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Livelihoods and adaptive capacity in Bangladesh Page 18

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Cover photo: Subarnabad resident cooking dinner
Photo: © Jennifer Pouliotte

Malawian fishermen

Photo: © EC/Story Workshop

Gender and climate change

Ulrike Röhr discusses the historical lapse in assimilating gender issues in the climate change debate

Until very recently, gender issues have not played a major role in climate protection discussions. This is surprising given the situation that equity in general, especially between South and North, is regularly on the agenda and is a key issue in the climate change negotiations.

Only in the past couple of years have discussions about gender during Conference of the Parties meetings to the United Nations Framework Convention on Climate Change (UNFCCC) been raised. At the Ninth Conference of the Parties, held in December 2003 in Milan, Italy, a network of people interested in gender issues was established. The network organized workshops on gender and climate at both the Tenth and Eleventh Conferences of the Parties.

Thus, at the international level of climate change negotiations, gender issues are on the rise. Moreover, many projects in developing countries are now addressing the different situation of women and men respective to their different vulnerabilities to climate change. In the industrialized countries of the North, after an absence of activities on gender and climate change, it would seem that this issue is about to be discovered.

There are a number of activities already underway. A research project at the Institute for Social-Ecological Research in Germany is dealing with gender issues and emissions trading. The Climate Alliance of European Cities coordinated the project Climate for Change: Gender Equality and Climate Change Policy. The regional government of Lower Austria has considered gender mainstreaming within their climate change programme. All of these activities are based on the premise that climate change policies will be more effective if more women are involved and if gender issues are addressed.

Against this background I want to look more closely at how climate change is tangent to gender relations – and *vice versa*. Questions to be raised when dealing with climate change from a gender perspective are:

1. Are there gender differences in the perception of, and the response to, climate change?
2. Who is causing climate change, by which activities and for what purposes? How is the polluter-pays principle taken into ac-

MAIN POINTS

- **The author argues** that gender issues have been neglected in the climate debate.
- **She shows** that gender can play an important role in both mitigation and adaptation, and in both the North and South.
- **It is concluded** that gender-just participation and recognition of gender relations will lead to a more comprehensive view of climate change.

count in mitigation and adaptation policies and measures?

3. Are there gender differences as to what policies and measures are preferred and, if so, what are the reasons for these differences?
4. Are women and men affected differently by the effects of climate change? What are the gender specific impacts of climate change and its resulting environmental damages?
5. Are there gender differences in negotiations and decisions on climate change policy? How and to what extent are women participating when it comes to working out and deciding about climate protection programmes and measures? How do the results and programmes impact gender relations, for example, climate policy guidelines and directives at the national, European Union and international level?

Because there is an obvious historical lack of research, many of these questions cannot be answered at present. And not all these questions are similarly relevant in each region of the world. In the climate debate, questions linked to adaptation are more relevant in the South, while in the North questions connected to mitigation are more on top.

Gender and climate change in the South: adaptation

It is widely acknowledged that the negative effects of climate change are likely to hit the poorest people in the poorest countries the hardest. In other words, the poor are the most vulnerable to climate change.

Women form a disproportionate share of the poor. Seventy per cent of human beings worldwide living below the poverty line are women. In particular, in developing countries and communities that are highly dependent on local natural resources, women are likely to be disproportionately vulnerable to the effects of climate change. Climate change often impacts the areas that are the basis of livelihoods for which women are responsible, for example, nutrition and water and energy supplies. Moreover, because of gender differences in property rights, access to information and in cultural, social and economic roles, the effects of climate change are likely to affect men and women differently.

The effects of climate change on gender inequality are not limited to immediate impacts and changing behaviours but also lead to subsequent changes in gender relations. Spending more time on traditional reproductive tasks reinforces traditional work roles and works against a change in which women might begin to play other roles.

For instance, because women are primary care-givers in times of disaster and environmental stress, the occurrence of magnified burdens of care-giving is likely to make them less mobile. Also, since climate change is expected to exacerbate existing shortfalls in water resources and fuel wood, the time taken to fetch water or wood (which in most countries is the responsibility of women) will certainly increase women's workloads, thus limiting their opportunities to branch out into other non-traditional activities.

To be successful, adaptation policies and measures within both developed and developing countries need to be gender sensitive. To understand the implications of adaptation measures for all people involved, it is necessary that all members of an adapting com-

DIFFERENTIAL GENDER IMPACTS

● The network Gender in Climate Change has given the following example of the differential impact of a natural hazard on women and men:
Following the cyclone and flood of 1991 in Bangladesh the death rate was almost five times as high for women as for men. Warning information was transmitted by men to men in public spaces, but rarely communicated to the rest of the family and, as many women are not allowed to leave the house without a male relative, they perished waiting for their relatives to return home and take them to a safe place. Moreover, as in many other Asian countries, most Bengali women have never learned to swim, which significantly reduces their survival chances in the case of flooding. Another clear illustration of the different vulnerabilities women and men face is offered by the fact that more men died than women during Hurricane Mitch. It has been suggested that this was due to existing gender norms in which ideas about masculinity encouraged risky, 'heroic' action in a disaster.

munity are represented in climate change planning and governance processes.

During a drought in the small islands of the Federal States of Micronesia, the knowledge of island hydrology from women as a result of their land-based work enabled them to find potable water by digging a new well that reached the freshwater lens. Women, however, are often expected to contribute unpaid labour for soil and water conservation efforts yet are absent from the planning and governance processes. Equal involvement of men and women in adaptation planning is important not only to ensure that the measures developed are actually beneficial for all those who are supposed to implement them, but also to ensure that all relevant knowledge, (that is, knowledge from men and women) is integrated into policy and projects.

Gender and climate change in the North: mitigation

The participation of women in decision making, in planning and working out climate protection programmes is as important in the North as in the South. In the project Climate for Change, the involvement of women has been investigated, leading to the following results.

The relevant fields of action for climate protection such as energy policy, urban mobility and urban planning, are definitely male-dominated because of their technical focus. Among others, two initial questions arise. Firstly, who might profit if climate protection programmes lead to job creation? And secondly, what is the effect on the planning of measures and policies if they are almost exclusively planned from the viewpoint of one gender, whose background of experience usually excludes the work involved in caring and providing for others? Such questions should encourage us all to reflect on and discuss these important, everyday issues.

Up to now, few studies have specifically addressed the gender aspects of climate protection in industrialized countries. But some data, especially from Germany, points to differences between the sexes, and leads to the assumption that the priorities of women in climate protection may be different from those of men. The data lead to the following conclusions:

- Women and men perceive and assess risks differently, and that is also true for climatic change. More than 50 per cent of the women, but only 41 per cent of the men, classify climate change caused by global warming as extremely or very dangerous. Consequently, women are more strongly convinced than men that global warming is unavoidable in the next 20 to 50 years.
- Trust placed in the role played by environmental policy also varies according to gender. More women than men are sceptical that Germany can cope with problems resulting from climate change. Nonetheless, some 62.9 per cent of the women, but only 53.8 per cent of the men, are in favour of a pioneering role for Germany in climate policy.
- These differing perceptions of climate change, and the political possibilities of reacting to it, affect each gender's motivation to protect the climate. Women are more willing to alter environmentally harmful behaviour. They do not rely as much on science and technology to solve

Photo: © Corel Corporation

environmental problems to the exclusion of lifestyle changes. As a result, they place a higher value on the influence exerted by each and every individual on preventing climate change.

- Studies show that women have a definite information deficit on climate politics and climate protection. This raises the question of how the subject matter is communicated. Is it slanted toward technically interested people? Does the selection of photographs and the layout of brochures and information material suggest that the target group is male? Browsing through such materials suggests this often seems to be the case. These discrepancies are particularly noticeable with regard to the extent to which people are informed about the international climate negotiations. But despite their relative lack of knowledge, women seem to be more prepared for behavioural changes than men, as they recognize the urgency of the need for changes in behaviour. In many areas they are already adjusting their behaviour to meet this need, for example, by reducing their energy consumption, using more public transport and changing their nutrition and shopping habits.
- The instruments used to prevent climate change are probably also gender-biased. For example, how are economically differing preconditions taken into account in the design of these instruments? In Europe, women generally earn 28 per cent less than men, and 27 per cent of single mothers live below the poverty line.

In general, all these gender-specific differences are either due to physiological differences or, to a much greater extent and scope, to differences in social roles assigned to women and men and gender-specific identities in society. Gender roles and identities are linked to gender hierarchies in terms of opportunity and participation in power structures in society. When considering the issue of gender relations, one must, therefore, also always bear in mind the power relations associated with them.

“Gender-just participation and recognition of gender relations will lead to a more comprehensive view of climate change”

Looking at climate change mitigation from a gender perspective we have to answer the following questions: who, primarily, is causing the problems of carbon dioxide emissions? Who gets the benefits? Why is it that the polluter-pays principle is so little taken into consideration in climate change policies? There might well be a strong connection between gender relations, power relations and these questions that has not yet started to be discussed.

The outlook

As mentioned above, gender issues have not been recognized in the UNFCCC negotiations until now, although there was a very weak decision at the Seventh Conference of the Parties in December 2001 in Marrakesh, Morocco regarding the nomination of women in the bodies of the UNFCCC. To improve this situation, some fundamental requirements have to be addressed immediately to provide a just and equitable approach to this issue.

These requirements are based on the paper *Gender and Climate Change in the North: Issues, Entry Points and Strategies for the Post-2012 Process and Beyond* which was written by Minu Hemmati for genanet – focal point gender justice and sustainability.

Research and data. We do not know enough about gender aspects of climate change, particularly in the North. For example, with regard to climate protection measures, there is no gender analysis from a Northern perspective, only, in some aspects, from a Southern perspective. All climate protection measures and programmes and all instruments for mitigating climate change or adapting to climate change must be subject to a gender-focused analysis. All climate change-related data, scenarios, and so on, need to be disaggregated by gender. Gender-disaggregated data are particularly lacking for the industrialized world.

Therefore, relevant research needs to be developed and financed. This requires gender experts and climate researchers to engage in the issues, and it requires funders to support such research projects. Based on existing knowledge in the area of climate change as well as in other areas, specific suggestions for research projects can easily be developed and advocated.

Gender mainstreaming. Gender must be universally integrated into climate protection negotiations and policy making at national and international levels. The different needs, opportunities and goals of women and men need to be taken into account. The beginning post-2012 process offers an important opportunity.

Participation. Women must be involved in climate protection negotiations at all levels and in all decisions on climate protection. Representation by numbers is not enough. We need women represented and we need gender experts involved.

Information/publications. There is a general information deficit on climate protection and related policies. New information materials and strategies need to be developed. They need to include gender aspects, and they need to be targeted to specific groups, including being tailored for women's information channels.

Monitoring. Gender mainstreaming of climate change-related research, policy making and implementation needs to be monitored at the national and international levels. This can be summarized within three main goals.

1. Closing knowledge gaps relating to gender aspects of climate change in the industrialized world, for example, through research and the collection of gender-disaggregated data.
2. Including more women and gender experts in climate protection-related negotiations and decision making at all levels.
3. Integrating gender-related knowledge into policy making, implementation, monitoring, and communication strategies and materials.

If any climate-protection policy ignores the afore-mentioned as well as many other, proven or as yet only suspected, gender aspects, it cannot be accepted as sustainable, since it would have a counter-productive effect on gender equality. Without taking gender aspects into consideration, the task of preventing climate change will be difficult to achieve.

I am absolutely certain that gender-just participation and recognition of gender relations will lead to a more comprehensive view of climate change. The full diversity of social groups and their living situations are more likely to be taken into account. Children, the elderly and migrants, for example, will be taken into rightful account. This will, in turn, lead to improvements in the measures taken, and to a higher acceptance of gender issues amongst the global populace. ■

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FURTHER INFORMATION

● **In the Cyberlibrary:** The Tiempo Climate Cyberlibrary provides a listing of websites on gender and climate change at www.tiempocyberclimate.org/portal/t56web.htm.
● **On the Web:** A World Bank study of gender differences in the impact of Hurricane Mitch is available at http://www1.worldbank.org/prem/PREMNotes/premnote57.pdf.

Deserts and desertification

Sarah Granich reports on the designation of 2006 as the International Year of Deserts and Desertification

The United Nations Convention to Combat Desertification (UNCCD) was adopted in 1994. Twelve years on and land degradation and advancing deserts constitute a worldwide environmental and humanitarian crisis. It is in recognition of this major threat to humanity that the United Nations General Assembly has declared 2006 to be the International Year of Deserts and Desertification (IYDD).

Preparations for the International Year were discussed at the Seventh Session of the Conference of the Parties to the UNCCD, held in October 2005 in Nairobi, Kenya. The meeting was attended by delegates representing the 191 countries party to the Convention. The Convention is the only internationally recognized and legally binding instrument that addresses the problem of land degradation and desertification. Full attendance from the global community was seen as vital in order to assess progress made over the past decade in addressing drought and desertification as well as effectively formulating plans and strategies over the coming years.

In his opening speech at the high-level segment of the UNCCD meeting, Klaus Toepfer, Executive Director of the United Nations Environment Programme, voiced his concern that there was a need to move from talk to action in order to effectively deal with this global problem. He warned that "land degradation and desertification are without question among the central issues facing the international community if we are to meet the Millennium Development Goals and achieve a just, healthier and more stable world. The world's soils are in some ways unique. You can clean up a river or the air, but cleaning up soils is far more difficult. If you lose soils, it can take centuries if not longer to replace them."

MAIN POINTS

- **The author discusses** a United Nations initiative, the International Year of Deserts and Desertification.
- **She describes** the threat posed by the degradation of arid lands in various parts of the world.
- **It is hoped** that 2006 will end with strategies developed for reducing and dealing with desertification greatly strengthened.

Background

According to the UNCCD Secretariat, desertification and drought cause an estimated loss of US$42 billion a year in the agricultural sector. Desertification and drought contribute to food insecurity, famine and poverty and can give rise to social, economic and political tensions that can cause conflicts, further impoverishment and further land degradation.

The African continent suffers the most from the impacts of desertification. Two-thirds of the land mass is classified as desert

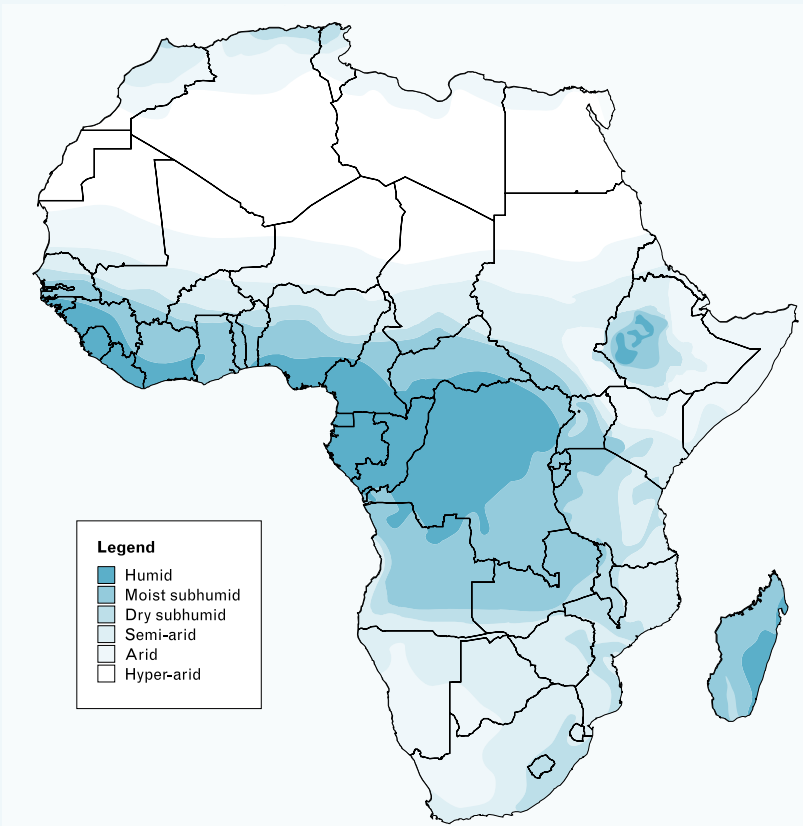
or drylands and, although there are extensive areas under agriculture, almost three-quarters of these drylands are already degraded to some degree. The entire drylands region is afflicted by frequent and severe droughts, whilst many of the dryland nations are landlocked, have widespread poverty, need external assistance and depend heavily on natural resources for subsistence. At present, almost half (46 per cent) of Africa's land area is vulnerable to desertification.

