consumerism, the proliferation of supermarkets and hypermarkets offering food sourced from across the world, the demand for off-season fruits and vegetables grown overseas and the dominance of global food trade by only a few transnational corporations has, on the other hand, changed the structure of the global food economy. Today, food is transported round the world at almost every step - from production to processing, packaging and marketing centres spread across the globe.

Agricultural trade liberalization under the WTO has accelerated this trend. As a result, the distance that the same food now travels on the world's airways and motorways has increased enormously (this long distance that a food travels is known as 'food-miles' and such foods as 'frequent-flyer foods'). Besides causing serious health and environmental problems through use of pesticides in areas where such foods are produced for export, this leads to GHG emissions from the energy used in transport, processing and packaging, and also from the extensive refrigeration that such foods need.

The USA, for example, exports food all over the world; it also imports lot of foods, particularly off-season foods from tropical countries. Its food system consumes about 19 per cent of the total fossil-fuel energy used in the country – 7 per cent for farm production, 7 per cent for processing and packaging and 5 per cent for preparation and distribution. Food picked up in any supermarket today would have traveled an average of 2,000-4,000 km. Making matters worse, consumers now drive ever-longer to buy these foods from supermarkets, burning up much more fuel.[83]

How Organic Farming Counters Climate Change

Organic agriculture is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and methods adapted to local conditions, rather than the use of inputs with adverse effects. Organic agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved.

Organic agriculture *mitigates* climate change because it:

(i) *reduces greenhouse gases,* especially nitrous oxide as no chemical nitrogen fertilizers are used and nutrient losses are minimized;

(ii) s*tores* carbon in soil and plant biomass by building organic matter and encouraging agro-forestry; and

(iii) *minimizes energy* consumption by 30-70 per cent per unit of land by eliminating the energy required to manufacture synthetic fertilizers and by using *internal farm inputs* which reduces fuel used for transportation.

Organic agriculture helps farmers *adapt* to climate change because it:

(i) *prevents nutrient and water loss* through high organic matter content and soil covers, making soils more resilient to floods, droughts and land degradation processes;

(ii) *preserves seed and crop diversity,* which increase crop resistance to pests and diseases, and crop diversity also helps farmers evolve new cropping systems to adapt to climatic changes; and

(iii) *minimizes risk* as a result of stable agro-ecosystems and yields, and lower production costs.

Organic agriculture, in fact, offers one of the quickest, cheapest and most effective means of mitigating climate change because it works *with* rather than *against* nature and supports localized food systems. Globalization feeds an artificial market that profits by moving food thousands of kilometres from where it is produced to where it is consumed, burning fossil fuels every step of the way. Localized food systems tend to reduce both fuel consumption and the production of climate-changing emissions.

In the highly-intensive monoculture farming practiced in the USA for example, it takes about two units of fossil fuel energy to harvest a unit of

crop energy while organic systems collect 180 per cent more solar energy than conventional agriculture. Fossil-fuel based industrial agriculture also moves carbon out of and into the atmosphere whereas organic agriculture takes carbon from the air and puts it back in the soil. Organic farming for carbon capture is also compatible with other environmental and social goals such as reducing erosion, minimizing impact on native ecosystems, and improving farmer livelihood. Converting 10,000 medium-sized US farms to organic farming would remove so much carbon from the air which is equivalent to taking 1,174,400 cars off the road. Moreover, converting 64.7 million hectares of US corn and soyabean to organic production would capture and store enough carbon to meet 73 per cent of the US carbon dioxide reduction targets under the Kyoto Protocol.

Monocultures that rely on high-input high-cost technologies are more risk-prone because they lack biodiversity. Farmers using low-external-input organic systems are better able to adapt to climate change as their farms are more resistant to extremes of droughts and floods.

(Sources: International Federation of Organic Agriculture Movements, Pesticide Action Network North America and The Rodale Institute, USA.)

Sustainable Agriculture, Incomes and Food Security

Several studies show that besides mitigating climate change, sustainable farming can provide better food security than conventional chemical-based agriculture at the household and local community levels and thereby help reduce hunger and poverty, especially among small-scale farmers. In Thailand, sustainable agriculture has helped over 10,000 farmers in the Alternative Agriculture Network in the north-eastern region to substantially raise their incomes (by over 90 per cent) and food supply, and improve their nourishment and health. In India, over 50,000 farmers in the Low External Input Sustainable Agriculture Network in the state of Tamil Nadu (where nearly 75 per cent of the small-scale farmers are in debt) have reported progressively higher incomes and food availability (because of the diverse crops grown) and the re-emergence of secondary food sources such as edible weeds (which the chemicals had killed off earlier) in the farms. As a result, farmers in the network are now reported to be free from debt. According to IFOAM, globally, over a period and on an average, production costs have fallen by 40 per cent and farm incomes have doubled.

But can sustainable agriculture feed growing populations at the national or regional levels? Recent studies show that it can.

Africa is said to be facing the threat of massive hunger because it has not caught on to "modern" chemical-based intensive agriculture. Agribusiness corporations and US foundations, backed by the US government, are now rushing there to create a "Second Green Revolution", using chemicals, industrial farming and genetically engineered crops to boost food production. "It has been conventional wisdom among African governments that modern, mechanized agriculture was needed to close the gap (in food production) but efforts in this direction have had little impact on food poverty and done nothing to create a sustainable approach", notes *The Independent,* UK, reporting on a large-scale study of organic farming in Africa, sponsored by the United Nations Environment Programme (UNEP) and the United Nations Conference on Trade and Development (UNCTAD) in 2008. The study, to find "to what extent organic agriculture can enhance food security in Africa", evaluated 114 projects in 24 African countries, and showed that "yields had more than doubled where organic or near-organic practices had been used". The study "indicates that the potential contribution of organic farming

to feeding the world may be far higher than many had supposed", says Achim Steiner, who heads UNEP.

Most of the organic farming projects studied in Africa showed improvements in soil fertility, water supply and retention and biodiversity. UNEP's report noted: "Organic farming leads to many improvements to the natural environment, including increased water retention in soils, improvements in the water table (with more drinking water in the dry season), reduced soil erosion combined with improved organic matter in soils leading to better carbon sequestration, and increased agro-biodiversity. As a result, soils are healthier, better able to hold water and more stable, can sustain plant growth better and have a higher nutrient content. All this enables farmers to grow crops for longer periods, with higher yields and in marginal conditions. This can make a major impact on reducing the food insecurity of a region."

The report's conclusion was even more emphatic: "Organic agricultural systems are making a significant contribution to the reduction of food insecurity and poverty in areas of Africa, and to an improvement in rural livelihoods.... which challenges the popular myth that organic agriculture cannot increase agricultural productivity. Organic and near-organic agricultural methods and technologies are ideally suited for many poor, marginalized small-holder farmers in Africa. There is the potential to do more in this area with enabling policy and institutional support."

(*Sources:* Howden, Daniel. *Organic farming "could feed Africa",* The Independent, London, 22/10/2008. http://www.independent.co.uk/news/world/Africa/organic-farming-could-feed-africa-96864 and United Nations Environment Programme and United Nations Conference on Trade and Development. Organic farming and food security in Africa, Geneva, 2008)

Some Farmer Responses to Problems from Climate Change	
"Biological Farming" Saves Crops and Cattle	*Farmers Julia Weston and Frank Giles (Tasmania, Australia) say:* Rainfall records have been kept here at Seaview Farm since 1929. We expect 1016 mm of rain a year, but in 2006 we received just 406 mm, the lowest ever. Day by day it got drier and drier. Everyone's pastures, crops, livestock and streams shriveled; old timers said the creeks had never dried up; we had barely enough water to keep our cherry orchard alive. Then the bushfire came with more extreme weather. We were worried, erratic weather can upset things in so many ways we can't plan for. Our blueberries might not get enough winter chilling. Will there be water for irrigation? How much more fodder should we keep on hand? Then we moved to "biological farming" using non-chemical fertilizers, rebuilding soil ecology to restore natural systems. After the bushfire, the drought's impact persisted and forced our neighbour to sell off a lot of his livestock. But our animals and pastures were in good condition, and we started buying more animals. People came and shook their heads. We came out of the drought so well because of our switch to biological farming. If we are to be affected by climate change in the future we'll have to find new ways of farming. Conventional "big" farming might turn a lot of farmland into a dustbowl. We need to be flexible and diversify our farming, and learn to farm with nature rather than fight it. *(Source:* Polly Buchhorn and Stephanie Long, Australia -- *Fire and Water, in Climate Change – Voices from Communities Affected by Climate Change*. Friends of the Earth International, 2007*)*

Combating Farming Problems with Native Knowledge	*Over 60 years old Hadi Eidar, a rice farmer (Sungai Acheh, Penang, Malaysia), says:* Since I was young, I learned to cultivate paddy using traditional methods, but in early 1970s, the authorities introduced new methods to grow paddy that yielded good results for a short time. Those methods are no longer sustainable due to environmental changes and rise in plant diseases. Constant heat and heavier downpours have also enabled the pests like brown hoppers, snails and rats to thrive in my paddy fields. These pests seem to have adapted to the changing hot and rainy weather, and know how to survive the pesticides. I returned to traditional *cedung* system, which uses lots of water, even when it rains and the fields get flooded. It keeps the pests at bay and also does not destroy the crop as the plants are tall and rise above the water level. The *cedung* system has rendered higher yields because of the native knowledge of keeping paddy fields healthy, including rearing catfish in the water, which eat the brown hoppers. And using buffalo, instead of tractors, to plough the land. I am also using organic pesticide *pachakavya* which does not kill earthworms, and keeps the soil healthy. I want to urge the government to reinstate the old methods of cultivating paddy fields because they would definitely help farmers to prepare for the drastic weather which is already showing its signs. *(Source:* Sangeetha Amarthalingam and Meenakshi Raman -- *Rising to the challenge, in Climate Change – Voices from Communities Affected by Climate Change.* Friends of the Earth International, 2007*)*

Biodiversity-based Ecological Agriculture – Cheaper and More Resilient	Faced with erratic rainfall, water shortages and the increasing cost of chemical fertilizers and pesticides, 41 yr-old Indonesian farmer Ade Saeful Komar in Sukahaji village (Ciasem, Subang district), decided to shift to organic farming in 1998, on the advice of Nastari Foundation. "Everybody, including my wife, was against me when I decided to start organic farming," he says. His wife was indeed skeptical, and indeed she was right – initially their harvest dropped from six to four tonnes. But by the fourth harvest, the yields were back to normal. "Now, after 18 harvests, this practice has turned out to be much better. I do not have to worry so much about water shortages or the cost of pesticides and chemical fertilizers," says Ade. According to him, when the soil is fertilized with organic manure rather than chemical fertilizer, it has a better structure and becomes more resilient to dry conditions. Today, Ade makes his own natural pesticide - mixing *nimbung/mindi* leaves with garlic in a blender, or using *brotowali*, along with *sirsak* and *jaringan* leaves. "Cheap and easy. I only need to buy half a kilo of garlic," he says. 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 such, his fields tend to be less infested now. Ade's success has encouraged some neighbouring farmers to start using less pesticides and chemical fertilizers. *(Source:* United Nations Development Programme, Indonesia. *"The other half of climate change – why Indonesia must adapt to protect its poorest people".* UNDP, Jakarta, 2007*)*

"This change in the food economy and food distribution strongly affects the food system, the farmers as well as consumers", says Tim Lang, Professor of Food Policy at City University, London, who has been studying food policies and food systems. "It gives retailers power over the entire food system. It affects what the farmer grows, and how she or he grows it – by the use of contracts and specifications. And it affects consumers, who have to pay for transport that they can ill afford. The specifications stipulate that food is unblemished, of a certain size, uniform and so on, which only a narrow form of farming can produce. Needless to say, agribusiness and agrochemicals go hand in hand." A key factor in this new globalized food economy is the "imposition of harmonized food standards". "The issue is not just what these standards are but who makes them... and whose interests they serve." (These standards are generally shaped by the food industry, represented mainly by transnational corporations.) Supermarkets now sell vegetables and fruits ferried from thousands of kilometres away even as 'local fruit trees are uprooted'. "Why import fruits and vegetables which can be grown locally?" asks Prof. Lang. "In fact, we should be localizing food trade, but the economic-powers-that-be are driving through a logic that forces us to trade more, not less, long-distance food."[84]

If food is grown organically and consumed locally, it could reduce GHG emissions substantially, improve local health and the environment, generate more local jobs and generally strengthen local economies. For this to happen, consumers and local communities need to play an active role along with farmers in developing a mutually responsive local food market. Consumers and communities need to support farmers, and farmers in turn need to respond to the requirements of the local communities. Such consumer- or community-supported biodiversity-based ecological agriculture is practiced in several countries where local consumers and farmers co-operate and discuss what food to grow, how to grow it and the likely price. Such systems integrate several environmental, social and rural economic goals. However, instead of trying to meet such goals which will mitigate climate change and also help the majority of the farmers and consumers, the corporate-controlled and globalized food system is being relentlessly pushed in a different direction to serve the sole purpose of accumulating profits for corporations and big traders and landlords. To quote Prof. Lang again, "The globalized food economy is going in the direction of being more concentrated, more fragmented,

more dominated by niche markets and more labour-shedding. Distributors and brands are sovereign (as opposed to producers and consumers). Production intensifies and people are thrown off the land. Meanwhile, distribution chains lengthen."

