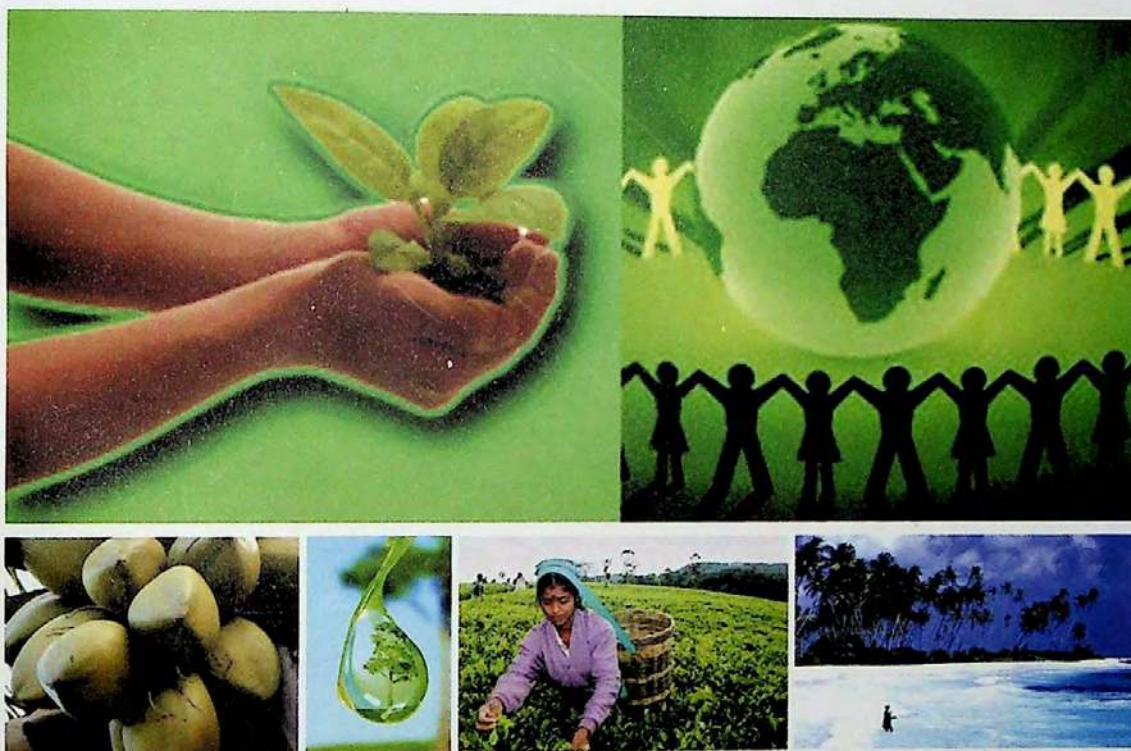




January to December 2012

Climate Change Issues in Sri Lanka



A Collection of Articles from the IPS CLIMATEnet BLOG

Research, Inform, Impact. A Publication by the Institute of Policy Studies of Sri Lanka

January to December

► Taking Forward the Climate Change Discussion in Sri Lanka	2
► Impacts of Global Climate Change on Inclusive Growth in Sri Lanka	3
► Our Water and Climate Change	4
► Impact of Climate Change on Agriculture in Sri Lanka	5
► Impact of Climate Change on Agriculture in Sri Lanka and Possible Response Strategies	7
► Traditional Rice Farming in Sri Lanka: Still Viable with Climate Change	10
► Combating Adverse Impacts of Climate Change on Tea Production in Sri Lanka with "No-Regret Strategies"	11
► Potential Impacts of Climate Change on Coconut Crops in Sri Lanka	12
► Assessing the Risk of Sea Level Rise: The Way Forward for Sri Lanka	14
► Climate Change and Coral Reefs in Sri Lanka	16
► Post-Copenhagen and Sri Lanka	18
► Rio+20: Towards a 'Green Growth' Path	19
► National Climate Change Policy and the Role of Citizens in the Post-Durban Era	21
► The Rio+20 Conference on Sustainable Development	24
► Human Development Report 2011 A Review	26
► Human Development Report 2007-2008 A Review	28
► IPS Research Studies on Climate Change	31
► IPS Contribution to Policy Making	32
► IPS Climate News	33