In terms of the number of people affected by desertification and drought, Asia is the most severely affected continent. The vast land mass has a total land area of 4.3 billion hectares of which 1.7 billion hectares, stretching from the Mediterranean coast to the shores of the Pacific, are classed as arid, semi-arid and dry sub-humid regions. Expanding deserts are affecting China, India, Iran, Mongolia, Pakistan, Syria, Nepal and the People's Democratic Republic of Lao. The causes of this severe land degradation vary from nation to nation including, for example, steeply-eroded mountain slopes in Nepal and deforestation and overgrazing of highlands in the People's Democratic Republic of Lao, but the resulting impacts remain similar.

Focus of the International Year

In designating 2006 as the International Year of Deserts and Desertification the United Nations has provided the world with a united objective to curb desertification around the

ARIDITY ZONES



Adapted from World Meteorological Organization, United Nations Environment Programme , 'Climate Change 2001: Impacts, Adaptation, and Vulnerability', Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change

globe and to work collectively towards substantially reducing its overwhelming environmental, social and economic costs.

Countries and communities around the world have activities and initiatives planned to raise awareness and to highlight the many additional issues arising from the impacts of desertification that affect both the environment and humanity. "I look forward to working with governments, civil society, the private sector, international organizations and others to focus attention on this crucial issue and to make every day one on which we work to reverse the trend of desertification and set the world on a safer, more sustainable path of development," said Kofi Annan, Secretary-General of the United Nations.

Two main issues arising directly from the impacts of desertification will be focused on throughout the year. One is the need to recognize that desertification and related environmental degradation are directly linked to ever-increasing poverty, hunger and forced migration. Prior to the Nairobi meeting, Hama Arba Diallo, the UNCCD's Executive Secretary, observed that desertification is now considered to be the most threatening ecosystem change that has a direct impact on the poor stating that, "the fight against desertification is fundamentally a fight against poverty." The other main issue focuses on the link between desertification and the world's ecosystems and the need to protect and maintain biodiversity in the arid lands that cover one-third of the planet.

One of the three honorary spokespersons designated for the year, Chérif Rahmani, Environment Minister of Algeria, addressing a side event at the United Nations General Assembly in November 2005, noted that the International Year presented an opportunity to highlight the issues and raise awareness of desertification and its related impacts. We must use this opportunity to "protect the biological diversity, knowledge and traditions of affected communities living in the desert," he said. "We want to raise awareness at the international, regional, national and local level about the deserts," he continued. "Desertification is a transnational issue and a global problem."

> **"desertification is now considered to be the most threatening ecosystem change that has a direct impact on the poor"**

The other two honorary spokespersons for the year are the Nobel Peace Laureate, Wangari Maathai of Kenya, and the Bulgarian international football star, Hristo Stoitchkov. At various venues and special events throughout the world, it is planned that the honorary spokespersons will speak of and highlight not only the serious problems for humanity associated with desertification but also that deserts, home to many of the world's oldest and most vibrant civilizations, are important and unique ecosystems that cannot be lost.

Stoitchkov committed himself at the side event to "promoting this message amongst future generations and particularly through soccer, probably the single most powerful and fraternal sport in the world that resonates among nations and brings people together." A major football match is planned between players from Europe and affected countries, particularly from Africa.

Activities

One of the first formal activities of the International Year was an international meeting with selected intergovernmental, governmentalandnon-governmentalorganizations in Rome, Italy. The workshop was organized by the UNCCD Secretariat in collaboration with the Italian Association of Non-Governmental Organizations and was supported by the Italian Ministry of Foreign Affairs.

The working title of the workshop was "Combating Desertification and Poverty in Drylands: Promoting Decentralized Cooperation and the Participation of Civil Society in Implementation of the UNCCD". This is a continuation of an Italian initiative which was launched at the end of 2004 and is aimed at raising awareness and promoting the role of civil society and regional governments

in assisting developing country Parties in the implementation of their National Action Programmes.

Italy will also be hosting another of the year's special events that has been planned to coincide with the World Day to Combat Desertification on June 17th 2006. Under the patronage of the Italian Ministry of Cultural Heritage, a five-day film festival will take place in Rome. The festival, called Desert Nights, will feature documentaries, films and real-life stories of people and communities in drylands. There will be five awards presented to the best fiction films from countries affected by desertification within the five regions of the UNCCD – Africa, Asia, Latin America and the Caribbean, Central and Eastern Europe, and the Northern Mediterranean.

Each year on June 5th activities around the globe are undertaken to commemorate World Environment Day. The United Nations Environment Programme has designated the theme for 2006 to be Deserts and Desertification, with the slogan "Don't Desert Drylands!" Major international celebrations will be held in Algeria, alongside thousands of other events worldwide.

Amongst the many international events that will take place through 2006, there are a number of conferences and symposiums that will discuss strategies to deal with specific issues related to desertification and its impacts. For example, in April, in Geneva, Switzerland, there will be an IYDD Symposium on Combating Desertification, Hunger and Poverty. In May, in Beijing, China, there will be an international conference on Women and Desertification and in September, in Nairobi, Kenya, a scientific conference on Environmental Arid Lands Management and the Millennium Development Goals will be held.

In December 2006, the Government of Algeria will host the final formal event of the International Year with a Summit Meeting of Heads of State. The theme will be "Desertification, Migration and Security".

Outcome

It is hoped that with the support and commitment of governments, international organizations and the global community, 2006 will end with strategies developed for reducing and dealing with desertification greatly strengthened. Effective mechanisms encompassing trade, poverty reduction, equity and sustainable development need to be implemented immediately if the global community is sincerely intent on not only reducing this global crisis but also on having any possibility of reaching the Millennium Development Goals. ■

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FURTHER INFORMATION

● **In the Cyberlibrary:** The Tiempo Climate Cyberlibrary maintains a selected list of websites covering drylands and desertification at www.tiempocyberclimate.org/portal/t26web.htm.

● **On the Web:** The official IYDD website at www.iydd2006.org provides a comprehensive listing of global activities and events from the international level to the national and local community level. The website also contains many links to information sources, ideas and reports and will provide, throughout the year, photographs, summaries and stories of global events. The UNCCD Global Mechanism site at www.gm-unccd.org/English/Events/upcoming.htm provides a listing of all meetings and conferences related to desertification that are planned for 2006.

NEWS

ACCELERATING CO_2

The amount of carbon dioxide in the atmosphere reached a record 381 parts per million by volume during 2005, according to preliminary figures from the United States National Oceanic and Atmospheric Administration (NOAA).

David Hofmann from NOAA said that levels rose by 2.6 parts per million from the previous year. Pieter Tans, a carbon dioxide analyst for NOAA, reckons the latest figures confirm a worrying trend. "We don't see any sign of a decrease; in fact, we're seeing the opposite, the rate of increase is accelerating," he said.

Read more:
www.tiempocyberclimate.org/newswatch/arnews06.htm#060326

TONGA SEA LEVEL

According to the South Pacific Sea Level and Climate Monitoring Project, sea level around the Pacific island of Tonga appears to have risen by about ten centimetres over the past 13 years.

Sea level has been rising at all stations monitored, but the rise has been greatest at Tonga, where it averaged 8.4mm per year. The oldest gauge in the Pacific, at Lautoka, Fiji, was installed in October 1992 and shows an average 2.8mm rise a year since then.

Read more:
www.tiempocyberclimate.org/newswatch/arnews06.htm#060312

OIL-FREE SWEDEN

Sweden is committing to replace all fossil fuels with renewable energy sources within 15 years in an ambitious attempt to become the world's first near oil-free economy.

"Our dependency on oil should be broken by 2020," said Mona Sahlin, Minister of Sustainable Development. "There shall always be better alternatives to oil, which means no house should need oil for heating, and no driver should need to turn solely to gasoline." At present, 32 per cent of the country's energy is generated from oil.

Read more:
www.tiempocyberclimate.org/newswatch/arnews06.htm#060219

CLIMATE REPORTS

A survey of 47 journalists in Honduras, Jamaica, Sri Lanka and Zambia, reveals that the media in these countries have a poor understanding of climate change and do not consider reporting the issue a high priority.

The survey, conducted by the Panos Institute, reported that in Zambia "the little reportage that appears barely scratches the surface, and lacks in-depth analysis of what climate change is, what its effects are, and the available strategies to cope with them." The journalists interviewed said they lacked access to clear, accurate information.

Read more:
www.tiempocyberclimate.org/newswatch/arnews06.htm#060319

KYOTO TARGETS

The industrialized nations have shown "significant progress" in working out new policies and rules, and the 2012 Kyoto targets remain within reach, according to the Secretariat of the climate treaty.

Overall emissions from the industrialized nations fell from 18.4 billion tonnes of carbon dioxide in 1990 to 17.3 billion tonnes in 2003. With extra measures, Richard Kinley, acting treaty head, considers that the Kyoto nations could reach the overall target of at least a five per cent cut below 1990 levels, but they would have to "sustain or even intensify their efforts."

Read more:
www.tiempocyberclimate.org/newswatch/arnews06.htm#060226

Climate and African fisheries

With examples from Malawi, Friday Njaya and Charlotte Howard describe concerns over the possible impacts of climate change on fisheries in Africa

Climate change could increase the vulnerability of fishing communities and also affect the contribution that fisheries make to the economies of developing countries. There are particular concerns for African fisheries where communities are already vulnerable and climate change might overstretch their coping strategies by increasing climatic variation, reducing fish catches and causing extreme climatic events. This article reviews current work on climate change and fisheries in Africa, using Malawi to explore the relationship between existing climate variation and African fisheries.

Fisheries provide vital livelihoods for coastal, lake and river dwelling communities in Africa. Significant lakes and surrounding countries include Lake Victoria (Uganda, Tanzania and Kenya), Lake Malawi (Malawi, Mozambique and Tanzania), Lake Tanganyika (Tanzania, Zambia, Burundi and the Democratic Republic of the Congo) and Lake Chad (Chad, Cameroon, Niger and Nigeria). Significant river basins include the Nile, which is home to 160 million people, and the Niger River, which runs through Guinea, Mali, Niger, Benin and Nigeria. West coast African countries rely on fisheries to provide significant contributions to their Gross Domestic Products (GDP). For example, fisheries constitute over six per cent of Namibia's and Senegal's GDP, five per cent of Mauritania's GDP, and three per cent of Angola's GDP. Small-scale fisheries dominate the livelihoods of eastern coastal communities in Kenya, Tanzania and Mozambique. Estimates suggest that fish provides over 50 per cent of essential protein requirements in these areas.

In Malawi, fisheries constitute four per cent of national GDP and provide livelihoods for over 400,000 people. Five major water bodies are important for fish production, including Lake Malawi, Lake Chilwa, Lake Chiuta and sections of the Shire River. Annual fish production in Malawi is currently estimated at 55,000 mt, with over 50 per cent of this coming from Lake Malawi. Fish production from Lake Chilwa varies greatly as the lake periodically recedes. However, in between recessions the average weight of fish landings is 15,000 mt per annum, which constitutes nearly a third of the national catch. The other water bodies

MAIN POINTS

- **The authors describe** the contribution of fisheries to local livelihoods and national economies in Africa.
- **Malawi is used** to illustrate how fishing communities cope with existing climate variability.
- **African fishers** are already poor and vulnerable, however, and the authors stress that climate change might overstretch existing coping strategies due to increases in climate variability and extreme events and reductions in productivity.

Waiting for the water to return to Lake Chilwa after recent droughts Photo: Eddie Allison

constitute about a third of national fish production and provide significant livelihood benefits for rural people engaged in fishing, fish processing, fish trading and other ancillary industries such as boat building.

A 2005 review by Edward Allison and colleagues, entitled *Effects of climate change on the sustainability of capture and enhancement fisheries important to the poor: analysis of the vulnerability and adaptability of fisher folk living in poverty*, found that Africa contains most of the world's top 20 countries vulnerable to changes in fisheries production. Angola, the Democratic Republic of the Congo, Mauritania, Mali, Sierra Leone, Senegal, Niger, Malawi, Uganda and Mozambique are also classed as highly vulnerable due to their high nutritional dependence on fish for protein, high catch rates and high reliance on exports for national revenue. These countries also have high poverty levels and limited capacity to cope with the adverse impacts of climate change.

Why is there concern about climate change impacts on fisheries? Fisheries are, after all, already subjected to high levels of climate variability and in many cases they have developed systems to cope with these fluctuations. For example, on Lake Malawi a system of access to the fisheries has developed over time to allow migratory and static Malawian communities to make the most of pelagic fish stocks, such as usipa (*Engraucypris sardella*) during highly productive seasons. On Lake Chilwa, fishers migrate southwards from the northern marshes as the water level decreases on a seasonal basis. And during periods of recession when the drought persists for more than three years, fishers migrate to other water bodies such as Lakes Chiuta and Malombe. Migratory fishers pay lakeside communities for access to productive sites and offer their services through labour. During the dry season when water levels are low, the lakeshore communities cultivate crops in dry areas of the lake. Periodically during recession periods they cultivate crops like rice, maize and vegetables on the lake bed until the lake refills.

Despite the alternative livelihood strategies adopted by fishing communities in the face of climate variation, there is concern about climate change leading to greater climate variability. Current coping strategies may not be sufficient to deal with an increasing number of extreme events, for example if water level recessions due to drought occurred every two years rather than every ten years. Furthermore, there is a lack of understanding about how fishing communities currently deal with climate variability and how fisheries management activities can support or undermine these coping strate-

gies. On Lake Chilwa there is a move to give lake communities more control over the management of fisheries. But without an understanding of the migratory nature of the fishers and the role they play in the fishery, such a management regime could undermine local livelihoods and social benefits from the fishery.

In addition to increasing climate variability, climate change also brings the threat of long-term changes in productivity or distribution of resources. For instance, declining productivity on Lake Tanganyika has been linked to decreasing wind speeds, and declining dry season river flows in Asia have been linked to reduced fish catches. These threats are made worse by additional anthropogenic influences such as water extraction for irrigation.

The third component of climate change impacts on the poor is the disastrous effect of extreme events, such as floods and storms, which are predicted to increase in frequency and intensity. As with other developing country communities, the poorest members of fishing communities live in the most vulnerable areas, for example, areas that are prone to floods or close to the shore. These people have no means of protecting their assets, for example their homes and fishing boats, and are more susceptible to problems following disaster events, such as disease.

Many African fisheries suffer from over exploitation and poor management. Most fishing communities are poor and are becoming increasingly exposed to health risks such as HIV/AIDS and malaria. Climate change poses an additional problem that can affect the resource base and expose fishing communities to the risks of floods, droughts and storms. Levels of savings and availability and uptake of insurance in African fishing communities is generally low, so if households lose their fishing gear or, at worst, their livelihoods, they have few assets or skills to start afresh.

The issue of climate change, fisheries and poverty has been the focus of a research programme supported by the United Kingdom Department for International Development under its Fisheries Management Science Programme. A policy brief has been produced under the Department for International Development/Food and Agriculture Organization Sustainable Fisheries Livelihoods Programme. This calls for more research to improve understanding about the impacts of climate change on developing country fisheries and to determine how current coping strategies can be supported for short-term and long-term adaptation. It also calls on climate change adaptation planners to focus on the needs of fishing communities and consider the ensuing impacts of adaptation activities in other sectors. Fisheries management needs to tackle over exploitation of resources and work with other sectors to reduce poverty and vulnerability in the fisheries sector. Policy-makers also need to be sensitized to ensure they actively integrate climate change issues into existing fisheries policies. ■

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FURTHER INFORMATION

● **On the Web:** For more information please visit the United Kingdom Department for International Development Fisheries Management Science Programme website at www.fmsp.org.uk.
● The paper by Allison and colleagues cited in the text can be obtained on request from the DFID Fisheries Management Science Programme (Project R4778J), 1 Palace Street, London SW1E 5HE, United Kingdom (email: enquiry@dfid.gov.uk).

CONFERENCES

Third World Congress of Environmental & Resource Economists
Kyoto, Japan
03-07-2006 to 07-07-2006
Organized by the Society of Environmental Economics and Policy Studies and the European Association of Environmental and Resource Economists amongst others. Main themes for presentation of papers and sessions include: climate change impacts/costs; air pollution; environmental taxation; emisssions permits; and, pollution regulation.
Details: Takamitsu Sawa, Chair of Organizing Committee, Institute of Economic Research, Kyoto University, Sakyo-san, Kyoto, Japan. Email: wc3-info@congre.co.jp
On the Web: www.worldcongress3.org/

Asia Oceania Geosciences 3rd Annual Meeting
Singapore
10-07-2006 to 14-07-2006
Meeting aims to act as a catalyst for Asian and international participants to develop partnerships and other professional networking. Scientific sessions will cover such topics as: Oceans and Atmosphere; Hydrological Science; Solid Earth; Planetary Science; Solar terrestrial; and Interdisciplinary Working Groups. Organized by the Asia Oceania Geosciences Society.
Details: Cheng-Hoon Khoo, AOGS Secretariat Office, Meeting Matters International, 5 Toh Tuck Link, 596224 Singapore. Fax: +65-64677667. Email: kch@meetmatt.net
On the Web: www.asiaoceania-conference.org/

Living with Climate Variability & Change: Understanding the Uncertainties & Managing the Risks
Espoo, Finland
17-07-2006 to 21-07-2006
Organized by the World Meteorological Organization and co-hosted by the Finnish Meteorological Institute and the International Institute for Climate and Society. The three discussion themes are: societies are becoming increasingly interdependent; the climate system is changing; and, losses associated with climatic hazards are rising.
Details: Living with Climate Conference, Finnish Meteorological Institute, Climate Service, PO Box 503, Helsinki, Finland. Fax: +358-919-293503. On the Web: www.livingwithclimate.fi

International Symposium on Environment
Athens, Greece
03-08-2006 to 05-08-2006
Conference intended to bring together a broad spectrum of participants from disciplines such as biology, geology, economics, geography, communications, environmental law, chemistry and government policy for discussion on the state of the environment. Proceedings and selected papers from the conference will be published in a Special Volume of the Conference Proceedings.
Details: Christina Theochari, Athens Institute for Education and Research, 8 Valaoritou Street, Kolonaki, 10671 Athens, Greece. Fax: +30-210-3634209. Email: atiner@atiner.gr
On the Web: www.atiner.gr

2006 ACEEE Summer Study on Energy Efficiency in Buildings
California, USA
13-08-2006 to 18-08-2006
Working theme of the study is "Less is More: En-route to Zero Energy Buildings". Subject areas for interactive discussion include: design and performance of buildings; market transformation; energy and information technologies; human and social dimensions of energy use; efficient buildings in efficient communities; and, programme design, implementation and evaluation.
Details: Rebecca Lunetta, ACEEE Summer Study Office, PO Box 7588, Newark, DE 19714-7588, USA. Fax: +1-302-2923965. Email: rlunetta@comcast.net
On the Web: www.aceee.org

World Renewable Energy Congress IX & Exhibition
Florence, Italy
19-08-2006 to 25-08-2006
Theme for this years Congress is "Energy/Water and Cleaner Environment". Hosted by the University of Florence Centro ABITA and organized by the World Renewable Energy Congress. Will act as a forum for networking for such interested parties as policy makers, researchers, manufacturers, economists, environmentalists and sociologists. Opportunities for presentation of ideas and views plus formal and informal discussions.
Details: Ali Sayigh, PO Box 362, Brighton BN2 1YH, UK. Fax: +44-1273-625768. Email: asayigh@netcomuk.co.uk
On the Web: www.wrenuk.co.uk

International Disaster Reduction Conference 2006
Davos, Switzerland
27-08-2006 to 01-09-2006
Conference will comprise of various events such as plenary sessions, thematic sessions, special workshops and regional seminars. Main topics and themes regarding this issue include: natural hazards; environmental, biological and chemical risks; climate variability and climate change; technical risks; risk and demographics: gender, indigenous people, special needs, poverty; and, risk and resources management.
Details: Conference Secretariat, IDRC Davos 2006, Fluelastrasse 11, CH-7260 Davos Dorf, Switzerland. Fax: +41-81-4170823. Email: davos2006@sif.ch
On the Web: www.davos2006.ch

5th Session of the Committee for the Review of the UN Convention to Combat Desertification (CRIC-5
Buenos Aires, Argentina
01-09-2006 to 05-09-2006
Exact dates have not yet been determined. Participants will review the implementation of the Convention and its institutional arrangements. Prepa-

ration documents to assist country Parties are available for delegates and observers through the UNCCD Secretariat. Consideration of necessary adjustments to the elaboration process and the implementation of action programmes will also be discussed.
Details: UNCCD Secretariat, PO Box 260 129, Haus Carstanjen, D-53153 Bonn, Germany. Fax: +49-228-8152898. Email: secretariat@unccd.int
On the Web: www.unccd.int

3rd International Symposium on Integrated Water Resources Management

Bochum, Germany
26-09-2006 to 28-09-2006
Conference will be held at the Ruhr-University Bochum and is organized by their Institute of Hydrology, Water Resources Management and Environmental Engineering. Will look at the interdisciplinary character of water resources management. Topics include: flood risk, flood vulnerability and flood protection; water management as a problem and solutions; and, vulnerable interactions.
Details: Jana Radoi, Conventus Congressmanagement & Marketing GmbH, Markt 8, 07743 Jena, Germany. Fax: +49-3641-3533271. Email: water@conventus.de
On the Web: www.conventus.de|water

Adaptation to the Impacts of Climatic Change on the European Alps

Wengen, Switzerland
04-10-2006 to 06-10-2006
Workshop is the twelth in an annual series on Global Change Research. Will draw together experts from countries within the Alpine Arc to examine the vulnerability of particular sectors and systems to climate change impacts. Also will assess progress on the formulation and implementation of adaptation responses at various levels.
Details: Martin Beniston, Department of Geosciences, University of Fribourg, Chemin du Musee 4, CH-1700 Fribourg, Switzerland. Fax: +41-26-3009746. Email: martin.beniston@unifr.ch
On the Web: www.unifr.ch|geosciences|geographie|EVENTS|Wengen?06|Wengen2006.html|

Monitoring of Mediterranean Coastal Areas: Problems & Measurement Techniques

Sardinia, Italy
04-10-2006 to 06-10-2006
Organized by CNR-IBIMET, the Institute for Biometeorology with other Institutes. Main symposium session topics are: evolution of coastlines and coastal erosion; coastal vegetation; sea beds, plant cover and water quality; coastal and submarine archaeology; coastal fires and environmental recovery; and, coastal anthropization and socio-economic exploitation of the territory.
Details: Organizing Secretariat, CNR-IBIMET sede di Sassari, Via Funtana di Lu Colbu 4|a, 07100 Sassari, Italy. Fax: +39-79-268248. Email: segr.org@ss.ibimet.cnr.it
On the Web: server.ss.ibimet.cnr.it|ita|simposio.htm

Rapid Climate Change International Science Conference

Birmingham, UK
24-10-2006 to 27-10-2006
Intended that the conference explore the scientific understanding of rapid climate change, with a main but not exclusive focus on the role of the Atlantic Ocean's thermohaline circulation in such change. Will bring together international community of scientists carrying out oceanographic observations, paleo studies and ocean and coupled climate modelling in order to discuss recent research findings and identify problems and ways forward.
Details: Andy Parsons, Natural Environment Research Council, Polaris House, North Star Avenue, Swindon SN2 1EU, UK. Fax: +44-1793-411545. Email: andy.parsons@nerc.ac.uk
On the Web: www.rapid.nerc.ac.uk|rapid2006|

12th Conference of the Parties to the UNFCCC & 2nd Meeting of the Parties to the Kyoto Protocol

Nairobi, Kenya
06-11-2006 to 17-11-2006
The next major meeting of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol.
Details: COP12, UNFCCC Secretariat, PO Box 260 124, D-53153 Bonn, Germany. Fax: +49-228-8151999. Email: info@unfccc.int
On the Web: www.unfccc.int

Global Environmental Change: Regional Challenges

Beijing, China
09-11-2006 to 12-11-2006
Conference is being organized by the Earth System Science Partnership (ESSP) which is a collaboration between DIVERSITAS, IGBP, IHDP and the WCRP. Intent of the 2006 conference is to present progress in understanding of the systems of global environmental change and to highlight the ESSP approach to the study of the earth system. Will also discuss integrated regional studies, global change in monsoon Asia, and science for sustainability.
Details: 2006 Conference Organizer, Institute of Botany, University of Basel, Schonbeinstr 6, 4056 Basel, Switzerland. Fax: +41-61-2673504. Email: gmba@unibas.ch
On the Web: www.essp.org|essp|ESSP2006|

Livelihoods in rural Bangladesh

Jennifer Pouliotte, Nazrul Islam, Barry Smit and Shafiqul Islam describe how livelihood diversification can influence adaptive capacities in rural Bangladesh

Masura lives in the rural village of Subarnabad in the southwest of Bangladesh. She owns no land, but rents a small piece from her father on which she has built a small mud home for her family. Since her husband left the village five years ago she is the household head and is, therefore, solely responsible for supporting herself and her daughter. To do this she works in a shrimp farm either pulling weeds or repairing embankments. This provides seasonal, part-time labour and pays only 35 taka (about 0.52 US$) a day. This wage income is supplemented by taking loans from her family or neighbours. She also takes care of the small number of livestock that she owns – two goats. When first visited, Masura had just finished repairing her straw roof from one of the many storms that blow in from the Bay of Bengal. She complained that she could not fully provide her daughter with basic needs such as nutritious food, adequate shelter, schooling and a dowry.

Current vulnerabilities in Subarnabad

Masura's story is like that of many of the poorest residents of Subarnabad, amongst whom, lack of money to provide for basic needs was repeatedly stated as a primary problem. This is related to the environmental changes that have been occurring during the last 25 to 30 years, and the resultant effects on people's environment, health and livelihoods. These changes include a more waterlogged environment, saltwater intrusion and changes in production systems from rice and other land-based crops to saltwater shrimp farming.

Villagers described the past when the area was dominated by rice and other land-based crops, common grazing lands and fresh water. Much of the food that was consumed in the village was grown in the area, either on large farms or small homestead gardens, and villagers relied little on wage incomes to provide basic necessities. These crops were traditionally the main source of employment and subsistence for the residents of Subarnabad, and the change to shrimp farming led to shifts in the livelihoods of many villagers. This change can be attributed to several factors, including the construction of coastal

MAIN POINTS

- **The authors** describe local vulnerabilities to environmental problems such as saltwater intrusion and shrimp farm introduction in rural Bangladesh.
- **They explain** how helping people cope with these environmental stresses can also enhance their adaptive capacity to climate change.
- **Enhancement and diversification** of livelihoods - common development activities - are key components of improving this adaptive capacity.

embankments in the south of Bangladesh, water diversion projects and attempts by successive Bangladeshi governments to liberalize and diversify the economy (shrimp farming is now Bangladesh's second largest export industry). It also reflects changes to the institutions and power relations that determine rights to land and water.

Although most healthy villagers work for a wage income, the labour required on a shrimp farm is much less than on a rice farm. Underemployment has therefore risen sharply and poor village residents lack sufficient land and/or other capital to begin their own shrimp farms. Masura's husband left due to poor employment opportunities in the area and is not expected to return.

The recent environmental changes in Subarnabad have had a number of implications for the poorest villagers. While economic gains from the proliferation of the shrimp industry are very important for the Bangladesh economy, associated environmental and social changes are a growing cause of concern. The increased reliance on a cash economy to provide for basic needs has meant that the poorest villagers have been exposed to new economic, social and cultural stresses. These include a reduction in affordable local food, common resources and livelihood options, and increases in financial expenses, underemployment, family disputes, women-headed households and difficulties educating and marrying off children. In general there has been a decrease in the diversity of livelihood options for the poorest villagers. Livelihoods used to be associated with rice production, livestock and homestead gardening, but these days they are increasingly dependent on shrimp production and related activities. This has important implications for local adaptive capacity.

Village of Subarnabad, southwest Bangladesh Photo: Jennifer Pouliotte

Saltwater intrusion in Subarnabad has also meant that the poorest villagers have been exposed to problematic conditions such as decreases in freshwater supplies, crop production and common resource availability, and increases in health problems and the fragility of mud homes. In the past, for example, access to renewable common property resources provided people with materials for fuel, fodder, building and food. Commonly available wood, shrubs and cow dung were used for cooking and heating. Mud, rice straw and palm leaves were used for housing construction. Grass and shrubs were used as animal fodder, and a variety of fruits were collected for food. The rice fields that were once widespread accommodated villagers'

livestock for grazing when lying fallow. Reduced livestock fodder meant villagers kept fewer cattle, which in turn provided less dung for fuel. Straw from the rice fields after the harvest was used as building materials for villagers' homes. Villagers said that in the past, excess rice from the harvest that was not used or sold by farmers was often given to the poor villagers.

Vulnerability and adaptation to climate change

Observations on environmental changes in the village, and people's ability to cope with these changes, provide insights about how they may be able to cope with future environmental change, including climate change. Concerns related to climate change in Bangladesh include sea-level rise, river flow and coastal geomorphology changes, and increases in cyclones, storms and saline water intrusion. These are expected to increase flooding risks, coastal zone soil erosion, stress on freshwater resources and human migration, as well as negatively affecting human health and disrupting agricultural production. Climate change may also threaten the shrimp farming industry in southwest Bangladesh, thus further jeopardizing the livelihoods of people who depend on this industry.

The United Nations Framework Convention on Climate Change commits parties to aid, develop and implement adaptation measures, particularly in vulnerable developing countries. It is increasingly recognised that effective climate change adaptation needs to be incorporated (or mainstreamed) into other development initiatives such as livelihood enhancement, poverty alleviation, environmental management and sustainable development. Although there has been much progress regarding the analysis of impacts and adaptations to climate change, and a recognition of the need for programmes and policies to implement and facilitate adaptation, to date there are very few practical 'on-the-ground' examples of climate change adaptation initiatives.

Initiatives that aim to contribute to adaptation practice now pay more attention to community-based, participatory approaches. These start with an assessment of current system vulnerability (for example the vulnerability of Subarnabad), and then examine the conditions that give rise to that vulnerability. The approach does not assume who is vulnerable and to what, but identifies the stresses and the nature of vulnerabilities based on information provided by the community. Although climatic conditions may acutely affect people's circumstances, they represent just one of the many stresses that people have to cope with now and in the future. Climate change is, therefore, considered in the context of other changing conditions and immediate needs, and climate change adaptation is viewed as something to be integrated into existing policies, management regimes and community priorities. By structuring adaptation initiatives to address existing vulnerabilities and to increase adaptive capacity, they should bring immediate benefits and strengthen people's ability to deal with future threats.

> **"effective climate change adaptation needs to be incorporated (or mainstreamed) into other development initiatives"**

Livelihood strategies and adaptive capacity in Subarnabad

Livelihoods influence exposure and sensitivity to current and future environmental stresses, including climate change related stresses. The ability of livelihoods to withstand shocks and stresses contributes to people's adaptive capacity to deal with climate change, and livelihoods influence people's capacity to build up assets to protect against future risks. Livelihoods can also be a strategic entry point for adaptation by considering local perspectives, capacities and priorities. Strategies to decrease vulnerability can thus be based upon an understanding of how people currently sustain their livelihoods.

Subarnabad residents are resourceful and

have adopted an array of adaptation measures to cope with the changing conditions associated with saltwater intrusion. Certain segments of the population are, however, more resilient than others. When shrimp farming was initially introduced to the area, this offered new livelihood opportunities. The large landowners saw it as a means to increase their profits. Better-off groups were still adversely affected by the changes, but they had more capacity to take advantage of them and more resources to protect themselves from stressful conditions.

Small landowners and other poor and disadvantaged groups could not benefit from the new conditions. The adaptive strategies that the poorest villagers employed to cope with saline water intrusion and associated stresses were mainly autonomous (without government or non-government organization intervention), undertaken by either the individual or household. Taking a loan was the most widely employed strategy. These loans paid for food, children's education, repairing homes or providing dowries for daughters. Other adaptive strategies included selling or leasing a small piece of land, increasing the number of family members working for a wage income (generally women or children), decreasing food intake, working outside the village, using fertilizers, selling livestock, raising goats as an alternative to cattle, theft and prostitution.

These adaptation initiatives addressed immediate needs, but did not generally improve people's adaptive capacities. Poverty and little or no access to fertile agricultural land resulted in few opportunities for the poor to escape their circumstances. Limited economic opportunities outside of the shrimp industry often prevented the pursuit of alternative livelihoods.

Subarnabad resident collecting crabs from her pond Photo: Jennifer Pouliotte

In Subarnabad this issue is being addressed by the Institute of Development Education for the Advancement of the Landless (IDEAL) within a larger project called Reducing Vulnerability to Climate Change (RVCC), funded by the Canadian International Development Agency and implemented by CARE Canada via CARE Bangladesh. IDEAL is one of a dozen non-government organizations involved in the RVCC project. It is a local organization, working directly with poor rural villagers for the broad purposes of environmental conservation, and establishing caste, class and gender equity within its working area. Through this project, IDEAL has been implementing adaptation to climate change initiatives in 12 villages.

The initiatives promoted in Subarnabad are generally new livelihood strategies for income and food generation. They include goat, duck and hen rearing, chicken and crab farming, tree planting, introduction of saltwater tolerant vegetable gardens and handicraft production. IDEAL has also helped raise awareness about climate change, personal

hygiene, sanitation and the construction of latrines and deep tube wells.

Villagers who are also group members of IDEAL can access loans, a savings bank, and training and technical support for new livelihood strategies. For example, through the RVCC project, IDEAL has been helping villagers establish small crab farming enterprises – a viable activity in a saline environment. Villagers purchase young crabs from the local market, raise them in saline ponds until they are mature, and then sell them for profit. Initiatives are still in their early stages, but villagers who were involved in these or similar activities felt they were successful. They were able to slowly pay off their loans and had begun to make some profits. The initiation of adaptation strategies by some residents also increased other villagers' willingness to try new activities. As people learnt about their neighbours' successes, they were willing to try measures that would otherwise have been deemed too risky. Organizations can be critical mediating factors for livelihoods since they can inhibit or facilitate the adoption of new adaptation initiatives. In Subarnabad, villagers' access to IDEAL and its projects strongly affected the villagers' ability to adopt new livelihood activities.

In Subarnabad, vulnerability is inherently connected with people's livelihoods. Adaptation initiatives undertaken by IDEAL, facilitated through the RVCC project, are sustainable development initiatives that address pressing community needs, and they are also adaptive strategies that reduce vulnerability to climate change. Promoting initiatives that enhance and diversify livelihoods may be seen as 'business-as-usual' in the field of development, but initiatives such as those in Subarnabad are still uncommon in the climate change field. By addressing local vulnerabilities and concerns, and building capacities in a broad sense, these initiatives can provide practical, effective and contextually-relevant ways to decrease vulnerability and facilitate adaptation to climate change within the context of ongoing development processes. Enhancing and diversifying livelihoods is a key component of this. ■

ABOUT THE AUTHORS

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Low coastal zone settlements

Gordon McGranahan, Deborah Balk and Bridget Anderson describe the distribution of human settlements in low elevation coastal zones around the world

About one person in ten lives in a coastal zone at less than ten metres of elevation, although this low elevation coastal zone (LECZ) only accounts for about 2.2 per cent of the world's land area. Human settlement has long been drawn to coastal areas, which provide many resources and trading opportunities, but also expose residents to various hazards. The hurricane hitting New Orleans in the United States in 2005 provided a well-publicized demonstration of how vulnerable even comparatively affluent settlements can be.

Some coastal hazards, including sea-level rise and extreme weather events, are expected to increase as a result of climate change. Yet increasing trade and market-driven movements are still attracting people to the coast. The coastal provinces of China, for example, experienced a net in-migration of about 17 million people between 1995 and 2000, creating pressures in an already crowded area. Globally, coastal zones have higher population densities than any other major ecologically defined zone, except for urban zones themselves. Small island states are raising public awareness of coastal vulnerabilities, but this article shows that significant populations of many other countries also live in potentially vulnerable low elevation coastal zones.

MAIN POINTS

- **The authors explain** how one person in ten lives in a coastal zone at less than ten metres of elevation.
- **Low-income countries** and Least Developed Countries have particularly high shares of their overall populations in low elevation coastal zones.
- **It is concluded** that, whilst small island states are raising awareness of coastal vulnerabilities, many people in larger countries also live in coastal zones and are potentially vulnerable.

This article calculates population and land area in the LECZ by overlaying gridded geographic data and constructing totals within the zone by country. We define the LECZ as contiguous land area up to 100 kilometres from the coast that is ten metres or below in elevation. All data are expressed at one kilometre resolution (see data sources on page 26).

The LECZ contains some ten per cent of the world's population and 13 per cent of the urban population. This amounts to about 600 million people, of which 360 million are urban. There is considerable variation between countries in the shares of population, land and urban settlement in this LECZ. Thus, of the 215 countries for which there are data on all of the principal indicators being presented in this article, 39 are landlocked countries with none of their population living in the LECZ, while 19 have more than 50 per cent of their population in this zone (ten

POPULATIONS AND LAND AREAS IN THE LOW ELEVATION COASTAL ZONE BY REGION

	Populations and land areas in the LECZ				Shares of population and land in the LECZ			
Region	Population (10^6)	Urban population (10^6)	Land (10^3 km^2)	Urban land (10^3 km^2)	Share of regional population	Share of region's urban population	Share of region's land	Share of region's urban land
Africa	55	40	206	15	8.2%	14.5%	0.9%	7.9%
Asia	438	232	819	109	12.3%	17.7%	3.3%	11.7%
Europe	48	38	459	54	7.1%	8.1%	2.1%	7.0%
Latin America	28	22	372	32	6.1%	6.9%	2.0%	6.6%
Austrialia/New Zealand	3	3	134	6	13.8%	14.4%	1.7%	13.4%
North America	25	22	523	52	7.8%	8.5%	2.8%	5.9%
Small island states	6	4	56	5	13.1%	14.0%	16.3%	13.1%
World	602	361	2,571	274	10.5%	13.5%	2.2%	8.2%

Note: The regions are based on, but not identical to, the IPCC regions. Countries not included in the Intergovernmental Panel on Climate Change (IPCC) list were assigned to one of the IPCC regions. Russia, which is split into two regions by the IPCC (Europe and Asia), is entirely attributed to Europe. The small island states region has 66 members, some of which are not listed as small island states in the IPCC regional listing.

of these are small island states).

Information presented here relies heavily on summary statistics for country groupings. These hide much of the variation within groupings. The table above provides a selection of statistics by region. In absolute numbers, Asia accounts for about a third of the world's land in the LECZ, but because of far higher population densities it accounts for almost two thirds of the urban population, and three quarters of total population in the zone. The region with the highest share of its total land area in the zone is the small island states region with about 16 per cent – roughly five times the share in Asia. On the other hand, the share of the total and urban populations of the small island states that are in the zone are only slightly more than the world average. Africa, the only region with less than one per cent of its land in the zone, and one of the lowest population shares in the zone, has over 14 per cent of its urban population in the zone.

In addition to geographic location, a country's vulnerability to coastal hazards depends in part on its per capita income. The table on page 25 provides summary statistics for countries grouped according to the World Bank's national income classification (the world totals are slightly less in this table due to missing income data). The low-income group has a higher share of its population living in the LECZ than the world as a whole, and the highest share of urban population of any group. Overall, there are about 246 million people in low-income countries living in the zone, of which some 107 million are urban.

In climate change negotiations, the Least Developed Countries – a group of about 50 very low-income countries – are explicitly recognized as vulnerable to climate change. This group also has a particularly high share

of its population and urban population in the LECZ (16 and 23 per cent respectively), despite a comparatively modest land share (1.7 per cent). Organization for Economic Cooperation and Development countries, by contrast, only have ten per cent of their overall population and 11 per cent of their urban population in the zone, with about 2.7 per cent of land in the zone.

As indicated above, these averages hide a great deal of variation, with some countries having far larger shares or quantities of land and population in the zone than others in the same group. Figures for the Least Developed Countries, for example, are heavily influenced by Bangladesh, which accounts for over half of the group's population in the LECZ.

The table on page 26 presents the ten countries with the largest populations in the LECZ and the ten with the largest population shares in the LECZ. The top ten in terms of population are mostly large Asian countries with significant delta regions. The LECZ's of these top ten countries combine to account for about 435 million people, or about 72 per cent of the people who live in the zone globally. The ten countries with the largest share of their population in the zone are a different set from those with large populations in the LECZ, with the exception of Bangladesh and Vietnam (shaded blue in the table).

Several features can lead a country to have a large share of its urban and rural populations in the LECZ. These include long coastlines (relative to the country's size), wide and heavily populated coastal lowlands and sparsely populated interiors. The results suggest that these factors relate to three different types of countries. There are the islands, such as the Maldives and the Bahamas, with their very long coastlines. There are countries with large delta regions and heavily populated coastal lowlands, such as Vietnam and Bangladesh. And there are a few countries, like Suriname and Guyana, with sparsely inhabited interiors and populations concentrated in a small coastal strip.

The vulnerabilities faced by these different types of countries are also likely to vary. Many urban and rural inhabitants of the LECZ live in countries with large delta regions. It is too early to say whether settlements in such regions contain most of the population vulnerable to the coastal hazards associated with climate change. These results do, however, illustrate the importance of looking beyond the small island states.

POPULATIONS AND LAND AREAS IN LOW ELEVATION COASTAL ZONE BY NATIONAL INCOME CATEGORY

	Populations and land areas in the LECZ				Shares of population and land in the LECZ			
Income category	Population (10^6)	Urban population (10^6)	Land (10^3 km^2)	Urban land (10^3 km^2)	Share of group's population	Share of group's urban population	Share of group's land	Share group's urban land
Low	246	107	646	36	11.0%	15.6%	2.7%	9.0%
Lower middle	209	128	653	65	9.9%	14.1%	1.6%	7.6%
Upper middle	36	29	375	40	7.8%	8.9%	1.9%	7.6%
High	107	93	890	129	11.7%	12.6%	2.9%	8.3%
World	598	357	2,563	270	10.4%	13.4%	2.2%	8.1%

COUNTRIES WITH LARGEST POPULATIONS AND POPULATION SHARES IN THE LECZ

Countries ranked by population in the LECZ – top ten			Countries ranked by share of population in the LECZ – top ten		
Country	Population in LECZ (10^3)	% of population in LECZ	Country	Population in LECZ (10^3)	% of population in LECZ
1. China	127,038	10%	1. Maldives	291	100%
2. India	63,341	6%	2. Bahamas	267	88%
3. Bangladesh	53,111	39%	3. Bahrain	501	78%
4. Indonesia	41,807	20%	4. Suriname	325	78%
5. Vietnam	41,439	53%	5. Netherlands	9,590	60%
6. Japan	30,827	24%	6. Macao	264	59%
7. Egypt	24,411	36%	7. Guyana	419	55%
8. United States	23,279	8%	8. Vietnam	41,439	53%
9. Thailand	15,689	25%	9. Djibouti	250	40%
10. Philippines	15,122	20%	10. Bangladesh	53,111	39%

Note: Countries with less than 100,000 people living in the LECZ are excluded. Fifteen small island states that are excluded have population shares greater than 39 per cent in the LECZ, and a combined population in the LECZ of 423,000.

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FURTHER INFORMATION

● **On the Web:** Estimates of year 2000 population, urban area and land area are based on the Global Rural Urban Mapping Project at http://sedac.ciesin.columbia.edu/gpw. Elevation data is from www2.jpl.nasa.gov/srtm/. World Bank national income classification data is at http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/0,,contentMDK:20420458~menuPK:64133156~pagePK:64133150~piPK:64133175~theSitePK:239419,00.html. Least Developed Country information is at www.un.org/special-rep/ohrlls/ldc/list.htm

A GAUNT VIEW

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US evangelicals and climate change

Every now and then significant encouragements emerge from unlikely places. In early February, the United States (US) National Association of Evangelicals (NAE), with 30 million members, stated "as evangelical leaders, we recognize both our opportunity and our responsibility to offer a biblically based moral witness that can help shape public policy in the most powerful nation on earth and therefore contribute to the wellbeing of the entire world… Many of us have required considerable convincing before becoming persuaded that climate change is a real problem and that it ought to matter to us as Christians. But now we have seen and heard enough."

THE FINAL WORD

Sam Berry describes how American evangelicals are beginning to see their biblically based responsibility for 'creation care'

The statement made four claims: human-induced climate change is real; the consequences of climate change will be significant and will hit the poor the hardest; Christian moral convictions demand our response; and, governments, businesses, churches and individuals all have a role to play in addressing climate change – starting now.

These claims were immediately challenged by an 'Interfaith Stewardship Alliance', welcoming global warming on the grounds that it will lead to increased agricultural productivity and that the poor will be the most affected by measures to mitigate climate change. However, two-thirds of US evangelicals are convinced that climate change is taking place, and 54 per cent believe that a person's Christian faith should encourage them to support environmental action.

The NAE accepts that "mankind has a sacred responsibility to steward the earth and not a license to abuse the creation of which we are a part." The path that led to this acceptance began in Oxford in 2002, when the John Ray Initiative (www.jri.org.uk) hosted leading scientists, policy-makers and Christian leaders from six continents to address the growing crisis of human-induced climate change. Richard Cizik, Vice President of Government Affairs for the NAE, was present, "dragged there by Jim Ball of the Evangelical Environmental Network" (and coordinator of the What Would Jesus Drive campaign). Faced with the evidence, Cizik says he had a 'conversion' on the subject so profound that he likened it to an 'altar call'. Since then, he has worked hard to convince the US evangelical community that creation care is a core Christian responsibility. He has not been unsuccessful.

The call from the Evangelical Climate Initiative (www.christiansandclimate.org) concludes, "we pledge not only to teach the truths communicated here but also to seek ways to implement the actions that follow from them. In the name of Jesus Christ our Lord, we urge all who read this declaration to join us in this effort". I can only add, 'Amen'.

Sam Berry moderates the Environmental Issues Network of Churches Together in Britain and Ireland. He is a former President of the British Ecological Society and of Christians in Science. **Email:** rjberry@ucl.ac.uk