Public policies and institutional support

The wider implementation of biodiversity-based ecological agricultural practices, as seen from the discussions above, relates to the basic issue of how we socially organize food production and distribution, which in turn depends on who makes decisions related to food production and distribution and the context within which these decisions are made - international, national and regional agricultural, food and trade policies that impinge on local agriculture. These policies and institutional support have a major role to play here; they set the course of the general development of agriculture. In recent times, these policies have promoted chemical-intensive monoculture and export-oriented farming and genetically modified crops worldwide, favouring agribusiness and agro-chemical corporations, especially transnational corporations, and large-scale farmers.

Modern chemical-based monoculture farming, being capital-intensive and corporate-led, uprooted diversified farming systems and small-scale farmers in the name of efficiency and created an agrarian crisis in developing countries. Focused solely on boosting production of single crops using heavy external inputs, the new system wiped out diverse crops, depleted soil nutrients, degraded and contaminated land, water and other natural resources. Though farm production rose substantially for some time, by the 1990s productivity began to decline everywhere despite the use of increasingly higher amounts of fertilizers. In Asia, for example, the average productivity growth declined from 3.35 per cent during the decade 1977-86 to 1.5 per cent during 1987-97 for rice, from 6.21 per cent to 2.96 per cent for wheat, and from 4.04 per cent to 3.34 per cent for corn.

As crop yields slipped or stagnated and the costs of external inputs mounted, more so after agricultural trade was liberalized in the mid-90s, incomes dwindled and indebtedness and distress rose among small-scale farmers. Along with the agrarian and environmental crises, a crisis of

hunger, caused by increasing (rural) poverty, was now building up; the recent food price crisis (fuelled by factors such as speculative trade and diversion of food to make agrofuels) and then the financial crisis (which led to large-scale loss of jobs) pushed food further beyond the reach of the rural as well as the urban poor all over the world. The number of the world's hungry jumped from 850 million in 2005 to over a billion in 2008, nearly one in every seven in the world. It needs to be noted that, of these hungry worldwide, nearly 80 per cent are small-scale and marginal farmers, the rest being landless farm workers, fishers, forest-dwellers, herders and the urban poor. The impacts of climate change now threaten to aggravate their condition.

It is in this context that biodiversity-based ecological agriculture has much significance – for the mitigation of climate change and increasing food production without poisoning the environment, as well as for the mitigation of poverty and hunger among the poor and small-scale farmers.

Conclusion

The looming threat of climate change and increasing hunger, and the fact that the poor, particularly poor farmers, are the most vulnerable to their impacts now make biodiversity-based ecological agriculture even more relevant.

The promotion of biodiversity-based ecological agriculture on a wider scale needs policy and institutional support from governments. Though a few countries such as Cuba and Switzerland have supported such agriculture through policy measures, in most other countries, policy and institutional support is still lacking. This is because international and national agricultural and trade policies, and international agencies and various foundations involved in agricultural promotion (such as the Rockefeller Foundation and the Gates Foundation which are now active in Africa) still favour high-input and high-cost chemical-based agriculture and genetically modified crops. Efforts to expand biodiversity-based ecological agriculture have also been undermined by agribusiness corporations by influencing international policies and the agenda for global agricultural development. These groups work in close proximity to the US government and international finance agencies which use tied financial aid and trade to promote high-input agriculture worldwide.

Further, corporations have been influencing the course of agricultural research in public institutions and universities in many countries. Agricultural trade liberalization under the WTO and the rash of recent regional and bilateral free trade agreements between the USA or the EU on one side and developing countries on the other have also sought to push intensive agriculture and genetically modified crops in developing countries. These national and international policies need to be changed to promote biodiversity-based ecological agriculture and food sovereignty among farming communities.

With landlessness and indebtedness among small-scale farmers increasing in many developing countries, there is also need for thorough agrarian and land reforms which will facilitate the greater adoption of biodiversity-based ecological agriculture. This would provide farmers the means to produce their own food, control over their land and thus the incentive to raise farm productivity and conserve natural resources by adopting the best farming practices suited to their economic and environmental conditions. In this context, it must be re-emphasized that biodiversity-based ecological agriculture, besides helping mitigate climate change, raises land productivity and farmer and community resilience at a low cost, particularly for small and marginal farms which form the base for much of the food production in developing countries. And, as history shows, agrarian reforms have boosted agricultural growth and reduced rural poverty.

To sum up, climate change and the related extreme events have been occurring too rapidly, and the poor and the marginalised who have been generally resilient to ecological changes, are finding it hard to cope with the rapid changes. Consequently, their livelihoods are being increasingly affected. Even as they are trying to adapt to the changes, there is much greater need to mitigate climate change, particularly in the developed countries. They need to be pushed into drastically cutting their carbon emissions through domestic measures instead of through carbon markets which will cut into the developmental space of the poor in the developing countries. While industries and fossil-fuel-based enegy and transport sectors should be the primary areas for mitigation, such efforts should also focus on chemical-intensive agriculture currently being promoted worldwide and which contributes substantially to climate change. Biodiversity-based ecological agriculture can help reduce much

of the GHGs emitted from this and related sources (such as emissions from the energy-intensive fertilizer industries). Equally important, it will also help the vast majority of the small-scale and marginal farmers in tropical countries, who are the most vulnerable to the impacts of climate change, enhance their natural resources base, food security, incomes and livelihood. In fact, as food and agriculture emerge as major problems along with climate change, increasing hunger, food security and livelihood issues should receive greater attention in climate change negotiations. Biodiversity-based ecological agriculture can help address some of these problems.

RECOMMENDATIONS

In December 2007, the same time that the governments of over 180 countries convened in Bali (Indonesia) to design the Bali roadmap to climate change, civil societies and people's movements initiated a "People's Protocol on Climate Change", which underlined the people's perspectives on the climate change problems. Today, this Protocol has grown into a global campaign, which aims to provide an avenue for grassroots, especially from the South - who are the worst-affected and yet are the least empowered to adapt to climate change - to participate in the process of drawing up a post-2012 climate change framework. It also seeks to bring the issue of 'climate justice' back to central discussions in UNFCCC. The Protocol has since been taken to the grassroots levels across the world, where NGOs and people's organizations have ratified it. PAN AP has strongly endorsed this Protocol.

The People's Protocol on Climate Change is included in Appendices (*See Annexure-1*). The following is the "Five Point Platform for Action" provided in the People's Protocol, here presented as our recommendations.

Comprehensive and concerted but differentiated and equitable global effort to achieve deep, rapid, and sustained emissions reductions

to stabilize CO_2 concentrations at 350 ppm and hold global average temperature rise to 1.5 degrees Celsius

1. Northern states and corporations, having inordinately used and damaged the atmospheric space and the environment enough to cause climate change, should unconditionally carry out deep emissions cuts at a rate and scale that will swiftly reduce CO_2 concentrations to 350 ppm or below, with peak emissions reached no later than 2015. All Northern states should be part of an internationally enforced, regulated, and binding framework for emissions reductions.

2. Southern states should reorient their economies towards low-carbon development and carry out measurable, reportable, and verifiable (MRV) emission reductions utilizing compensatory financial and technology transfers from the North.

3. Rapidly transition away from fossil fuels as energy sources towards new, renewable energy sources such as wind, solar, geothermal, and mini-and micro-hydropower; and from centralized to decentralized energy systems.

4. Abandon unsustainable agricultural and food production dominated by profit-seeking agribusiness and agrochemical TNCs. Industrial agriculture as practiced today causes major GHG emissions from land conversion and soil degradation, and the heavy use of fossil fuels for fertilizers, pesticides, and long distance transportation. Switch to ecologically-sound farming methods that keep carbon in the soil, within the context of diversified and community-based agricultural production that prioritizes achieving food security and self-sufficiency.

5. End deforestation once and for all. Stop large-scale mining and commercial logging activities by TNCs in the South, and the encroachment of export cash crop plantations into forests.

6. Reject aid conditionalities and policy impositions by the WB and IMF, and revoke unequal multilateral and bilateral trading arrangements that undermine environmental regulations and allow for the

unrestricted exploitation, pollution, and destruction of Southern resources by Northern corporations.

7. Immediately end all subsidies and investments by Northern governments and international public financial institutions to fossil fuel projects that will lock the world with carbon-dependent energy, production, and transportation systems far into the future. Redirect public funds to research and investments in developing environmentally-friendly technologies, renewable energy systems, sustainable mass transportation, and so on.

8. End wasteful and destructive wars and redirect military budgets in support of environmental conservation and the transition to sustainable technologies and systems.

Demand the reparation of Southern countries and the poor by Northern states, TNCs, and Northern-controlled institutions to redress historical injustices associated with climate change

1. Demand the mandatory and unconditional provision and transfer of financial and technological resources by the North to support adaptation (coping with and covering the losses from adverse climate impacts, and building climate-resilient systems) and mitigation (transition to low-carbon and sustainable development paths, and carrying out non-binding MRV emissions reductions) in the South.

2. Northern states should provide sufficient, predictable, and mandatory climate financing to developing countries. Climate funds are compensation and not aid. Funds should be over and above longstanding and unmet official development assistance commitments by developed countries (0.7 percent of Gross National Income); should mainly come from public sources; should take the form of outright and unconditional financial transfers; and should be democratically governed and directly accessible to communities and their organizations. Carbon markets should have no role in climate financing.

3. Rechannel all resources from donor-controlled climate funds and funding mechanisms, and oppose the involvement of Northern aid agencies and international financial institutions in climate finance. Intended recipients have no power and meaningful participation over these funds' design, governance, and delivery; they add to the debt burden of many poor countries, and will be forced to accept policy conditionalities in exchange for access to these funds.

4. Reject private insurance schemes and the sale of debt instruments to capital markets as mechanisms to raise financing for adaptation. These schemes transfer the burden of financing to developing countries and individual entities, and allow private corporations and funds to profit from the vulnerability they face.

5. Remove intellectual property rights and trade restrictions that place severe constraints on the people's access to climate-friendly technologies and thus on the ability to promote low-carbon alternatives.

6. Reject the imposition of debt-creating climate funds and the neoliberal policy conditions tied to the access of these funds.

Reject false solutions that allow Northern states and corporations to continue harming the environment and communities, provide new and greater opportunities for profit, and reinforce and expand corporate control over natural resources and technologies

1. Abolish all carbon markets. Put an immediate end to emissions trading and offsetting as mechanisms for Northern countries and corporations to meet emissions commitments. The cap and trade system has failed to deliver what little emissions reductions rich countries have committed to, and has effectively privatized and commodified the atmosphere. Northern carbon markets allow big historical polluters to evade making deep emissions cuts by trading among themselves rights to pollute the atmosphere which they had been given for free by Northern governments. Carbon offsetting allows Northern corporations to continue polluting by funding environmentally and

socially questionable projects in developing countries, offloading the responsibility and associated risks of cutting emissions to the South.

2. Oppose the expansion of carbon offsetting, which will transfer the burden of cutting emissions to the South, reward big polluters, and further weaken and delay efforts to curb Northern emissions through mandatory measures. Oppose its extension into Southern spaces, including:

    a. forests, which threaten to displace indigenous peoples and forest-dependent communities; bring standing forests to the control of private corporations; promote the expansion of monoculture tree plantations that damage forest biodiversity and ecosystems; and reward deforesters; and

    b. agricultural soils, which threaten to further decimate forests and land devoted to food production; enclose communal lands and displace farmers and rural communities; reward landlords and agribusiness TNCs, and bring more lands under their private control; and intensify industrial agriculture. Oppose the large-scale deployment of corporate-controlled technology such as biochar and no-till agriculture that will facilitate the inclusion of soils into carbon offsetting mechanisms. End the large-scale commercial production and use of agrofuels.

3. Large-scale agrofuel production worsens GHG emissions by forcing the extensive conversion of good farmlands, forests, and grasslands into plantations that release carbon into the atmosphere – apart from reducing agricultural land for food production, driving food prices up, increasing food insecurity, and displacing forest and rural communities.

4. Reject “clean coal” and carbon capture and storage, nuclear power, and megadams as substitutes to fossil fuels as power sources. These projects are intended to supply the increasing energy needs of TNCs and global elites but do not stem dependence on fossil fuels and the increase in GHG emissions. They also pose huge risks to the safety and health of communities, and the stability of ecosystems.

5. Oppose geo-engineering mega projects that manipulate the environment and alter naturally operating systems on a large scale. These ill-conceived schemes are extremely costly, complex, and risky; and totally ignore sounder, realistic, and practicable measures to stem climate change. Such extreme technological fixes include ocean fertilization, spraying sulphates into the atmosphere, putting sunshades in space, and plastic-coating deserts.

6. Reject proprietary genetically-modified "climate-proofed" crops. Stop the extension of patent rights on farmer-developed climate-resilient seeds by biotechnology and agrochemical corporations, which would deny small farmers the ability to cope with the negative impacts of climate change. End the genetic manipulation of crops by corporations, and promote the increase of agricultural biodiversity as an effective way of increasing agricultural resilience to erratic and extreme weather.

Struggle for ecologically sustainable, socially just, pro-people, and long-lasting solutions

1. Ensure that official bodies for climate action become democratic, participatory, and equitable institutions. Allow for the sectoral representation and participation of groups most vulnerable to climate change (including women, indigenous people, small island and desert countries, the youth, farmers, fishers) in the governance of these institutions and the delivery of support and solutions. Assert the people's sovereignty and democratic control over planetary resources and productive assets, and the equitable distribution of the wealth accruing from their use. Nations, communities, and sectors should be able to utilize their resources to meet their social needs, and pursue independent and ecologically sustainable paths to development.

    - Reverse neoliberal globalization.

    - Transform international economic and policy institutions, or replace them with democratic and accountable institutions that respect national sovereignty and people's rights, and emphasize international equity and solidarity.

- Abolish unequal trade and investment arrangements that allow for the unrestricted Northern exploitation, privatization, and destruction of Southern natural resources, and lock Southern economies into dependence on export-oriented resource extraction and industrial agriculture which prioritize Northern and TNC demands over domestic needs, and at the same time are major GHG emissions sources.

- Reorganize international trade and investment relations around rules that value economic sovereignty, self-reliance, people's rights, and cooperation over indiscriminate integration, dependency, corporate power, and ruinous competition.

- Reform domestic trade and investment regimes in favor of people's rights and sovereignty over natural resources. Regulate foreign-corporate ownership and exploitation of natural resources, and hold corporations accountable to strict environmental and community standards.

- Promote sustainable, community-based food production oriented towards achieving self-reliance and food sovereignty.

- Countries, especially of the South, should adopt a comprehensive national policy framework for economic diversification and for meeting the collective needs of the present and future generations, especially the poor and marginalized in society.

3. Reorganize corporations and productive units along democratic and community based forms of ownership and management. Replace the pursuit of profits and private accumulation with the fulfillment of social need and broader social goals such as education, health and food security as the goals of production.

4. Institutionalize democratic planning and participatory management in the use and conservation of resources for present and future production, consumption, and other social uses. Social planning ensures resources are utilized in such a way that people's rights are protected, and social needs are met in ecologically sustainable ways.

Planning and management should incorporate scientific and locally-adapted knowledge and practices. Community-based resource conservation should be promoted.

5. Invest more public resources on research and development (R&D) of ecologically sustainable energy, production, and transportation systems. Reorient science, education, and R&D away from their current commercial and proprietary character towards producing knowledge for social welfare and development. Promote education on ecology and socially responsible consumption.

6. Institutionalize cooperative arrangements with other countries in the stewardship of global commons or shared resources such as oceans, rivers, forests and the climate, based on solidarity and shared commitments.

Strengthen the peoples' movement on climate change

It is clear that solving the climate crisis requires far-reaching social transformation. Unequal patterns of power behind such injustices as poverty, hunger, exploitation, and colonialism are the same ones that have caused ecological destruction and climate change. And as with other injustices, the climate crisis and its roots can only be dealt with through political struggles by the people.

- We affirm the importance of grassroots education, organization and mobilizations to promote and realize our alternative vision and program.

- We retain our vigilance even where governments have expressed support for a progressive agenda, and hold them accountable through popular participation and mobilization.

- We are ever critical of attempts to compromise the interests of the majority and the marginalized.

- We commit to building on the powerful networks of movements for climate action that have emerged worldwide. Localized actions

against greenhouse gas emissions have spread across the globe and deepened everyday development struggles.

- We shall further develop and advance a strong, broad, widespread, grassroots-based people's movement on climate change, in solidarity with other social movements, to promote the peoples' agenda on climate action and social transformation, fight for solutions that secure justice and democratic rights for the people, and challenge efforts from powerful elite and corporate interests that seek to divert and undermine our movement.

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LIST OF ABBREVIATIONS USED

ADB	Asian Development Bank
BBC	British Broadcasting Corporation
CDM	Clean Development Mechanism
CEGIS	Geographic Information Services
EU	European Union
FAO	Food and Agriculture Organization
FIBL	Forschungsinstitut für biologischen Landbau (International Trade Centre and the Research Institute for Organic Agriculture)
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse gases
IAASTD	International Assessment of Agricultural Knowledge, Science and Technology for Development
ICARRD	International Conference on Agrarian Reform and Rural Development
IFOAM	International Federation of Organic Agriculture Movements
IPCC	Intergovernmental Panel on Climate Change
IPR	Intellectual Property Rights

IRRI	International Rice Research Institute
ITDG	Intermediate Technology Development Group
LEISA	Low External Input Sustainable Agriculture
MASIPAG	Magsasaka at Siyentipiko para sa Pag-unlad ng Agrikultura (Farmer-Scientist Partnership for Agricultural Development)
NASA	National Aeronautics and Space Administration
NTFP	Non Timber Forest Product
ppm	parts per million
SRI	System of Rice Intensification
TWN	Third World Network
UK	United Kingdom
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework for Convention on Climate Change
USA	United States of America
WTO	World Trade Organization

APPENDICES

Annexure – 1
PEOPLE'S PROTOCOL AND PEOPLE'S MOVEMENT ON CLIMATE CHANGE

Injustice lies at the root of the climate crisis. A tiny minority of the world's population based in the advanced capitalist countries in the North is primarily responsible for accelerating climate change that is already inflicting more death, destruction and suffering to millions of the world's poor and disadvantaged.

In their relentless pursuit of profits, Northern corporations have burned vast and increasing amounts of fossil fuels and destroyed forests to feed energy and inputs into production, dumping greenhouse gases in the atmosphere at levels that is now warming the planet and disrupting the climate. The global economic system involves the appropriation and lopsided use by powerful global elite of the planet's shared resources, and the disempowerment and dispossession of the majority of the world's people. This basic social process is behind two centuries of profit-oriented capitalist growth. It bequeathed increasing prosperity and power to the Global North and private corporations through the over-exploitation of natural resources, and forced poverty, underdevelopment, colonialism,

and war upon millions of people, who now suffer the hardest impacts of climate change despite having no responsibility for it. In the last 30 years, under the banner of free market globalization, and with the help of the IMF, World Bank, and WTO, Northern-based transnational corporations have expanded their power over Southern economies and resources, and intensified their pollution of the atmosphere and destruction of the environment.

Current mainstream efforts for climate action have hitherto failed to stem the causes of climate change and bring justice to the poor and peoples of the South. Northern governments and corporations have not only refused to fully honor their historical obligation to reduce emissions and support climate actions in the South, but have exploited the climate crisis to enforce false solutions that create new profit opportunities, expand their control over natural resources, and exacerbate global warming. Powerful Northern and corporate interests have undermined the United Nations Framework Convention on Climate Change, as evidenced by its Kyoto Protocol. The same powers are sabotaging current negotiations for a just post-2012 climate regime, as they stall on committing emissions cuts that the scientific evidence requires, as well as sufficient funding to cover the costs of adaptation and mitigation in developing countries. They are also aggressively pushing for an agreement that would require developing countries to take on binding emissions cuts, or worse, abandon multilaterally determined binding emissions commitments altogether.

We, the people, need a platform that raises real solutions, registers our voices, and articulates our demand for social justice. Real solutions go beyond “business-as-usual” technology- and market- fixes along which powerful interests have set and confined the climate agenda. Real solutions require the reallocation of the world’s resources between and within nation’s for equity and social justice; the reversal of neoliberal globalization; the restoration of people’s sovereignty over resources, economies, and institutions; and the compensation by corporations and the Global North of the poor and peoples of the South for the losses they are forced to bear as victims both of climate change and the social system that is behind it. Socially just solutions also make for scientifically and ecologically sound ones. Using natural resources equitably and democratically, and supplanting the drive for private profit with the

fulfillment of social needs as the principal economic goal will reset human society's relationship with the environment on a far more sustainable path.

We need a people's movement to advance our solutions. Solving the climate crisis requires far-reaching social transformation. Unequal patterns of power behind such injustices as poverty, hunger, exploitation, and colonialism are the same ones that have caused ecological destruction and climate change. And as with other injustices, the climate crisis and its roots can only be dealt with through political struggles by the people. We need a grassroots-based people's movement on climate change to promote the people's agenda on climate action and social transformation, fight for solutions that secure justice and democratic rights for the people, and challenge efforts from powerful elite and corporate interests that seek to divert and undermine our movement.

Peoples' Protocol on Climate Change

The planet is experiencing a climate crisis of catastrophic proportions. Drastic action is required to reverse the situation. Global surface temperature has risen twice as fast in the last 50 years as over the last century and is projected to rise even faster in the coming decades. Thirteen of the last fifteen years (1993-2008) rank as the warmest years on record. This is disrupting weather patterns, endangering ecosystems and biodiversity, and destroying people's lives and livelihoods, especially of the poorest and most vulnerable.

With more frequent extremes of heat, changed rainfall patterns, stronger tropical cyclones, and sea-level rise, climate change will inflict the hardest impacts to millions of the world's poor and disadvantaged – women, indigenous peoples, farmers, fishers, small island and desert nations. Africa, Asia, and Latin America face shorter growing seasons, lost or degraded agricultural land, decreased agricultural and food production, and freshwater shortages. Droughts in Africa would bring widespread malnutrition, hunger, and famine. Asia is already confronting flooding and landslides, with mounting casualties from injury, death, and diseases. In Latin America, higher temperatures and reduced biodiversity in tropical forests will devastate indigenous communities. Rising sea

levels and increased storm surges threaten small island populations and coastal communities, and warmer waters are diminishing fish stocks.

The destabilization of the planet's climate is driven by the unprecedented increase in human-generated greenhouse gases (GHGs) in the atmosphere over the last two centuries. The most dangerous increase is in carbon dioxide (CO_2) emissions, attributed to the unrestrained burning of fossil fuels for energy to feed capitalist industry, commerce, transportation, industrial agriculture and food production, and militarism. Widespread deforestation also contributes to emissions and cripples the planet's carbon-cycling capacity. The increased concentration of GHGs in the atmosphere is causing warming that fast approaches 2 degrees Celsius above pre-industrial levels, the estimated threshold for catastrophic climate change.

The last two centuries are hallmarked with great strides in technology, production, and standards of living. But these advances were achieved by the lopsided use and overuse of the planet's shared resources, for the benefit of a minority of the world's population, and to the detriment and deprivation of the rest. At the forefront of this injustice are Northern Transnational Corporations (TNCs), whose relentless pursuit of private profits demands the command of vast energy and natural resources, an arrangement that not only led to ecological destruction, but the dispossession and impoverishment of large numbers of people.

Indeed, the two centuries of increasing emissions and ecological destruction coincide with two centuries of worsening economic inequality between and within countries; with the increasing concentration of wealth to a narrow global elite, and the universalization of want to the mass of humanity; with wars of aggression for the control of strategic resources; with the colonial and neo-colonial subordination of countries; with the corporate takeover and exploitation of Southern natural and productive resources; and with the loss of Southern economic and policy sovereignty to powerful economic and policy organizations such as the World Bank (WB), the International Monetary Fund (IMF), and the World Trade Organization (WTO). The system that has resulted in climate change is the same system behind structural poverty, underdevelopment , and war, which all magnify the vulnerability of millions who have little or no responsibility for causing climate change.

Scientific evidence indicates that climate change and its impacts are being felt sooner and stronger than had originally been projected. Arctic, Antarctic, and Greenland ice are melting fast; oceans are rapidly acidifying; and higher surface temperatures in the Pacific and Atlantic oceans are spawning stronger cyclones. Drastic and socially just solutions are urgently needed. Emissions must peak and decline rapidly to stabilize CO_2 concentration in the atmosphere at 350 parts per million (ppm), and hold warming to 1.5 degrees Celsius, in order to limit the devastating effects of climate change on the world's poorest and most vulnerable. The global action in pursuit of this end must recognize and redress the socially unjust arrangements at the root of climate change; must be fair and equitable; must reflect historical responsibility and capability to act; must allow for the democratic representation and participation of the poor, and must truly meet their needs.

However, existing official efforts for climate action are far behind the pace with which climate change and its impacts are occurring. Northern governments and corporations have heretofore not only refused to fully honor their historical responsibility to reduce emissions and support climate actions in the South, but have notably exploited the climate crisis to develop, legitimize, and enforce self-serving solutions that create new profit opportunities, and sustain and expand corporate power over natural resources, production and energy systems, funds, and technologies.

Powerful Northern and corporate minority interests have undermined the United Nations Framework Convention on Climate Change (UNFCCC). The Convention's Kyoto Protocol has diminished responsibility and accountability for the climate crisis through the mercerization of the atmospheric commons. The offsets and emissions trading system transfers adjustment costs from rich to poor, creates new dependencies, rewards corporations for polluting and increases their opportunities for profits. Northern TNCs and investors have sustained and even increased their energy intensive operations through relocation to Southern countries, capturing and co-opting local elites into the destructive process of capitalist-dominated production and consumption.

Moreover, current negotiations for a post-2012 climate regime appear headed towards worsening the problem rather than resolving it. Major powers have stalled on committing drastic emissions cuts that the scientific

evidence requires, and the funding to cover the costs of adaptation and mitigation in developing countries. They are also aggressively pushing for an agreement that would expand the responsibility to make binding emissions cuts to developing countries, or worse, abandon binding emissions commitments altogether, in sheer disregard of equity, justice and their responsibility for causing climate change.

Therefore it is urgent to come out with a Peoples' Protocol on Climate Change (PPCC) that captures the peoples' stand on this most urgent problem confronting humanity. This declaration articulates the values and principles that should guide international action and peoples' struggles against climate change and its associated ecological and socioeconomic destruction.

Statement of values and principles

We, the people, are united behind certain core development values and principles of social justice, democracy, equality and equity, gender fairness, respect for human rights and dignity, respect for the environment, sovereignty, freedom, liberation and self-determination, stewardship, social solidarity, participation, and empowerment. This statement further articulates these principles in the context of the global climate crisis.

1. **Social Justice** must be guaranteed, acknowledging the systemic roots of the climate crisis, the disproportionate responsibility of a narrow elite, the disproportionate vulnerability of the majority to the adverse effects, the grossly uneven capacity to confront and respond, and the legitimate aspirations to development of the people apart from the crisis.

    1.1. Climate change must be understood not merely as an environmental issue but as a question of social justice – its causes are rooted in the current capitalist dominated global economy which is principally driven by the relentless drive for private profits and capital accumulation.

    1.2. The current global capitalist order, driven by the Global North and their TNCs is the fundamental origin of over-exploitation

and depletion of resources, of the gratuitous use of energy resources and the excessive release of greenhouse gases into the atmosphere. "Free market" policies of "globalization", and its aggressive and intrusive expansion into every sector of the economy and into the Global South, and the exploitation by TNCs of the people and the planet must be condemned.

1.3. Neoliberal policies are imposed particularly on the people of the Global South by powerful foreign governments wielding influence through multilateral, regional and bilateral mechanisms such as WTO agreements, regional and bilateral free trade agreements (FTAs), investment agreements, and aid conditionalities.

1.4. A very significant part of supposedly "Southern" emissions actually result from the energy-intensive operations of Northern TNCs located in the South for the purposes of exploiting local labor and natural resources. We further acknowledge that the severe deforestation across Latin America, Asia and Africa is most of all due to Northern TNC-driven commercial logging, plantation agriculture, mining activities, and dam projects.

2. **People's Sovereignty** means asserting people's power over resources and institutions as the foundation of the global response to climate change.

2.1. Central to the history and structure of global capitalism that caused climate change is the monopolization of resources, wealth, and institutions by a privileged elite, and the consequent dispossession and marginalization of basic producers, peasants, workers, women, fishers, indigenous peoples. Through colonial and neo-colonial arrangements, Northern countries, TNCs, and powerful global bureaucracies such the IMF, WB, and WTO have wrested control of Southern economies and natural resources away from Southern peoples, damaging them in the process.

2.2. Communities and marginalized peoples also do not have proportionate control over planning, decision-making, and

management of existing bodies and initiatives devoted to climate action, and in the conduct of the projects and programs they carry out. They do not have proper access to information, funds,and technologies. Northern governments, international financial institutions, and aid agencies retain control of these.

2.3. Communities, workers, peasants, indigenous peoples, women, and other marginalized sectors should assert democratic control over natural, intellectual, and financial resources, technologies, and reorient them towards serving social needs rather than increasing profits and corporate growth. Southern peoples should assert national sovereignty over their economies and pursue independent and sustainable paths toward national development.

2.4. Communities and peoples who stand to bear the worst impacts of climate change have a vital role in defining, guiding, and determining the work of any climate action body at the local, national, regional, and global levels. They should be afforded equitable representation, meaningful participation, and the power to decide over what means to use in mitigation and adaptation, and how best to use them in a way that serves their particular needs. Funds and technologies must be accessible to them.

2.5. People should actively participate through social movements and struggles to assert democratic control over resources and institutions that is indispensable to dealing with the problem of climate change.

3. **Respect for the Environment** means a rejection of market mechanisms that impose the cash nexus on ecological priorities. The needs of the planet and its people must take precedent over the push for growth and profits.

3.1. We recognize that nature is vital for the survival of all and that natural resources and their use are essential for sustainable human development, and the elimination of poverty, ill-health, and hunger. We are committed to building societies where the

people enjoy all human rights and fundamental freedoms, and in a way that the world we create does not unjustly deny the same for future generations.

3.2. We assert that the needs of people and planet must be placed above those of global capital and the wholesale pursuit of private profits. Property rights, which allow things to be traded, accumulated, and monopolized by a few for the sake of private gain, must not cover resources and assets upon which people's livelihood depend, including local and planetary commons.

3.3. We believe that population growth increases humanity's demands on nature but that the resources of the planet are sufficient to meet these demands if only production, resource-use, and consumption are organized to meet the needs of the people for life and not of a select few for profits.

3.4. Corporations and international financial institutions have focused on developing, enforcing, and expanding market-based and profitable "solutions" that are unsustainable, unsafe, and further the commodification of the environment, such as carbon trading, forest carbon offsetting, biochar, biofuels, carbon capture and storage, and "clean coal", nuclear and large hydropower energy, to name a few. Market arrangements and technologies that extend the privatization and enclosure of the environmental commons and pose new threats to ecosystems and the livelihood, health, and food security of communities should be opposed.

4. **Responsibility**, expressed in the principle of common but differentiated responsibilities, requires a mechanism for globally-inclusive equity. Northern countries share a disproportionate responsibility for historic emissions.

4.1. The poor and marginalized communities are most vulnerable to the adverse effects of climate change.

4.2. Elite segments of society whose current levels of consumption are grossly excessive and cannot and should not be maintained,

even as those large populations globally who are denied basic needs should have these met. These elite segments of society must bear the greatest responsibility for the climate crisis.

4.3. There are large parts of humanity who are more dependent for their survival on their access to and use of natural resources, as well as on the state of the climate and the natural environment. The specific needs of farming communities, indigenous peoples, coastal communities, fisherfolk, and other marginalized, poor and rural producers need to be given special attention in all adaptation efforts.

4.4. Adaptation is not acceptance of climate change but is necessary to provide urgent relief from the actual impacts of climate change that are already being felt by the most vulnerable communities and countries until global mitigation efforts are sufficiently developed to halt global warming.

A five-point platform for action

Comprehensive and concerted but differentiated and equitable global effort to achieve deep, rapid, and sustained emissions reductions to stabilize CO_2 concentrations at 350ppm and hold global average temperature rise to 1.5 degrees Celsius.

1. Northern states and corporations, having inordinately used and damaged the atmospheric space and the environment enough to cause climate change, should unconditionally carry out deep emissions cuts at a rate and scale that will swiftly reduce CO_2 concentrations to 350 ppm or below, with peak emissions reached no later than 2015. All Northern states should be part of an internationally enforced, regulated, and binding framework for emissions reductions.

2. Southern states should reorient their economies towards low-carbon development and carry out measurable, reportable, and verifiable (MRV) emission reductions utilizing compensatory financial and technology transfers from the North.

3. Rapidly transition away from fossil fuels as energy sources towards new, renewable energy sources such as wind, solar, geothermal, and mini-and micro-hydropower; and from centralized to decentralized energy systems.

4. Abandon unsustainable agricultural and food production dominated by profit-seeking agribusiness and agrochemical TNCs. Industrial agriculture as practiced today causes major GHG emissions from land conversion and soil degradation, and the heavy use of fossil fuels for fertilizers, pesticides, and long distance transportation. Switch to ecologically-sound farming methods that keep carbon in the soil, within the context of diversified and community-based agricultural production that prioritizes achieving food security and self-sufficiency.

5. End deforestation once and for all. Stop large-scale mining and commercial logging activities by TNCs in the South, and the encroachment of export cashcrop plantations into forests.

6. Reject aid conditionalities and policy impositions by the WB and IMF, and revoke unequal multilateral and bilateral trading arrangements that undermine environmental regulations and allow for the unrestricted exploitation, pollution, and destruction of Southern resources by Northern corporations.

7. Immediately end all subsidies and investments by Northern governments and international public financial institutions to fossil fuel projects that will lock the world with carbon-dependent energy, production, and transportation systems far into the future. Redirect public funds to research and investments in developing environmentally-friendly technologies, renewable energy systems, sustainable mass transportation, and so on.

8. End wasteful and destructive wars and redirect military budgets in support of environmental conservation and the transition to sustainable technologies and systems.

Demand the reparation of Southern countries and the poor by Northern states, TNCs, and Northern-controlled institutions to redress historical injustices associated with climate change

1. Demand the mandatory and unconditional provision and transfer of financial and technological resources by the North to support adaptation (coping with and covering the losses from adverse climate impacts, and building climate-resilient systems) and mitigation (transition to low-carbon and sustainable development paths, and carrying out non-binding MRV emissions reductions) in the South.

2. Northern states should provide sufficient, predictable, and mandatory climate financing to developing countries. Climate funds are compensation and not aid. Funds should be over and above longstanding and unmet official development assistance commitments by developed countries (0.7 per cent of Gross National Income); should mainly come from public sources; should take the form of outright and unconditional financial transfers; and should be democratically governed and directly accessible to communities and their organizations. Carbon markets should have no role in climate financing.

3. Rechannel all resources from donor-controlled climate funds and funding mechanisms, and oppose the involvement of Northern aid agencies and international financial institutions in climate finance. Intended recipients have no power and meaningful participation over these funds' design, governance, and delivery; they add to the debt burden of many poor countries, and will be forced to accept policy conditionalities in exchange for access to these funds.

4. Reject private insurance schemes and the sale of debt instruments to capital markets as mechanisms to raise financing for adaptation. These schemes transfer the burden of financing to developing countries and individual entities, and allow private corporations and funds to profit from the vulnerability they face.

5. Remove intellectual property rights and trade restrictions that place severe constraints on the people's access to climate-friendly

technologies and thus on the ability to promote low-carbon alternatives.

6. Reject the imposition of debt-creating climate funds and the neoliberal policy conditions tied to the access of these funds.

Reject false solutions that allow Northern states and corporations to continue harming the environment and communities, provide new and greater opportunities for profit, and reinforce and expand corporate control over natural resources and technologies

1) Abolish all carbon markets. Put an immediate end to emissions trading and offsetting as mechanisms for Northern countries and corporations to meet emissions commitments. The cap and trade system has failed to deliver what little emissions reductions rich countries have committed to, and has effectively privatized and commodified the atmosphere. Northern carbon markets allow big historical polluters to evade making deep emissions cuts by trading among themselves rights to pollute the atmosphere which they had been given for free by Northern governments. Carbon offsetting allows Northern corporations to continue polluting by funding environmentally and socially questionable projects in developing countries, offloading the responsibility and associated risks of cutting emissions to the South.

2) Oppose the expansion of carbon offsetting, which will transfer the burden of cutting emissions to the South, reward big polluters, and further weaken and delay efforts to curb Northern emissions through mandatory measures. Oppose its extension into Southern spaces, including:

    a) forests, which threaten to displace indigenous peoples and forest-dependent communities; bring standing forests to the control of private corporations; promote the expansion of monoculture tree plantations that damage forest biodiversity and ecosystems; and reward deforesters; and

    b) agricultural soils, which threaten to further decimate forests and land devoted to food production; enclose communal lands and displace farmers and rural communities; reward landlords

and agribusiness TNCs, and bring more lands under their private control; and intensify industrial agriculture. Oppose the large-scale deployment of corporate-controlled technology such as biochar and no-till agriculture that will facilitate the inclusion of soils into carbon offsetting mechanisms. End the large-scale commercial production and use of agrofuels.

3) Large-scale agrofuel production worsens GHG emissions by forcing the extensive conversion of good farmlands, forests, and grasslands into plantations that release carbon into the atmosphere – apart from reducing agricultural land for food production, driving food prices up, increasing food insecurity, and displacing forest and rural communities.

4) Reject "clean coal" and carbon capture and storage, nuclear power, and megadams as substitutes to fossil fuels as power sources. These projects are intended to supply the increasing energy needs of TNCs and global elites but do not stem dependence on fossil fuels and the increase in GHG emissions. They also pose huge risks to the safety and health of communities, and the stability of ecosystems.

5) Oppose geo-engineering megaprojects that manipulate the environment and alter naturally operating systems on a large scale. These ill-conceived schemes are extremely costly, complex, and risky; and totally ignore sounder, realistic, and practicable measures to stem climate change. Such extreme technological fixes include ocean fertilization, spraying sulphates into the atmosphere, putting sunshades in space, and plastic-coating deserts.

6) Reject proprietary genetically-modified "climate-proofed" crops. Stop the extension of patent rights on farmer-developed climate-resilient seeds by biotechnology and agrochemical corporations, which would deny small farmers the ability to cope with the negative impacts of climate change. End the genetic manipulation of crops by corporations, and promote the increase of agricultural biodiversity as an effective way of increasing agricultural resilience to erratic and extreme weather.

Struggle for ecologically sustainable, socially just, pro-people, and long-lasting solutions

1) Ensure that official bodies for climate action become democratic, participatory, and equitable institutions. Allow for the sectoral representation and participation of groups most vulnerable to climate change (including women, indigenous people, small island and desert countries, the youth, farmers, fishers) in the governance of these institutions and the delivery of support and solutions.

2) Assert the people's sovereignty and democratic control over planetary resources and productive assets, and the equitable distribution of the wealth accruing from their use. Nations, communities, and sectors should be able to utilize their resources to meet their social needs, and pursue independent and ecologically sustainable paths to development.

    - Reverse neoliberal globalization.

    - Transform international economic and policy institutions, or replace them with democratic and accountable institutions that respect national sovereignty and people's rights, and emphasize international equity and solidarity.

    - Abolish unequal trade and investment arrangements that allow for the unrestricted Northern exploitation, privatization, and destruction of Southern natural resources, and lock Southern economies into dependence on export oriented resource extraction and industrial agriculture which prioritize Northern and TNC demand over domestic needs, and at the same time are major GHG emissions sources.

    - Reorganize international trade and investment relations around rules that value economic sovereignty, self-reliance, people's rights, and cooperation over indiscriminate integration, dependency, corporate power, and ruinous competition.

    - Reform domestic trade and investment regimes in favor of people's rights and sovereignty over natural resources.

Regulate foreign-corporate ownership and exploitation of natural resources, and hold corporations accountable to strict environmental and community standards.

- Promote sustainable, community-based food production oriented towards achieving self-reliance and food sovereignty.

- Countries, especially of the South, should adopt a comprehensive national policy framework for economic diversification and for meeting the collective needs of the present and future generations, especially the poor and marginalized in society.

3) Reorganize corporations and productive units along democratic and community based forms of ownership and management. Replace the pursuit of profits and private accumulation with the fulfillment of social need and broader social goals such as education, health and food security as the goals of production.

4) Institutionalize democratic planning and participatory management in the use and conservation of resources for present and future production, consumption, and other social uses. Social planning ensures resources are utilized in such a way that people's rights are protected, and social needs are met in ecologically sustainable ways. Planning and management should incorporate scientific and locally-adapted knowledge and practices. Community-based resource conservation should be promoted.

5) Invest more public resources on research and development (R&D) of ecologically sustainable energy, production, and transportation systems. Reorient science, education, and R&D away from their current commercial and proprietary character towards producing knowledge for social welfare and development. Promote education on ecology and socially responsible consumption.

6) Institutionalize cooperative arrangements with other countries in the stewardship of global commons or shared resources such as

oceans, rivers, forests and the climate, based on solidarity and shared commitments.

Strengthen the peoples' movement on climate change

It is clear that solving the climate crisis requires far-reaching social transformation. Unequal patterns of power behind such injustices as poverty, hunger, exploitation, and colonialism are the same ones that have caused ecological destruction and climate change. And as with other injustices, the climate crisis and its roots can only be dealt with through political struggles by the people.

We affirm the importance of grassroots education, organizing and mobilizations to promote and realize our alternative vision and program. We retain our vigilance even where governments have expressed support for a progressive agenda, and hold them accountable through popular participation and mobilization. We are ever critical of attempts to compromise the interests of the majority and the marginalized.

We commit to building on the powerful networks of movements for climate action that have emerged worldwide. Localized actions against greenhouse gas emissions have spread across the globe and deepened everyday development struggles.

We shall further develop and advance a strong, broad, widespread, grassroots-based people's movement on climate change, in solidarity with other social movements, to promote the peoples' agenda on climate action and social transformation, fight for solutions that secure justice and democratic rights for the people, and challenge efforts from powerful elite and corporate interests that seek to divert and undermine our movement

Annexure - 2
UNITY STATEMENT OF THE PAN AP CONFERENCE "CONFRONTING FOOD CRISIS AND CLIMATE CHANGE"

We, 113 participants from 22 countries representing peasants, small farmers, agricultural workers, women, indigenous peoples', fisherfolk organizations, and health, environmental and consumers CSOs met in the Conference on Confronting the Food Crisis and Climate Change from 27-29 September, 2009 in Penang, Malaysia.

We met in the midst of the worst global recession of the century and a global financial crisis. This is the worst in the cycle of crises of monopoly capitalism, now manifesting in the collapse of global financial institutions and speculative international markets. Another consequence of monopoly capitalism is the global food crisis which is compounded by climate crisis. With the collapse of food self-sufficiency due to globalization, the massive speculation in the global commodities market and the expansion of agrofuel policies have resulted in spiraling food prices and hence, the food crisis.

The climate crisis has been caused by unprecedented unsustainable industrial development, chemical intensive agriculture and overproduction under monopoly capitalism mainly in the developed countries since the last 200 years and intensified in the last 3 decades. Both the food and climate crises are exacerbated by imperialist globalization, a process to ensure the expansion of markets for excess goods and capital to secure super profits. The over-consumption and unsustainable lifestyles of affluent societies have further contributed to the crises.

In food and agriculture, the globalization process has intensified the expansion of corporate monopoly control over the food chain from production to marketing and the exploitation of rural labour, natural resources and biodiversity. It has further marginalized and impoverished indigenous peoples, women, dalits, small and marginal farmers, and fishers. Corporate monopoly of agriculture through the collusion of landlords, autocratic and corrupt governments and other elites has caused great misery for peasants and other rural people. Governments have reneged on their responsibility to uphold the rights and welfare of the people.

The food and climate crises indicate the failure of the FAO, CGIAR, IFIs and national governments in addressing hunger and perpetuating the paradigm of toxic, unsustainable growth for profit. The call by G8 countries for a new global governance on food and agriculture in response to food crisis is a renewed offensive that will only further entrench corporate control on food and agriculture production. Subsequently, the current initiative for the World Summit on Food Security in Rome in November 2009 drives the same agenda of corporate agriculture. Despite the fact that the World Food Summit in 1996, the corporate model of agriculture was heralded as the solution to end world hunger and it brought us the food crisis and increased hunger for our people.

Corporate farming systems such as plantations, intensive aquaculture and livestock systems, floriculture, contract farming and now, agrofuel production, perpetuate the over-exploitation and pollution of lands, forests, seeds, waters, marine resources and other natural resources that have been the sources of livelihood for small food producers. Moreover, the resultant loss of biodiversity and the diminishing number of crop varieties grown worldwide are major concerns for small producers who

depend on such biodiversity for their survival. The introduction and forced expansion of genetically engineered crops (GE) is increasingly threatening the agro-biodiversity in the fields and, reports of health impacts and environmental contamination by GE crops are cause for grave concern. Hazardous pesticides and chemicals also harm human health and the environment.

Moreover, climate change adversely impacts food production, deepens the food crisis and exacerbates rural poverty, joblessness and misery, as people face crop losses through droughts, floods and climatic disasters. In the meantime, corporations including agrochemical and agribusiness companies are continuing their unsustainable form of production through "carbon trading" schemes. Worse, they have seized the opportunity to amass more profits with the use of public funds in so-called carbon emissions reduction technologies and projects. Adaptation and mitigation technologies are not the final solutions to climate crisis. The final solution is through people-oriented ecological development. This should be the target for adaptation funding through mechanisms that are directly channelled to communities rather than through the World Bank and its corporate-oriented technologies. This will meet the principle of compensation for centuries of ecological debt of the North to the South.

In the face of the greater challenges posed by the food crisis and climate change, the people now have to struggle even more to confront oppressive structures and institutions.

As we, women, face the greatest burden from calamities, war, crises and displacement, we must struggle harder against patriarchy, fundamentalisms and extremisms, and endeavor for full participation and involvement.

As we, peasants, lose our livelihood and land, and are forcibly exiled from our communities; we have to fight much harder against the onslaught of corporate land grabbing and for our rights.

As we, agricultural workers, continue to slave in pesticide-drenched corporate farms and plantations, we need to struggle even more for our rights, jobs, lives and livelihoods.

As we, the fisher people, are further displaced by corporate fishing and intensive industrial aquaculture as well as corporate coastal and offshore development projects, we have to struggle even more to conserve, gain access, manage and control marine and aquatic resources as well as fishing implements.

As we, indigenous peoples, lose our ancestral domains due to land grabbing and corporate exploitation, we have to defend our indigenous knowledge, ancestral history and legends, culture and our very lives.

As we, the working people as consumers deprived of nutritious, safe, adequate, culturally appropriate food and pushed to unnatural and unsustainable lifestyles, we must strive even more to tackle the negative effects of all crises and, exert our right to food and our responsibilities as conscious, ethical and ecological consumers.

We will be resolute in our struggle to put people and the planet first over profits. We will work together to regenerate and restore nature and society.

We have gathered now to further strengthen and consolidate our movements to advance food sovereignty, gender justice and climate justice. We will work with full dedication and commitment to:

1. Fully resist corporate monopoly control over food and agriculture;

2. Advocate for the establishment of compensatory funds to support communities' capacity to address the impact of climate change;

3. Advance genuine agrarian, fisheries, forestry and pastoral reforms that ensure gender justice and the rights of women to land and productive resources;

4. Assert food self-sufficiency in our societies and stop land use conversions;

5. Advance the rights of indigenous peoples over ancestral land and domains as well as protect and uphold indigenous knowledge and wisdom as basis of ecological agriculture and sustainable development;

6. Defend the rights of marginalized communities, ethnic minorities and Dalits;

7. Stop the killings of and violence against peasants, agricultural workers, fisherfolks and indigenous peoples struggling for their peoples' rights;

8. Ensure market access for the poor and marginalized people, and fair price for their harvests;

9. Promote local knowledge particularly the nurturing values and expand biodiversity-based ecological food production as foundation for food self-sufficiency;

10. Promote and support community-based seed and grain conservation systems;

11. Build stronger links between consumers and small food producers to promote the production and consumption of affordable, local, ecologically produced and safe food, and to work towards ethical consumption and sustainable lifestyles;

12. Protect the rights and well-being of agricultural workers and their communities, and ensure fair wages for them;

13. Promote pro-people, farmer-led research technologies and institutions;

14. Resist imperialist globalization, fundamentalism, feudalism, patriarchy, militarization and, autocratic and corrupt governments, and end racial, caste and all other forms of discrimination;

15. Endorse the People's Protocol on Climate Change which provides the framework of our demands for climate justice based on the principles of social justice, sovereignty, respect for the environment, gender justice and, responsibility and call for an economic system that is sovereign, socially just, democratic and ecologically sustainable.

We claim our right and, the right of all excluded and marginalized people, to restore and recover the regenerative ability of nature by reorienting our methods of production, consumption and marketing. We deviate from the present destructive processes of greedy exploitation of humans and nature to ensure the long-term survival of all life forms. We endeavor to heal the earth.

We call for the people's right to food and uphold People's Convention on Food Sovereignty* as the sustainable framework for food production and distribution, and for national and international trade and investment policies.

** as adopted during the People's Convention on Food Sovereignty held in Dhaka, Bangladesh on 27th November, 2004*

Annexure - 3
CLIMATE CHANGE TIMELINE

1827: French polymath Jean-Baptiste Fourier predicts an atmospheric effect keeping the Earth warmer than it would otherwise be. He is the first to use a greenhouse analogy.

1863: Irish scientist John Tyndall publishes a paper describing how water vapour can be a greenhouse gas.

1890s: Swedish scientist Svante Arrhenius and an American, P C Chamberlain, independently consider the problems that might be caused by CO_2 building up in the atmosphere. Both scientists realize that the burning of fossil fuels could lead to global warming, but neither suspects the process might already have begun.

1890s to 1940: Average surface air temperatures increase by about 0.25^0 C. Some scientists see the American Dust Bowl as a sign of the greenhouse effect at work.

1940 to 1970: Worldwide cooling of 0.2^0 C. Scientific interest in greenhouse effect wanes. Some climatologists predict a new ice age.

1957: US oceanographer Roger Revelle warns that humanity is conducting a "large-scale geophysical experiment" on the planet by releasing greenhouse gases. Colleague David Keeling sets up first continuous monitoring of CO_2 levels in the atmosphere. Keeling soon finds a regular year-on-year rise.

1970s: Series of studies by the US Department of Energy increases concerns about future global warming.

1979: First World Climate Conference adopts climate change as a major issue and calls on governments "to foresee and prevent potential man-made changes in climate."

1985: First major international conference on the greenhouse effect at Villach, Austria, warns that greenhouse gases will "in the first half of the next century, cause a rise of global mean temperature which is greater than any in man's history." This could cause sea levels to rise by up to one metre, researchers say. The conference also reports that gases other than CO_2, such as methane, ozone, CFCs and nitrous oxide, also contribute to warming.

1987: Warmest year since records began. The 1980s turn out to be the hottest decade on record, with seven of the eight warmest years recorded up to 1990. Even the coldest years in the 1980s were warmer than the warmest years of the 1880s.

1988: Global warming attracts worldwide headlines after scientists at Congressional hearings in Washington DC blame major US drought on its influence. Meeting of climate scientists in Toronto subsequently calls for 20% cuts in global CO_2 emissions by the year 2005. UN sets

up the Intergovernmental Panel on Climate Change (IPCC) to analyze and report on scientific findings.

1990: The first report of the IPCC finds that the planet has warmed by 0.5C in the past century. IPCC warns that only strong measures to halt rising greenhouse gas emissions will prevent serious global warming. This provides scientific clout for UN negotiations for a climate convention. Negotiations begin after the UN General Assembly in December.

1991: Mount Pinatubo erupts in the Philippines, throwing debris into the stratosphere that shields the Earth from solar energy, which helps interrupt the warming trend. Average temperatures drop for two years before rising again. Scientists point out that this event shows how sensitive global temperatures are to disruption.

1992: Climate Change Convention, signed by 154 nations in Rio, agrees to prevent "dangerous" warming from greenhouse gases and sets initial target of reducing emissions from industrialized countries to 1990 levels by the year 2000.

1994: The Alliance of Small Island States -- many of which fear they will disappear beneath the waves as sea levels rise -- adopt a demand for 20% cuts in emissions by the year 2005. This, they say, will cap sea-level rise at 20 centimetres.

1995: The hottest year recorded to date. In March, the Berlin Mandate is agreed by signatories at the first full meeting of the Climate Change Convention in Berlin. Industrialized nations agree on the need to negotiate real cuts in their emissions, to be concluded by the end of 1997.

In November, the IPCC states that current warming "is unlikely to be entirely natural in origin" and that "the

balance of evidence suggests a discernible human influence on global climate". Its report predicts that, under a "business as usual" scenario, global temperatures by the year 2100 will have risen by between 1^0 C and 3.5^0 C.

1996: At the second meeting of the Climate Change Convention, the US agrees for the first time to legally binding emissions targets and sides with the IPCC against influential sceptical scientists. After a four-year pause, global emissions of CO_2 resume their steep climb, and scientists warn that most industrialized countries will not meet Rio agreement to stabilize emissions at 1990 levels by the year 2000.

1997: Kyoto Protocol agrees legally binding emissions cuts for industrialized nations, averaging 5.4%, to be met by 2010. The meeting also adopts a series of flexibility measures, allowing countries to meet their targets partly by trading emissions permits, establishing carbon sinks such as forests to soak up emissions, and by investing in other countries. The precise rules are left for further negotiations. Meanwhile, the US government says it will not ratify the agreement unless it sees evidence of "meaningful participation" in reducing emissions from developing countries.

1998: Follow-up negotiations in Buenos Aires fail to resolve disputes over the Kyoto 'rule book', but agree on a deadline for resolution by the end of 2000. 1998 is the hottest year in the hottest decade of the hottest century of the millennium.

2000: IPCC scientists re-assess likely future emissions and warn that, if things go badly, the world could warm by 6C within a century. A series of major floods around the world reinforce public concerns that global warming is raising the risk of extreme weather events. But in November, crunch talks held in The Hague to finalize

the 'Kyoto rule book' fail to reach agreement after EU and US fall out. Decisions postponed until at least May 2001.

2001: The new US president, George W Bush, renounces the Kyoto Protocol because he believes it will damage the US economy. After some hesitation, other nations agree to go ahead without him. Talks in Bonn in July and Marrakesh in November finally conclude the fine print of the protocol. Analysts say that loopholes have pegged agreed cuts in emissions from rich-nation signatories to less than a third of the original Kyoto promise. Signatory nations urged to ratify the protocol in their national legislatures in time for it to come into force before the end of 2002.

2002: Parliaments in the European Union, Japan and others ratify Kyoto. But the protocol's complicated rules require ratification by nations responsible for 55% of industrialized country emissions, before it can come into force. After Australia joins the US in reneging on the deal, Russia is left to make or break the treaty, but hesitates. Meanwhile, the world experiences the second hottest year on record.

2003: Globally it is the third hottest year on record, but Europe experiences the hottest summer for at least 500 years, with an estimated 30,000 fatalities as a result. Researchers later conclude the heat wave is the first extreme weather event almost certainly attributable to man-made climate change.

Extreme weather costs an estimated record of US $60 billion this year. 2003 also sees a marked acceleration in the rate of accumulation of greenhouse gases. Scientists are uncertain if it is a blip or a new, more ominous trend. Meanwhile Russia blows hot and cold over Kyoto.

2004: A deal is struck on Kyoto. President Putin announces in May that Russia will back the Protocol - and the EU announces it will support Russia's membership of the World Trade Organization. On November 18, the Russian parliament ratifies the protocol, paving the way for it to come into force in 2005.

2005: Second warmest year on record. Researchers link warming to a record US hurricane season, accelerated melting of Arctic sea ice and Siberian permafrost, and apparent disruption of the global ocean current that warms Europe. The Kyoto Protocol comes into force. In December, Kyoto signatories agree to discuss emissions targets for the second compliance period beyond 2012, while countries without targets, including the US and China, agree to a "non-binding dialogue" on their future roles in curbing emissions.

(*Source: www.newscientist.com*)

Annexure – 4
THE IMPACT OF CLIMATE CHANGE IN ASIA-PACIFIC

According to IPCC, in Asia (*See Figure 9*) the observed and long-term trends (*See Table 4*) in climate change include:

- "A significant acceleration of warming" during this century (likely 1-3^{0}C increase, particularly in winter) - highest in North, Central and West Asia, followed by South and East Asia, and then South-east Asia.

- Lower rainfall in some parts (North and North-east China, parts of India, Pakistan, Bangladesh, Indonesia and the Philippines). Decreasing rainfall in Central and West Asia will increase aridity. Higher rainfall in some parts (western coastal Philippines, parts of Bangladesh, western and south-western China, *etc*.).

- Increase in the frequency and intensity of extreme weather events, particularly in South-east Asia as a result of *El Niño* warming, which is getting more severe.

- Increasing frequency and intensity of tropical cyclones in the Pacific (affecting the Philippines, Cambodia, Vietnam, China and Japan) and

fewer but more intense cyclones in the Bay of Bengal and the Arabian Sea (affecting India, Iran and others).

- Faster rise in the sea level – the sea level rose by an average of 3.1 mm per year over the past decade (marginally higher than the global average for the period) against 1.7-2.44 mm per year over the 20th century.

These climate changes in the region will affect agriculture, fishery, forestry, *etc*., and a broad picture of these impacts can be drawn from various studies. These impacts include:

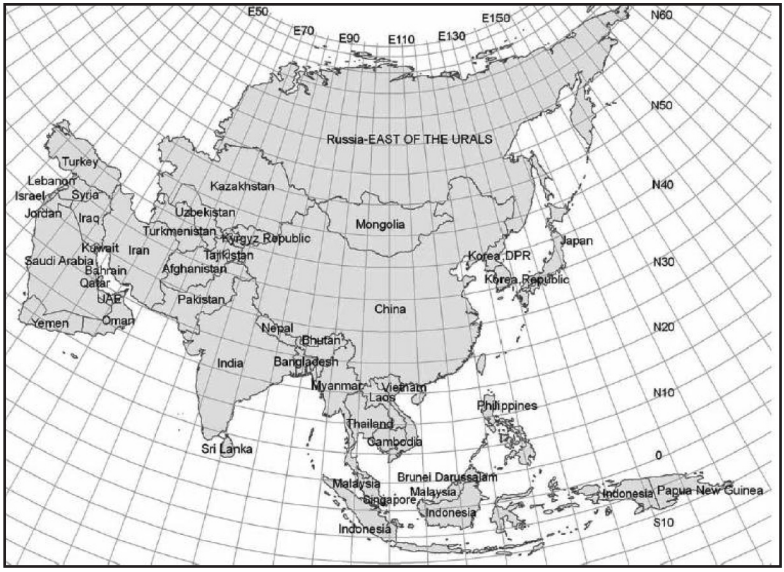
- Cereal production in Asia is expected to drop substantially over the century, with the highest losses of up to 30 per cent in Central and South Asia; rice yields may decline by around 4 per cent even under very conservative estimates (taking into account the possible benefits of increased carbon dioxide concentrations). East Asia, on the other hand, may see an increase in cereal production.

- Water sources will diminish or dry up in South, South-east and Central Asia, and a water scarcity will constrain agriculture and curtail the area under agriculture.

- Warming will cause rapid melting of the Himalayan glaciers which feed water into major rivers in India (the Ganges, for example) and China (the Yellow and Yangtze rivers) in the summer. This will significantly reduce water flow (after some initial flooding) downstream and consequently cereal production in the large river basins. Being the world's leading rice and wheat producers and also most populous countries, a fall in cereal producton in these two countries will not only threaten their food security but push up global food prices. Several important Himalayan glaciers, including the Gangotri which feeds the Ganges, are fast receding. Receding glaciers and drying glacial lakes are also reducing availability of water in other smaller countries in the region.

- Increased coastal flooding, land erosion and salt water infusion inland will curtail coastal agriculture, specially rice production, in the many large low-lying delta regions and coastal zones across Asia.

Figure 9. Asian latitudes. 0 is the Equator, and N10 is 10 degrees North of the equator. Tropics are up to 23 degrees North and South of the Equator.



(*Source: Climate Change 2007, Asia, in Impacts,Adaptation and Vulnerabilty, Intergovernmental Panel on Climate Change*)

- "Subsistence farmers producing crops such as sorghum and millet could be at great risk, both from a potential drop in productivity as well as from the danger of losing crop genetic diversity that has been preserved over generations." (IPCC. "Asia." *Climate Change 2007: Impacts, Adaptation and Vulnerability,* 2007)

- Higher temperatures and humidity will also promote the growth and spread of pests, leading to increased pest populations and plant diseases which will affect crop yields.

- There could be a northward shift of plant species and agricultural zones (with the current triple- and double-cropping zones moving northwards towards single-cropping zones and a likely shrinkage in single-cropping zones).

Table 4. Vulnerability of agriculture and related sectors to climate change in Asian countries

Region	*Food & fibre*	*Water resources*	*Coastal ecosystems*
ARID AND SEMI-ARID ASIA			
Central Asia	Highly vulnerable	Highly vulnerable	Moderately vulnerable
Tibetan Plateau	Slightly or not vulnerable	Moderately vulnerable	Not applicable
Temperate Asia	Highly vulnerable	Highly vulnerable	Highly vulnerable
TROPICAL ASIA AND SMALL ISLAND STATES			
South Asia	Highly vulnerable	Highly vulnerable	Highly vulnerable
South-east Asia	Highly vulnerable	Highly vulnerable	Highly vulnerable

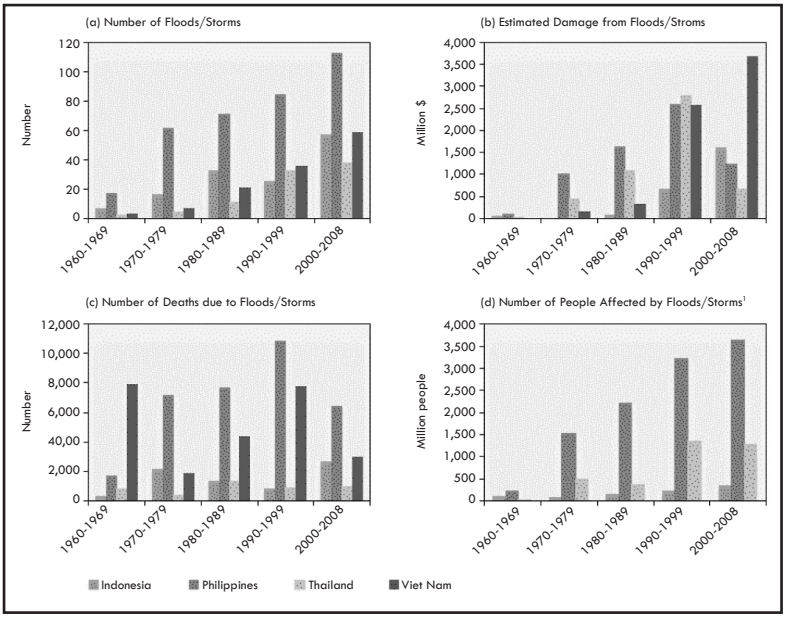
Source*: Climate change impacts and adaptation implications for agriculture in the Asia-Pacific region, Andrew Ash, CSIRO, Australia, www.csiro.au*

Annexure – 5
THE IMPACT OF CLIMATE CHANGE IN SOUTH-EAST ASIA

South-east Asia is home to 563 million inhabitants, with the population rising by almost 2 per cent annually compared with the 1.4 per cent global average. It relies heavily on agriculture for livelihood (especially the poor), and on natural resources and forestry in many countries; and it has long coastlines, and a high concentration of population and economic activity in coastal areas.

Climate change is already evident in the region. IPCC (2007) reported several such changes: an increasing trend in mean temperature in the past several decades (0.1^0-0.3^0 C increase per decade recorded between 1951 and 2000), a decreasing trend in rainfall, and rising sea levels (at 1–3 mm per year). The frequency and intensity of extreme weather events, such as heat waves, intense rainfalls and tropical cyclones, have also increased in recent decades. These climatic changes have led to massive flooding, landslides, and droughts in many parts of the region, causing extensive damage to property, assets, and human life (*See Figure 10*).

Figure 10. Extent of damages due to floods, storms (1960-2008)



Note: 1 Data not available in Viet Nam for the number affected due by floods/storms.
[*Sources: CRED (2008), CCFSC (2005)*]

Climate change is also exacerbating the problem of water shortages in many parts of the region, constraining agricultural production and threatening food security, causing forest fires and degradation, and damaging coastal and marine resources. Droughts have reduced stream flows in major rivers and increased water stress in many countries, particularly during El Niño years, causing damage to crops and shortages of drinking water. The area of forest burned increased from about 4 million hectares in 1982–1983 to 5 million in 1994 and 10 million in 1997–1998 while about 18 per cent of the marine coral systems were bleached during the 1997–1998 El Niño.

The problems are projected to intensify in the coming decades, with an associated rise in the frequency and intensity of extreme weather events. Estimating precisely how climate change would evolve is subject

to considerable uncertainty though, and the results should be considered as indicative rather than precise forecasts.

According to IPCC (2007), mean surface air temperature in the region would increase by 3.77^0 C by the end of this century relative to the baseline period of 1961–1990, and weather conditions would turn drier in the next 2–3 decades under a high emissions scenario. Global warming is also projected to lead to an increase in global average sea level of 59 cm by 2100 relative to the baseline period of 1980–1999, or even higher than 1 metre as suggested recently by climate experts, if the rapid melting of ice sheets and glaciers is taken into account. These could have serious consequences for the region as projected by IPCC and a number of other studies.

For example, climate change is likely to lead to a significant decrease in grain production potential in the region by the end of this century and threaten food security; crop yield declines could range from15 per cent in Viet Nam to 26 per cent in Thailand. About 20 per cent of the 13-94 million annual increases in the number of people flooded in coastal areas of South, South-east and East Asia by the end of the century is predicted to be in Indonesia, Philippines, Thailand and Viet Nam; a 1-metre rise in sea level could also devastate 2,500 square kilometres of mangroves in Asia.

Recent studies commissioned by the Asian Development Bank using a global integrated assessment model and focusing on the four countries—Indonesia, Philippines, Thailand and Viet Nam—confirm many of these findings. Modeling results (under a high emissions scenario) show that:

- The annual mean temperature in the four countries is projected to rise by 4.8^0 C on average by 2100 from the 1990 level. The western part of South-east Asia is predicted to become hotter than the eastern part. Global mitigation efforts to stabilize atmospheric concentration of greenhouse gases at 550 part per million (ppm) would reduce the four countries' annual mean temperature increase to 2.3^0 C and at 450 ppm to 1.8^0 C by 2100.

- Increasingly drier weather conditions are projected to prevail in Indonesia, Thailand and Viet Nam in the next 2–3 decades (this trend is likely to reverse by the middle of this century). The Philippines, however, is likely to have higher rainfall for most of this century.

- *Agriculture*: Rice yield potential in the four countries is projected to fall by about 50 per cent by 2100 relative to the 1990 level on average. The decline would range from 34 per cent in Indonesia to 75 per cent in the Philippines, and is projected to start in 2020 for most countries. *However, greenhouse gas emission stabilization and better agricultural practices could prevent this decline.*

- *Water resources:* Global warming is likely to worsen water stress in some parts of the region, particularly in Thailand and Viet Nam. About 3.9 million people in Thailand and 8.4 million in Viet Nam are projected to experience water stress by 2050.

- *Forestry*: The loss of high-quality forests is projected to lead to significant biodiversity loss. A large part of the dominant tropical evergreen, semi-deciduous and deciduous forest/woodland—all with high carbon-capturing potential—are projected to be replaced by tropical savannah (grass land) and tropical shrub land that have low or no carbon-capturing potential.

The study estimated that the economy-wide cost of climate change for the four countries, without global mitigation efforts, is relatively low in the medium term but rises significantly thereafter. By the end of this century, the economy-wide cost each year on average could reach 2.2 per cent of GDP if only market impact is considered, 5.7 per cent if non-market impact is included, and 6.7 per cent when catastrophic risks are also taken into account. These figures are much higher than the global averages. This is because the four countries, as mentioned earlier, have high dependence on agriculture and natural resources, relatively long coast lines, high concentration of population in coastal areas, and mostly tropical climate.

With greenhouse gases stabilization at 450–550 ppm, the economy-wide cost due to global warming would be significantly lower, suggesting that mitigation could offer significant benefits for the four countries.

(Source: The Economics of Climate Change in South-east Asia: A Regional Review, Asian Development Bank, April 2009)

Annexure - 6
REPAY CLIMATE DEBT - A JUST AND EFFECTIVE OUTCOME FOR CLIMATE TALKS

(*On 5 June 2009, World Environment Day, over 230 organization endorsed the following Appeal*)

We the undersigned groups, including development, environment, gender and youth organizations, faith-based communities, indigenous peoples and social and economic justice movements in Africa, Asia, Latin America and the Caribbean, Europe and North America call on the rich industrialized world to acknowledge its historic and current responsibility for the causes and adverse effects of climate change, and to fully, effectively and immediately repay its climate debt to poor countries, communities and people.

Climate change threatens the balance of life on Earth. Oceans are rising and acidifying; ice caps and glaciers are melting; forests, coral reefs and other ecosystems are changing or collapsing. The existence of some communities is imperiled, while others face growing barriers to their development. Unless curbed, an impending climate catastrophe risks

increasingly violent weather, collapsing food systems, mass migration and unprecedented human conflict.

Poor countries, communities and people have contributed least to the causes of climate change, yet are its first and worst victims. At greatest risk are women, indigenous peoples, poor people, small farmers, fisher-folk and forest communities, people relying on scarce water resources, youth and other groups susceptible to harm and health impacts.

A wealthy minority of the world's countries, corporations and people, by contrast, are the principal cause of climate change. The developed countries representing less than one fifth of the world's population have emitted almost three quarters of all historical emissions. Their excessive historical and current emissions occupy the atmosphere and are the main cause of current and committed future warming.

Developed countries have consumed more than their fair share of the Earth's atmospheric space. On a per person basis, they are responsible for more than ten times the historical emissions of developing countries. Their per person emissions today are more than four times those of developing countries.

For their disproportionate contribution to the causes and consequences of climate change, developed countries owe a two-fold climate debt to the poor majority:

- For their excessive historical and current per person emissions – denying developing countries their fair share of atmospheric space – they have run up an "emissions debt" to developing countries; and

- For their disproportionate contribution to the effects of climate change – requiring developing countries to adapt to rising climate impacts and damage – they have run up an "adaptation debt" to developing countries.

Together the sum of these debts – emissions debt and adaptation debt – constitutes their climate debt, which is part of a larger ecological, social

and economic debt owed by the rich industrialized world to the poor majority.

Honouring these obligations is not only right; it is the basis of a fair and effective solution to climate change. Those who benefited most in the course of causing climate change must compensate those who contributed least but bear its adverse effects. They must compensate developing countries for the two-fold barrier to their development – mitigating and adapting to climate change – which were not present for developed countries during the course of their development but which they have caused.

Developed countries, however, intend to write-off rather than honour their debt. In their submissions to the climate negotiations they seek to pass on substantial adaptation costs to developing countries; evading rather than honouring their adaptation debt. And they seek to continue their high per person emissions; deepening rather than repaying their emissions debt, consuming additional atmospheric space, and crowding the world's poor majority into a small and shrinking remainder.

We are concerned that continued excessive consumption of atmospheric space by the world's wealthy at the expense of the world's poor – who need access to energy and resources to build the schools, houses and infrastructure that the rich world already has and continues to benefit from – puts at risk the prospects of any viable solution to climate change and, with it, the safety of all nations and peoples, and the Earth.

As the basis of a fair and effective climate outcome we therefore call on developed countries to acknowledge and repay the full measure of their climate debt to developing countries commencing in Copenhagen. We demand that they:

- Repay their adaptation debt to developing countries by committing to full financing and compensation for the adverse effects of climate change on all affected countries, groups and people;

- Repay their emissions debt to developing countries through the deepest possible domestic reductions, and by committing to assigned amounts of emissions that reflect the full measure of

their historical and continued excessive contributions to climate change; and

- Make available to developing countries the financing and technology required to cover the additional costs of mitigating and adapting to climate change, in accordance with the Climate Convention.

Meeting these demands is a basic prerequisite for success in December 2009. Copenhagen must be a key turning point for climate justice – a major milestone on the journey towards safeguarding the Earth's climate system and ensuring a future in which the rights and aspirations of all people can be realized.

Annexure – 7
SMALL TRADITIONAL BIODIVERSE FARMS ARE MORE RESILIENT AND SUSTAINABLE

Despite the onslaught of industrial farming, the persistence of thousands of hectares of farming under traditional practices around the world documents a successful indigenous agricultural strategy of adaptability and resiliency. These microcosms of traditional agriculture that have stood the test of time and that can still be found almost untouched for 4000 years in the Andes, MesoAmerica, South-east Asia and parts of Africa, offer promising models of sustainability as they promote biodiversity, thrive without agro-chemicals, and sustain year-round yields even under marginal environmental conditions. The accumulated local knowledge and the forms of agriculture and agro-biodiversity it has nurtured comprise a legacy with ecological and cultural resources of fundamental value for the future of humankind.

Recent research suggests that many small farmers cope and even prepare for climate change, minimising crop failure through the increased use of drought-tolerant local varieties, water harvesting, mixed cropping, opportunistic weeding, agro-forestry and a series of other traditional

techniques. Surveys conducted in hillsides after Hurricane Mitch in Central America showed that farmers using sustainable practices such as *mucuna* cover crops, intercropping and agro-forestry suffered less damage than their conventional neighbours. The study spanning 360 communities and 24 departments in Nicaragua, Honduras and Guatemala showed that diversified plots had 20-40 per cent more topsoil, greater soil moisture, less erosion and lower economic losses.

A re-evaluation of indigenous technology can therefore serve as a key source of information on the adaptive capacity and resilient capabilities of small farms, features of strategic importance for world farmers to cope with climatic change. Indigenous technologies often reflect a worldview and an understanding of our relationship to the natural world that is more realistic and more sustainable than those of the West.

The wide variety of cultivars (plants developed to have particular features) that traditional small-scale farmers grow are more genetically heterogeneous than modern cultivars. These offer greater defence against vulnerability and enhance harvest security in the midst of disease, pests, droughts and other stresses. In a worldwide survey of crop varietal diversity on farms involving 27 crops, scientists found that considerable crop genetic diversity continues to be maintained on farms in the form of traditional crop varieties, especially of major staple crops. In most cases, farmers maintain diversity as an insurance to meet future environmental change or social and economic needs.

Many researchers have concluded that rich variety also enhances productivity and reduces yield variability. Studies by plant pathologists provide evidence that mixing of crop species and or varieties can delay the onset of disease by reducing the spread of disease-carrying spores, and by modifying environmental conditions so that they are less favourable to the spread of certain pathogens. In a recent research in China, four different mixtures of rice varieties grown by farmers from 15 different townships over 3000 hectares suffered 44 per cent less blast incidence and gave 89 per cent greater yield than homogeneous fields without the need to use chemicals.

However, there is now a possibility that traits important to indigenous farmers (drought resistance, competitive ability, performance on

intercrops, storage quality, etc) could be traded for (genetically modified) transgenic qualities which may not be important to farmers. This could increase risk, and, significantly, farmers would lose their ability to adapt to changing biophysical environments and produce relatively stable yields with a minimum of external inputs while supporting their communities' food security.

As for mitigating climate change, while industrial agriculture contributes directly to climate change, small biodiverse organic farms have the opposite effect of increasing carbon in the soil. Small farmers usually treat their soils with organic compost materials which absorb and store carbon better than soils that are farmed with conventional fertilizers. Further benefits accrue from the fact that most use significantly less fossil fuel in comparison to conventional agriculture mainly due to a reduction of chemical fertilizer and pesticide use, relying instead on organic manures, legume-based rotations and diversity to enhance beneficial insects. Farmers that live in rural communities near cities and towns and *linked to local markets* avoid the use of energy and gas emissions associated with transporting food hundreds and even thousands of kilometres.

For these reasons, rural social movements in the South oppose industrial agriculture in all its manifestations. Consumers, both in the South and the North, can play a major role by supporting equitable and fair trade markets which do not perpetuate the colonial model of "agriculture of the poor for the rich", but rather a model that builds up small biodiverse farms as the basis for strong rural economies in the South. Such economies will not only support sustainable production of healthy and accessible food for all, but will allow indigenous peoples and small farmers to continue their millennial work of building and conserving agricultural and natural biodiversity on which we all depend now and more so in the future.

(*Source: Miguel Altieri - Small Farms as a Planetary Ecological Asset: Five key reasons why we should support the revitalization of small farms in the global South, 2008*)

Climate crisis has become the scourge of the past several decades, threatening our lives and livelihoods in the most devastating ways. And its most serious impacts are being felt on the food and agriculture and food security of the world and on its majority practitioners - the small food producers, fishers and herders and, particularly the indigenous peoples and the women.

But this climate change is no longer the natural phenomenon that it once used to be. In fact, today, most of the otherwise called 'natural disasters' like floods, typhoons, hurricanes, drought and famine are found to be direct consequences of the climate change and global warming. This climate change - more rapid, more uncertain, more recurrent with more wide-ranging impacts and more catastrophic - is almost entirely man-made.

Yet at the global level, governments and international agencies continue to evade addressing its deep rooted causes. On the contrary, the international discourse on climate change has converted an essentially justice issue into one of trading options and opportunities. At the same time, on food and agriculture too, agriculture is blamed for contributing to climate change, without specifying that it is corporate agriculture – mono-crop, intensely chemical-based and effecting land use changes away from growing food – which is the one to blame. It is essential that these anomalies are rectified.

Studies and experiences worldwide have shown that localized, small scale biodiversity based ecological agriculture plays a major role in mitigating climate change. The potential of this agriculture and the local knowledge systems needs to be recognized, harnessed and established for a sustainable response to the climate crisis.

ABOUT PAN AP

Pesticide Action Network Asia and the Pacific (PAN AP) is one of the five regional centres of PAN, a global network dedicated to eliminating the harm caused to humans and the environment by pesticides and promoting biodiversity-based ecological agriculture.

PAN AP's vision is a society that is truly democratic, equal, just, and culturally diverse; based on the principles of food sovereignty, gender justice and environmental sustainability. It has developed strong partnerships with peasants, agricultural workers and rural women movements in the Asia Pacific region and guided by the strong leadership of these grassroots groups, has grown into a reputable advocacy network with a firm Asian perspective.

PAN AP's mission lies in strengthening people's movements to advance and assert food sovereignty, biodiversity-based ecological agriculture, and the empowerment of rural women; protect people and the environment from highly hazardous pesticides; defend the rice heritage of Asia; and resist the threats of corporate agriculture and neo-liberal globalization.

Currently, PAN AP comprises 108 network partner organizations in the Asia Pacific region and links with about 400 other CSOs and grassroots organizations regionally and globally.

EMPOWERING PEOPLE FOR CHANGE
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ISBN 978-983-9381-56-6