RIO+20
United Nations
Conference on
Sustainable
Development



The Institute of Policy Studies of Sri Lanka (IPS) is an autonomous institution that aims to promote policy-oriented economic research and to strengthen the capacity for medium-term policy analysis in Sri Lanka. Its mission is to contribute to the socio-economic development of the country through informed, independent and high quality research that seeks to influence the policy process. With twenty five years of substantial research expertise, IPS has emerged as a regional centre of excellence and the most influential think tank in Sri Lanka.

CLIMATEnet Blog

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EXECUTIVE DIRECTOR'S DESK

Climate change impacts are now visible all over the world. The Arctic cap has melted to its lowest level on record. In the US, the 2012 summer was one of the hottest in history and the 2012 drought triggered wild fires, crops stunting, and costing the US economy billions of dollars. Carbon dioxide emissions have not seen a significant reduction and if the current trends continue, global temperature will increase by six degrees Celsius by 2100 warns the International Energy Agency. Clearly, climate change is no longer a peripheral issue in global and local policy dialogues.

Developing countries may not be great environmental polluters and contributors to the changing patterns of climate; but are victims of



it. They have a number of environmental concerns such as combatting environmental disasters, preventing industrial pollution, managing urbanization, conserving biodiversity, etc. Sri Lanka has similar concerns, but being a small island economy it has major concerns on rising in sea levels, coastal erosion, etc.

The IPS being a leading economic policy research institute in Sri Lanka,

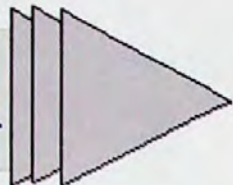
embarked on climate change impact related research in 2007 under its Environment Economic Policy Unit. IPS research on the subject was shared with many stakeholders in mid-2009 at a seminar organized in Dambulla. Based on the feedback the Institute received from the stakeholders, first, the IPS brought out a report titled 'Mainstreaming Climate Change for Sustainable Development in Sri Lanka: Towards a National Agenda for Action'. This report was presented to the Minister of Environment and Natural Resources in late 2009 before the Copenhagen Summit on Climate Change. Second, IPS initiated a web-portal and blog titled CLIMATEnet to take forward the climate change debate in Sri Lanka across to a wider audience. This is elaborated by Athula Senaratne, Head of the Environment Economic Policy Unit of the IPS, in the very first article of this bulletin.

The CLIMATEnet blog was a successful endeavour and it received a number of interesting articles over the last two years. These articles were compiled together with some other articles on the subject matter to bring out this bulletin. It covers a number of Sri Lanka related issues starting with the general theme of inclusive growth and then moving on to specific issues such as water, agriculture, and the ocean. In agriculture, climate change impacts related to rice, tea, and coconut sectors are highlighted while in the Ocean related issues, coastal erosion and coral reef depletion are examined. In the final lot of essays, post-Copenhagen, post-Durban, and post-RIO+20 general issues are highlighted in the context of sustainable development. Reviews of the UNDP Human Development Reports that focused on climate change and sustainable development are also carried with a general account of IPS activities on climate change research.

This publication was supported by a generous sponsorship of the People's Bank and topping up grant by the Think Tank Initiative (TTI). The IPS hopes that the contents in the bulletin will sensitize the readers on the subject and generate further debate that will lead to appropriate policy action to adopt and mitigate the impacts of climate change in Sri Lanka.

Dr. Saman Kelegama

Taking Forward the Climate Change Discussion in Sri Lanka



by Athula Senaratne, Research Fellow and Head of Environmental
Economic Policy Unit - IPS

The IPS commenced its climate change research programme three years ago with the support of a UNESCO partnership programme. From the outset, we assessed our strengths on how we can make a productive contribution to the emerging field of climate change research in the country. Despite the increasing research on various aspects of the subject, we recognized that there is a gap in policy dialogue on issues that are emanating from the findings of research. So we decided to fill this gap by opening a dialogue on climate change policy which is accessible to, and participated by, other concerned stakeholders.

The first milestone of this process was a national workshop held at Dambulla in 2009 with the participation of a number of scholars, researchers, and policy makers (http://www.ips.lk/events/workshops/19_8_09_climate_change/more_detail.html). The web portal, *Climatenet*, is the second milestone of the climate change research programme of the IPS. Our aim is to make it an important source of climate policy research in Sri Lanka as well as in the region. We first announced *Climatenet* in 2009 in Dambulla and allocated a short session to elaborate our vision. Participants were invited to offer their views and all their inputs were given due consideration in designing *Climatenet*.

Climatenet is primarily intended to serve the purpose of a platform for policy dialogue on climate change issues in Sri Lanka and the South Asian region.

It has now become a repository of information on climate change issues in Sri Lanka that is open for scholars, policy makers, and the public. We update our resources page regularly with important material on the subject so that concerned parties can find a reliable source on climate change issues on Sri Lanka. *Climatenet* also brings in news and information on important developments in the field on a regular basis. This was achieved through developing an extensive network with other important stakeholders. *Climatenet* provides a forum for exchange of ideas among relevant stakeholders through blogging. We initially launched this activity with invited guest contributions in addition to contributions by IPS staff members. Later it was opened up for more unrestricted forms of exchanges.

Climate change is a complex issue and complex issues involve many stakeholders. Solutions for such issues also cannot be found without the participation of all stakeholders. It needs frequent exchange of information and ideas among stakeholders and *Climatenet* is designed purely to facilitate this process. This is the underlying principle of all activities involved with *Climatenet*.

Climatenet belongs to all stakeholders who are involved in the climate change issues and you are welcome to contribute to the goals of this venture. You can make your contribution through providing us with useful material that can be stored in the resources page, sending us important information to be published in the news page or by sharing your valuable opinions and ideas on the Blog*. Not limited to that, you can also send us your suggestions on how we can improve and develop *Climatenet* so that it would serve its purpose even better in the future.

We hope you will continue to visit, and we look forward to engaging with you in the future.

(*<http://climatenet.blogspot.com>)

Impacts of Global Climate Change on Inclusive Growth in Sri Lanka

by Kanchana Wickramasinghe

The scientific evidence proves that climate change is a reality. Despite the negligible contributions towards global greenhouse gas emissions, and consequently to global climate change, Sri Lanka is a victim of the impacts of global climate change. These impacts are numerous in Sri Lanka and a number of economic sectors will be drastically affected. As the "National Climate Change Adaptation Strategy for Sri Lanka - 2011 to 2016" highlights; the major impacts would come in the form of increased frequency and intensity of disasters such as droughts, floods and landslides; variability and unpredictability of rainfall patterns; increase in temperature; and sea level rise. These impacts will have numerous impacts on agriculture, coastal zone, forests and natural ecosystems, human settlements and infrastructure, human health, energy, and industry¹.

The increased intensity and frequency of natural disasters and its cost in terms of human, physical, financial and environmental losses have a significant impact on growth. The vulnerability to and impacts of natural disasters also differ across segments of society, which then becomes an additional dimension to existing economic disparities. Natural disasters affect inclusive growth by constraining the participation of vulnerable segments in the development process. They also lead to the diversion of resources, which otherwise could be allocated for pro-poor development activities.

The impacts of natural disasters also tend to be unevenly distributed as the physical vulnerability of different regions to different natural disasters, varies across regions. In Sri Lanka, for instance, the Dry Zone is highly vulnerable to drought and certain districts of the Wet Zone are at risk of recurrent floods. Moreover, these vulnerable areas host a large proportion of the poor population, who are dependent on weather-reliant livelihoods such as agriculture and fisheries. The agriculture sector, in particular, is going to be particularly affected by a range of climate change impacts. The burden on agriculture will mainly be felt in the form of implications on food security and foreign exchange earnings through agricultural exports.

Climate change can cause distributional impacts owing to two key reasons. First, physical vulnerability to climate change varies across regions. Second, natural disasters can lead to worsening regional disparities due to the differences in the ability to manage climate change impacts effectively among different endowment classes.

The Dry Zone, coastal areas, and certain parts of the Wet Zone, are experiencing most of the natural disasters occurring in Sri Lanka. Most of the Dry Zone districts depend on agriculture for livelihoods whereby concurrent droughts and floods will make significant adverse effects on output. Water scarcity in the Dry Zone can further exacerbate existing inequities in poverty outcomes. Moreover, adverse impacts on plantation agriculture, which shows the highest incidence of poverty in comparison to urban and rural sectors of the country, will lead to widening the equity gaps.

Climate-induced water scarcity has implications on energy security of the country as well. During 2000-08, for instance, hydroelectricity is estimated to have contributed 43 per cent on average to the national

electricity supply.² A lack of adequate water in the country's major reservoirs, thus leads to a reduction in hydro power generation. If appropriate mitigation and adaptive strategies are not implemented, natural disasters and climate change can have considerable implications on poverty and inequality.

The impacts of climate change depend on a host of varying factors such as, segments of society; income groups; livelihood categories; and geographical regions, etc. Further, the impacts are becoming more significant for vulnerable groups, with increased intensity and frequency of disaster events as well as changes in rainfall pattern. Therefore, adopting an inclusive strategy for managing disasters is critical.

Adaptation remains the way out when faced with the impacts of global climate change. There is an important need to mainstream climate change into national development strategies, as it cuts across a number of sectors including agriculture, infrastructure, and poverty, etc.³ Given the wide-spectrum of issues in relation to climate change adaptation, a number of measures have to be taken to mitigate the impacts on inclusive growth in Sri Lanka. The measures should address the differential impacts of climate change, and aim to minimize the consequent implications on poverty and equality. Firstly, the reduction of physical vulnerability should receive priority attention in order to lessen the impacts. Secondly, in line with the physical measures, the socio-economic system, in terms of coping and adaptation strategies has to be strengthened to enable vulnerable groups to better manage risks. It is only with the adoption of both types of measures that efforts to reduce impacts of climate change will successfully support inclusive growth strategies.

1 Department of Census and Statistics, Statistical Abstract 2008, Available online: www.statistics.gov.lk

2 Department of Census and Statistics, Statistical Abstract 2008, Available online: www.statistics.gov.lk

3 Senaratne, A., N. Perera, K. Wickramasinghe (2009), Mainstreaming Climate Change for Sustainable Development in Sri Lanka: Towards a National Agenda for Action, Working Paper Series No. 14, Institute of Policy Studies, Colombo, Sri Lanka

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Our Water and Climate Change

by Herath Manthirithilake

Not so long ago, the Ceylon Electricity Board (CEB) and the authorities rang the alarm bells about power cuts due to not having any rains in catchment areas. Just a few months ago, and last year as well, we had unprecedented devastating floods. What is really happening?

Based on historical data, experts say rainfall over the Dry Zone of Sri Lanka is reducing and over some parts of Wet Zone it is increasing. The highest decrease of rainfall is observed in the Mahaweli catchment areas. At the same time, we are witnessing a very high amount of rainfall over a short period, i.e., the intensity of rainfall is increasing, causing floods, after which there is no rain for longer periods, causing droughts. Similarly, it is noticeable that the longer-term average day and night time temperatures are increasing and the gap between them is reducing. They say the sea around us too, would gradually rise above the current level. These are now accepted as the impacts of climate change.

Whatever said and done, the predictions seem to be correct: the frequency and the severity of occurrence of these extreme events are increasing. In many areas, water-related extreme events have already become more frequent and/or more severe, and projections indicate a further increase of frequency and severity. If this is the case, the crucial question is, "are we factoring these valuable observations into our plans and programmes?"

Studies which spell out accurate future climate scenarios for Sri Lanka are scarce and even the ones that do exist appear to have contradictory projections, especially with respect to future rainfall. Therefore, accurate quantification of climate change impacts is difficult. The identification of suitable adaptation strategies depends on the quantified impacts.

These impacts trigger a wide variety of secondary effects on water resources, agriculture, livelihoods, health and well-being, and the economy and nature as a whole.

Whether these are due to climate change or not, we may not be able to stop them occurring continuously. If we can't stop them, we need to adapt and live with them. We may be able to mitigate some impacts by adopting certain measures.

In my view, we have two options: first and foremost we need to improve the current management practices. We may not be able to and should not manage our water and related infrastructure the way we have done for the last 100 years. We need to manage things differently and we should begin now, especially by introducing better practices than what we have now, before starting special or extraordinary measures.

After the floods, authorities were concerned about reservoir and spillway capacities to accommodate such a high influx of water. However, we should not forget that existing reservoirs seldom get filled and therefore, encroachments are not only along the spill traces but also in and around reservoirs. This brings to mind the hard fact that water management can no longer be passive or reactive. It should be active and strategic.

The problem scientists and engineers face is that the current practices of estimation based on historical data may not be valid under the new conditions. They need to develop new methodologies to estimate suitable measures. We may have to build new reservoirs, look at spillways and discharge traces, and redesign bridges, culverts and pipes increasing their capacities to pass excess water. We need to deal with encroachments and protect the lands in and around water bodies and along natural streams, allowing them to transmit large quantities of spill water without damage to life and property.



In order to avoid disasters and wasteful expenditure, we should adopt "no regrets" options available to us and "climate proof" all new and old infrastructures, similar to Environment Impact Assessment (EIA).

One of the 'no regret' adaptation measures recommended is to increase water storage across a continuum: from increasing soil moisture, recharging ground water, wetlands, to surface storage (from minor to larger reservoirs) where possible. This recommendation is important for Sri Lanka because we are solely dependent on rainwater. Although we repeat his sayings many a times and are proud of King Parakramabahu's water management policy, we still use only about 4 - 5 % of our rains tapping from surface and groundwater sources and more than 30% still flows to the sea without serving mankind. At the same time, we need to be mindful that many of

our existing reservoirs are not getting filled for many years and they get emptied very quickly. This could be due to design data errors or poor water management, or both.

We should cherish our small tank cascades system - an ideal solution for climate woes. Thanks to the untiring efforts of a knowledgeable few, the single-tank approach has been somewhat shelved and the cascade approach is being adopted. It should move further from cascade to 'mini watersheds' surrounding those cascades. The cascade system would not function properly unless the surrounding catchments, including other elements of the system, are functioning and protected. However, what we often see are haphazard settlements and misuse. Smaller water bodies in the catchments are meant for sediment trapping, groundwater recharging, and for the use of animals. Those are part of the same system of tank cascades and not appendages. Increasingly, those smaller waterholes are converted to irrigation tanks under the guise of 'participatory rehabilitation' through the projects.

In the water catchment areas of the central highlands, we need to stop soil erosion on slopes and increase the moisture retention capacities. Otherwise, our rivers will run dry, anicut schemes will have to be abandoned, and all irrigation systems located in the Dry Zone will suffer from water shortages. As a result, hydropower generation will be in jeopardy. There will be more land and mudslides, denuded hills, dried waterfalls, devastated tea and vegetable gardens, and rampant poverty. In the lower lands, most of the suitable areas for water storage are already occupied and it is not feasible to allocate land for reservoirs which only fill up once in 10-15 years. Also, the existing reservoirs are heavily polluted, silted, and have poor storage capacities.

Heavy rains during short periods may not help recharge groundwater. Pollution and over-abstraction could hamper the available limited quantities of groundwater, particularly in coastal areas. Coastal zone freshwater could become salinized either by over-extraction or sea level rises which will in turn threaten the livelihoods of millions of people.

Dr. Herath Manthirithilake serves as the Head, Sri Lanka Development Initiative of the International Water Management Institute (IWMI), which is one node of a research network called Consultative Group of International Agricultural Research (CGIAR). He has vast experience in civil engineering, water resources management, watershed management, rural infrastructure development, environment conservation, teaching at postgraduate institutes and on project management.





Impact of Climate Change on Agriculture in Sri Lanka

by C. Shanthi de Silva

Human activities have been recognized as the primary cause for global warming. The build-up of greenhouse gases (GHGs) threatens to set the earth on the path to an unpredictably different climate. A key challenge, in that instance would be food security, crucial to sustain the growing world population. An enormous amount of water is required to produce food. Irrigation needs vary according to the balance between rainfall and evapotranspiration, and the resultant fluctuations in soil moisture status. Anthropogenically induced climate change is expected to influence rainfall and temperature patterns. Since climate change will influence temperature and rainfall patterns, there are likely to be direct impacts on soil moisture. Changes in soil moisture due to global warming will have other hydrological effects which will, in turn, affect agriculture around the world.

Sri Lanka is no exception to this, as it is also prone to natural disasters. During the last few decades, for instance, Sri Lanka has witnessed a number of extreme rainfall events in the south western regions during south-west monsoon season (May to September) and in contrast northeast and north central regions experienced severe drought during the paddy and other field crop growing seasons. Farmers used to start paddy cultivation during Maha season, expecting the north east monsoonal rains. Sri Lanka is experiencing uncertainty and inadequacy of north east and inter-monsoonal rains, in recent years which has caused damage to paddy and other field crop cultivations. Each year, the Government of Sri Lanka spends huge amounts of funds on drought, floods and other, relief services.

Studies on past climate data will not predict the future, as drastic changes are taking place in climatic factors due to climate change. To predict the future, there are general circulation and weather forecasting models which are capable of predicting the future climate. This article is based on the findings of a study undertaken to focus on the impacts of climate change on water resources in Sri Lanka, with the collaboration of Cranfield University, UK. The HadCM3, which is a coupled atmosphere-ocean general circulation model (AOGCM) developed at the Hadley Centre for Climate Prediction and Research in the UK, has been used for this study. This model is

considered to be significantly more sophisticated than the earlier versions, and the HadCM3 model provides information about climate change occurring across the globe during the 21st century. In order to provide information on possible changes in the world climate, the climate change models are forced to consider future scenarios.

According to IPCC-SRES, those future scenarios are A1, economic-global; B1, environmental-global; A2, economic-regional; and B2, environmental-regional. In this study, scenarios A2 and B2 for 2050 were selected to compare with the baseline data (1961-1990). A2 scenario is considered as representing the highest impact of climate change and the B2 is the second highest impact. Further the results of the HadCM3 predictions of monthly rainfall for 2050s were also compared with that of the baseline (1961-1990) and data for the period of the last ten year (1999-2008) of Meteorological Department, Colombo.

Under these two scenarios tested, the average annual rainfall is predicted to increase by 14% (A2) and by 5% (B2) across the country. Among the wet zone areas, the average annual rainfall in Colombo, Galle, Kandy, Nuwara Eliya and Ratnapura is predicted to increase. The highest increase in Colombo by 32% (A2) and 24% (B2). However the rainfall is predicted to decrease in other dry zones areas such as Anuradhapura, Batticaloa and Trincomale. The highest decrease is predicted in Batticaloa 14% (A2) and 12% (B2).

During the southwest monsoon (May to September), rainfall across the country is predicted to increase considerably, by over 30%, compared to the baseline. Therefore, south western regions (wet zone areas) of the country such as Colombo, Ratnapura, Galle and Nuwara Eliya will be experiencing a significant increase in rainfall. In addition, predicted higher rainfall in Nuwara Eliya and Ratnapura areas will cause floods and land slides. This increase in rainfall will have serious impacts on the country's infrastructure to cope with floods in the south western region. Therefore, it will be advisable to store the excess runoff water safely within these regions.

According to the results, the north-east monsoon (December to February) is predicted to decrease on average by 34% (A2) and 26% (B2). The north east monsoon rainfall in dry zone areas such as Jaffna, Mannar, Vavuniya, Anuradhapura, Batticaloa, Trincomalee and Hambantota are predicted to decrease (Table 1). The highest decrease is predicted in Trincomalee and Batticaloa 27% (A2) 29% (B2) followed by Anuradhapura, Vavuniya, Mannar and Puttalam. It will create severe drought related problems in these areas.

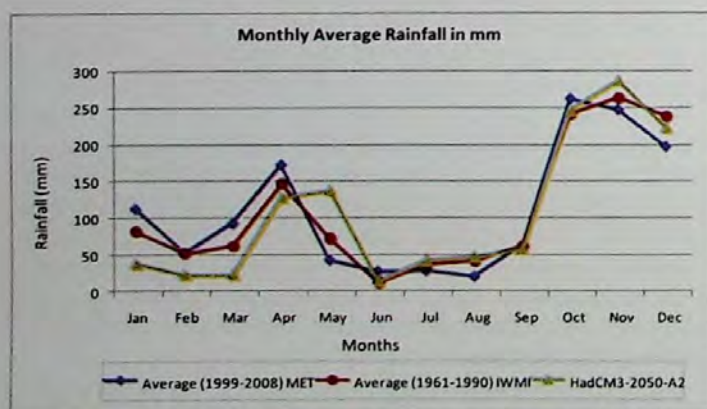
Table 1: Percentage Decrease in Northeast Monsoon Rainfall according to HadCM3 prediction for A2 scenario in 2050s compared to the baseline (1961-1990) in the dry zone areas in Sri Lanka.

Weather station	Latitude	Longitude	Percentage decrease in 2050s compared to the Baseline (1961 - 1990) (%)
Jaffna	9.65°N	80.02°E	23%
Puttalam	8.03°N	79.83°E	19%
Vavuniya	8.75°N	80.5°E	27%
Trincomalee	8.58°N	81.25°E	32%
Anuradhapura	8.35°N	80.38°E	27%
Batticaloa	7.71°N	81.7°E	37%
Hambantota	6.12°N	81.13°E	11%
Mannar	8.98°N	79.91°E	22%

For example, according to HadCM3 model prediction for Anuradhapura there will be a 27% decrease in rainfall during northeast monsoon in 2050, and the gradual decrease will be 9%, 13.5%, 18%, 22.5% and 27% in 2010, 2020, 2030, 2040 and 2050, respectively. According to the Meteorological department data, the northeast monsoon rainfall in Anuradhapura has decreased by 6% during the last ten year period (1999-2008). Further, there was a significant decrease in rainfall in the months of November and December (16%) over the same period compared to the base line (1961-1990) in Anuradhapura, whereas the HadCM3 predicted decrease in rainfall for 2050s for the month of December is only 6%, which is considerably less than the observed decrease over the past ten years (1999-2008) (Figure 1). It shows that climate change effects on north-east monsoonal rains in north, central and eastern regions is taking place at an accelerated pace. It will have serious impacts on paddy cultivation as it depends on the north-east monsoon rainfall.

Further, the rainfall during yala season (May- August) also has been decreased during the past ten years (1999-2008) when compared with the base line (1961-1990).

Figure 1: Monthly average rainfall of Anuradhapura by Meteorological Department for (1961-1990), (1999-2008) and HadCM3 model prediction for 2050s.



The temperature increase predicted by HadCM3 is mainly in the north, north eastern and north central regions of the country. The average annual temperature is predicted to increase by 1.6° C (A2) and 1.2° C (B2). Highest increase in temperature is predicted in Anuradhapura by 2.1° C (A2) and 1.6° C (B2). The lowest annual average temperature increase is predicted in Nuwara Eliya by 1.1° C (A2) and 1° C (B2). Due to the predicted increases in temperature and the decrease in rainfall, the evapotranspiration is predicted to increase in the north, north central and eastern regions of Sri Lanka. Further, the soil moisture deficit is also predicted to be high in the north, north central and eastern areas (Jaffna, Mannar, Vavuniya, Trincomalee, Anuradhapura and Batticaloa) where agricultural activities are intensive. These predicted changes

in rainfall, temperature, evapotranspiration and the soil moisture deficit, will demand additional irrigation water to compensate for the crop water requirement now and in the coming years. Therefore the climate change effects on Maha and Yala seasonal rains will cause serious problem for agricultural activities, such as paddy and other field crop cultivations in the north, north central and eastern regions, unless suitable adaptation measures are implemented to provide additional irrigation water as the rainfall will not be sufficient for food production in these areas.

Adaptation measures must be clearly planned to complement climate change impacts in the various regions. For sustainable agricultural production of paddy and other field crops, additional irrigation water is a must by any means as the rainfall alone will be sufficient to fulfill the crop water requirements. