The Greenhouse Effect : Economic Impacts and Policy Options

by Fahmida Akter

THE global climate is changing, this change threatens the humanity with a major environmental impact. The late 1980s have seen an unprecedented but growing concern about global warring or greenhouse effect. Greenhouse effect is often perceived as a problem of carbon dioxide emission. Yet several different gases, arising from a wide range of human activities, make significant contributions.

To understand the greenhouse effect we have to know a little bit of science. The earth receives most of its energy from the sun's radiation. The wavelength of the radiation emitted by a body varies with its absolute temperature. The warmer a body is the shorter will be the wavelength of its radiation. The sun has an approximate temperature of about 6000 k and radiates energy mostly in the form of visible light and ultraviolet rays.

However, solar radiation forms only a part of the total radiation received by objects on the earth. Sixtyeight per cent of the radiation they receive is from the earth (which has an approximate temperature of 285k) and atmosphere and consists largely of infrared waves.

Some of the infrared radiation escapes from the earth into the troposphere. The proportion that so escapes is reduced by the presence of certain gases in the atmosphere principally carbon dioxide (co_2, 50 per cent), nitrous oxide (N_2O, 6 per cent), methane (CH_4, 18 per cent) chlorofluorocarbons (CFCs, 14 per cent). Tropospheric ozone, stratospheric water vapour and other gases comprise the rest 12 per cent. Thus the "greenhouse effect" is created in the troposphere, on account of the presence of these gases which are termed as greenhouse gases.

The anthropogenic sources of these gases are many and varied. Sources of the main gases are summed up in the table.

Atmospheric CO_2 concentration has increased phenomenally from the pre-industrial level of about 280 parts per million by volume (PPMV) in 1750 to about. 315 ppmb in 1958 and to about 380 today. Recent evidence suggests that the increased emission of trace gases will significantly add to any CO_2 greenhouse effect.

As a result of increases in those economic activities which emit greenhouse gases, the concentration of these gases are projected to increase quickly. Thus within the next 50 years, the radiative effect of the trace gases may exceed that of the increasing CO_2 concentration, CFCs in particular will have an increasingly important impact, second only to CO_2, on the greenhouse effect.

By adding to the warming effect of trace gases, the equivalent of such a doubling in CO_2 would occur as early as 2030. By then, as a best gases, we could experience an actual temperature change of 1.0^0C-2.1^0C warmer than today, and because of the lag effect due to the thermal inertia of the ocean, we could be committed to an eventual temperature change of 1.5^0C-3.1^0C warmer than today.

If the above scientific consensus is accurate, there will be some economic and environmental consequences. To date, most attention has been focused on the effects on agriculture, as this activity is directly altered by changes in climate. This is rather a short-term effect. But increasingly concern has been expressed about the possible implications for forest zones and about the effects of a sea-level rise which may occur in the long-run.

Greenhouse gases and their main anthropogenic sources.

Carbon Dioxide (CO_2)	Fossil fuel burning; Deforestation and land use changes; cement manufacture.
Methane (CH_4)	Rice paddy cultivation; Ruminants (e.g. cows, sheep); Biomass (wood, wastes etc.) burning and decay.
Chlorofluorocarbons (CFCs)	Manufactured for solvents, refrigerants, aerosol spray, propellants, foam packaging etc.
Nitrous Oxide (N_2O)	Fertilizers; Fossil fuel burning;
Nitrogen Oxides (NOx)	Land conservation for agriculture; Fossil fuel burning.
Non-methane Hydrocarbons	Evaporation of liquid fuels and solvents;
Carbon Monoxide (CO)	Fossil fuel and biomass burning

The regions which are at risk from global warning resulting from a greenhouse effect include :

— the irrigated semi-arid areas of northern mid-latitudes, particularly in the US Midwest;

— the lowland areas and island countries of the humid tropics in Asia, the Pacific and the Caribbean that are susceptible to excessive precipitation, violent storms and flooding;

—the arid and semi-arid tropic of Africa, South Asia and the Mediterranean climate of West Asia and the North Africa that are already vulnerable to climate variability;

rainfed upland and highland regions, particularly with poor soil conditions; and

—livestock raising in extreme northern latitudes;

Global warming may also cause change in some of the world's major river systems (Brahmaputra in case of Bangladesh). Changes in the flows or storage capacities of these rivers would result in either less surface and underground flow or more frequent flooding which could be disastrous for irrigated agriculture. In many countries irrigated agricultural systems have been intensively developed in correspondence with the precise seasonal variations of delta flooding and run-off.

Changes in seasonal flows would mean severe disruptions in cultivation. Moreover, many river systems do not have adequate water control and management facilities to cope with any variations in flooding or underground storage. For example, in the lowlands of the humid tropic, the result could be destructive flooding in the vast delta networks of Thailand, Laos, Cambodia, Vietnam, India, China and Bangladesh.

So, the economic impact of any greenhouse effect will most likely be in terms of the rising costs of agricultural displacement and adoption in the face of climate instability with potentially grave consequences for the pattern and distribution of global food production and for food security in many developing countries.

As a result, sustaining even minimum nutritional standards for millions of people in the Third World will require a surplus in the world agricultural production and the availability of that surplus to the Third World in the form of food or aid import.

The impact of climate change on the world's major ecosystems would also affect human welfare. This is particularly true for major forest systems. For example, the boreal forests found at higher northern latitudes may be particularly vulnerable. For the mid-latitude temperate forests in the Northern Hemisphere, a high rate of warming of 0.8^0-1^0C per decade will have major impacts — including large-scale forest dieback between 2000 and 2050. The result will be that more and more production forests would need replanting and increased management.

Furthermore, there will also be impacts on recreational values if important national parks an wildlife habitats are decimated. There could also be dramatic impacts on the major rain forests of the world, such as the extensive Indonesian, Amazonian and Central African tropical forest systems.

In the long-run, the possibility of a rise in global sea-levels has been accepted seriously by many scientists. Even a one-metre rise would require expenditures of between US dollars 10 and US dollars 100 billion to maintain threatened beaches and coastal areas on the Eastern Coast of the USA. Low-lying, densely populated countries — such as Bangladesh and the Netherlands — will be particularly affected.

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Other direct impacts include decreased availability of fresh water due to salt-water intrusion, greater exposure to salinization and increased risk of sea surge and storm damage.

A rise in sea-level means that less land would be available for food production which would result in extensive food shortage, greater risk of malnutrition and health problems. Island population would most certainly have to be moved from coastline areas either by in — country migration from low to high islands or to urban centres or to continental countries.

With such a potentially vital future problem, there is a call for taking measure. Two types of measures are suggested in this regard. One is adaptive and the other is preventive.

Adaptive measures include 1) development of a global food security system 2) provision of additional financial assistance to developing countries 3) allocation of development funds to Third World countries in order to expand food production and to develop a sustainable agriculture 4) a greater international effort to halt the trend of accelerating global desertification 5) a commitment to humane method of curbing population growth where it inhibits development.

On the otherhand, preventive measures would include 1) reducing burning of fossil fuel, particularly through the development of non-fossil fuel energy sources and through improvements in the efficiency of extracting useful energy from fossil fuels 2) reducing emission of trace gases from other anthropogenic sources 3)increasing pollution control and developing technological processes to scrub, recover and recycle the carbon and other trace residuals emitted when fossil fuels are burnt 4) halting unnecessary tropical deforestation through alternative development strategies and incentives 5) increasing the rate of replanting in deforested areas, encouraging afforestation and improving forest management.

To make any major impact on reducing carbon and trace gas emissions quickly would require rapidly implementing the above measures and would necessitate diverting resources from economic activity. This could result in some decrease in short-term economic growth. But in the long-run it would save energy costs.

One final point, the potential of global warming is plagued with uncertainties in terms of climate change and sea-level rise which calls for further research and is followed by rigorous analysis of the policy options. This in turn requires the continuation of international co-operation if the world has to survive.

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Juba Turns Its Wasteland Lavatories into Farms

by Modi Bulson De Kiden

IN the midst of Sudan's civil war, the besieged people of Juba have turned faeces-ridden wasteground in the city into food plots.

The greening of the capital of Equatoria state, 1,200 kilometres (746 miles) from the capital Khartoum, is the result of efforts by the state ministries of agriculture and education and a group of non-government organisations (NGOs).

The first attempt at an environmental clean-up came almost a decade ago, when the local Directorate of Forestry launched a tree-planting and beautification campaign.

By 1990, thousands of Juba residents had planted trees, mainly eucalyptus and neem, around their homes. But as shelling by soldiers of the rebel Southern People's Liberation Army (SPLA) was stepped up, and emergency food supplies from Kenya and Uganda became scarcer, residents were encouraged to plant foodcrops. (The SPLA is fighting for a bigger say in the central government, dominated by Muslim Arabs from the north, for the predominantly Christian and animist African southerners.)

The Red Cross, the British and Canadian NGO consortium Acord and several church-affiliated NGO supplied seeds and implements.

"These inputs helped transform Juba's former open-air latrines into green gardens," said one resident. They were also used to increase agricultural output in areas around the town not under rebel control, ecompassing a radius of 15-20 kilometres (9-12 miles).

One of two Southerners in the central Government Cabinet, Father George Kinga, said after visiting Juba recently that wherever he drove his car was trespassing on people's groundnuts, maize, beans and sorghum. "Nearly every available space has been cultivated," he commented. This has helped hold down food prices for the city's estimated 400,000-500,000 people.

The Juba Directorate of Agriculture estimates that about 90 per cent of open spaces have been cultivated with such crops, as well as surrounding areas.

The state Minister of Agriculture and Natural Resources, Caesar Baya, told the local Assembly that the city was producing about one-third of its basic food requirements, though this was less than the Ministry's original forecasts.

Those reaping the urban harvest are now confronted with a new problem: fending off thieves. Several suspected thieves have been shot dead by farmers.

Much popular blame falls on the 7,000 Toposa nomads who have taken refuge in Juba and are camped in appalling conditions in an old boatyard. Lack of food and proper sanitation led to the deaths of about 2,500 of them, according to government social worker Elly Abudraga Ramadhan.

Medical officers say the cultivation of open spaces has also cut down the number of flies. Said James Laku Wani, a medical assistant at Juba Teaching Hospital: "These places were breeding grounds for flies and a health hazard." He believes that most diarrheal diseases in Juba were a direct result of the excreta-filled spaces.

The afforestation and beautification drive has also been resurrected, which has also helped provide much-needed building poles and firewood.

But some reserves have been damaged by military activities and by fires, and the Forestry Department reckons that three-quarters of the families in Juba each consume about 250 kilograms of firewood a month — which, Yupet stresses, is "an alarmingly rapid rate" to keep up with.

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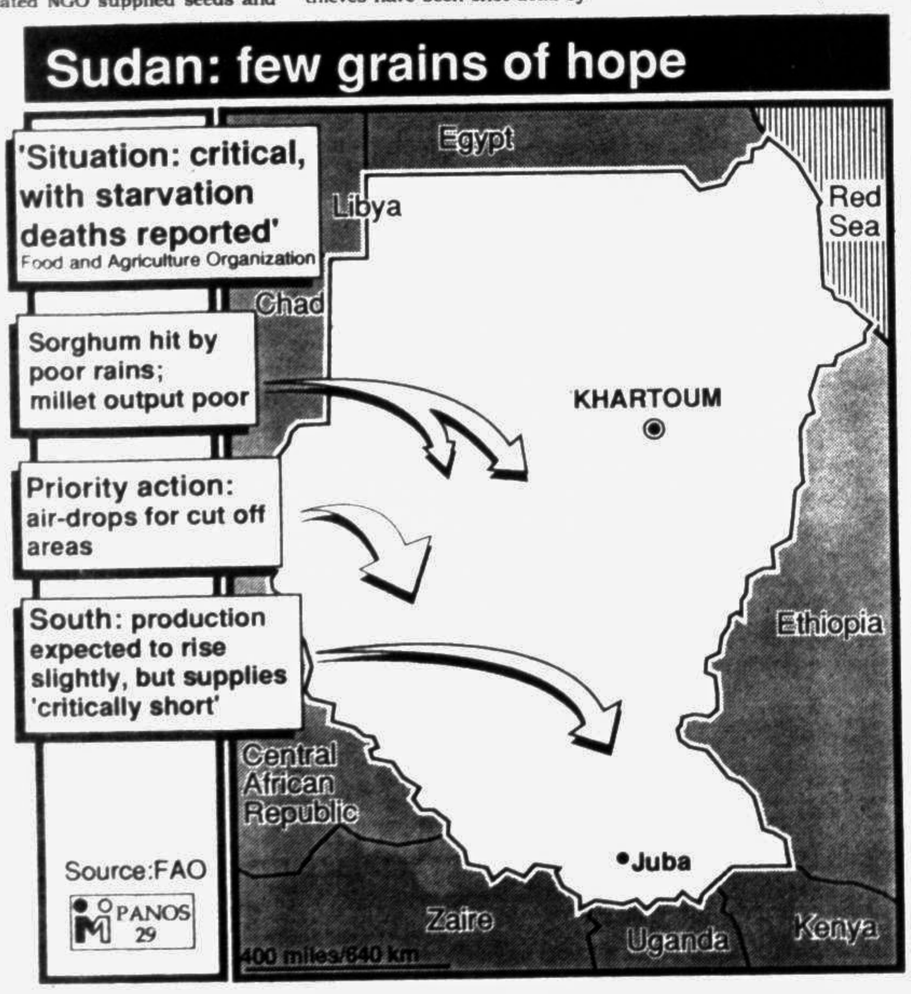

Fragile Islands of Maldives

by Mary Lynn Hanley

Heavenly Islands of Maldive face environmental threat.

A large imposing monument sits in the middle of a square on the island of Male, the capital of Maldives.

It is not a statue of the founder of the country, nor a military hero on horseback. Rather, it is the likeness of a large tetrapod, or four-pronged building block — the kind used to construct the sea wall which shields the island from the surrounding Indian Ocean.

For Maldives, the oceans is the greatest threat as well as its greatest asset. It provides a basis for the thriving tourist industry, now the largest earner of foreign exchange, as well as the fish and seafood which sustain the population and constitute the main export. But the waters also hold an ever-present danger.

People still talk about the giant waves which engulfed Male in 1987, flooding two-thirds of the capital and causing more than US $40 million worth of damage. Severe storms hit the islands again this June, rendering 10 per cent of the nation homeless and inflicting damages estimated at $ 30 million.

An even greater catastrophe may be in the offing for the low-lying archipelago if the worst-case global warming scenario comes to pass. Some scientists predict that warmer temperatures could cause ocean levels to rise, since molecules in warmer water expand and icebergs could melt.

It this happened, as most of the islands of the Maldives rise only one or two metres above sea level, the country could disappear entirely within the next hundred years.

"Some people have asked whether we are making plans to move our entire population," says Hassan Sobir, Deputy Minister of Planning and Environment. "That is something that we do not look forward to." While international specialists debate long-term possibilities, Maldives is concentrating on the immediate practical matters it has the ability to control.

The government intends to further develop fisheries and tourism, to increase agricultural production, to train a skilled work force, and to improve living conditions. These efforts receive support from the United Nations Development Programme (UNDP). Underlying them is the firm conviction that development and the environment are linked.

Straddling the equator, to the south-west of India and Sri Lanka, Maldives is made up of 1,200 small islands, 202 of which are inhabited by the nation's 214,000 citizens. While the country extends over 90,000 square kilometres, its land surface is no more than 298 square kilometres.

The islands are grouped into atolls, or necklaces of islands surrounding a lagopn. Most are no more than one kilometre in length.

Balmy temperatures, crystal clear waters and pristine sandy beaches ringed by tall coconut palms have made Maldives an increasingly popular tourist haven. So far the government has turned 50 uninhabited islands into resorts, separating vacationers from the general population, which is Sunni Moslem and of mixed Sinhalese, Indian and Arab stock.

The annual number of visitors has reached 200,000. They bring in $80 million in foreign exchange, though much of this goes out again due to the need to import most of what the tourists require.

"There is no acute poverty here", says Mohammed Farashuddin, UNDP resident representative. "People have their basic minimum requirements". Over 90 per cent of minimum daily calorie intake is met. The adult functional literacy rate is over 95 per cent. Communications are well developed with inhabited island linked by high frequency telephone or radio facilities.

Transport is more of a problem. "Dhoanis", the traditional boats used for fishing and transporting people and goods, regularly travel back and forth among the islands. Most are privately owned.

Only a few are mechanized, however, and a trip from Male to some of the inhabited southern islands can easily take five days.

Despite recent advances, Maldives remains one of the countries the UN classifies as "least developed". Yearly per capita income in Male is $1,100, but only $400 in the outer atolls. At least 90 per cent of the goods consumed are imported, as well as all capital goods.

Apart from a few garment factories in the south there is virtually no manufacturing. The only indigenous activities are fishing, agriculture, and cottage industries. There is also an acute shortage of skilled labour, requiring the use of many foreign workers. Nearly 50 per cent of the population is under 15 years of age.

As it is growing at the rate of 3.7 per cent yearly, the number of Maldivians could double within the next 20 years.

Keeping the environment intact for the coming generations is the challenge the government is squarely confronting. "In some of the projects we have undertaken we have not been very careful about the environment," says Mr. Sobir. "Sometimes we have been breaking up our reefs and using the coral for building purposes.

"We are now identifying areas where people should not be taking coral." The reefs provide a home for bait fish and protect islands from waves. Once mined for constructing houses and sea walls, coral takes many years to grow back.

"We also have guidelines on waste disposal and the storage of hazardous wastes," says Mr. Sobir, adding that the government will clear all future public and private sector projects to ensure that they are environmentally sound.

Male and the outer atolls have different development needs. The capital's main problem is its growth. Sixty thousand people are already crammed into an area of 1.6 square kilometres. Since there is no more room to expand, the government plans to develop the neighbouring island of Vilingili, only a few kilometres away, as a satellite town to take the overflow.

Another problem concerns the 28 tonnes of garbage Male generates each day. A UNDP-funded study conducted by the UN Centre for Human Settlements (HABITAT) determined that recycling is not the answer since the bulk of the refuse is non-recyclable household waste.

Instead, garbage will be collected at night, placed into containers, and transported to the airport island across the lagoon where it will be used as landfill for a planned expansion.

Dumping sites will be closely monitored for any biological or chemical seepage.

Johamed Jabir, Chief of Meemu Atoll, speaks for the majority of Maldives' atoll chiefs in naming his priorities. "We want to construct jetties," he says. "We must prevent coastal erosion and build water tanks.

We need to deepen island passages." The deeper channels are needed to make the islands more accessible.

In many parts of Meemu Atoll the lagoon is so shallow that dhoanis must be anchored more than a kilometre from shore, where supplies and passengers destined for the islands are transferred to small rowboats.

Mr. Sobir must weigh the atolls' needs against their environmental implications. "To make entries for harbours we need to blast the reef," he says. "We have guidelines on how much we should do." UNDP is providing several fellowships for environmental studies abroad to train additional Maldivians to make these vital decisions.

Agriculture is of varying importance for the atolls. Some islands can support little vegetation beyond breadfruit and pandanus, a sweet, fibrous fruit distantly related to the pineapple.

Others, endowed with better soil, cultivate a variety of fruits and vegetables, including mangoes, bananas, papayas, watermelons, limes, yams, squash, pumpkins, chilies, sweet potatoes and taro.

Mohamed Zuhair, Assistant Director of Planning and Environ-ment in the Ministry of Agriculture and Fisheries credits some gains in production to the UNDP-supported Integrated Atoll Development Project.

Executed by UNDP's Office for Project Services, it works in both Maldives and the Pacific. "Although most income still comes from fishing," he says, "we now find some people who are virtually dependent on the soil." The project has also helped to raise consciousness about the need to include vegetables in the diet.

Among the farmers who have benefited from training, seeds and agricultural tools is Aishath Ada, a resident of the island of Mulah in Meemu Atoll.

Proudly displaying her giant squash and watermelons, she recalls her battle against insects, which she was taught to control using natural methods such as treating plants with solutions of water mixed with pounded chilies or tobacco leaves.

"We don't encourage the use of insecticides because of the fragile conditions," says Mr. Zuhair.

Looking to the atolls for a future source of skilled labour, as well as for locations for new industries, the government is planning to create regional growth centres. "It is very difficult for a small country like ours with minimal or non-existent resources to develop 202 islands for habitation," says Mr. Sobir.

"We would have to provide generation capacity, waste disposal facilities, telecommunications, hospitals, schools — all this on every tiny dot." Instead they will try to attract people to the larger islands by equipping them with these amenities.

A major fisheries project is already planned for Huvadhu Atoll in the south, said to be the largest atoll in the world. Maldives already exports some frozen fish to canneries in Thailand and the dried Maldives fish" produced by women on the atolls is a highly prized delicacy in Sri Lanka.

But total fish exports of 30,000 metric tonnes a year will be considerably augmented by the new project, which will set up additional cold storage facilities for the export of frozen fish.

Estimated costs are $28 million to $30 million, with investment coming from a consortium of donors including Norway and the International Development Association. "It has become very expensive because of the environmental concerns," says Mr. Sobir. "We are not allowing any mining of coral for this project. All building materials will have to be imported." Also to be provided is equipment to clean up possible oil spills from the ships that will be coming in to load fish and unload fuel.

Finally, there is Maldives' campaign to involve the public in environmental protection, notably through the media. But while the islanders are putting forth their best efforts to protect their fragile ecosystem there is little they can do about their country's long-term fate.

— UNDP.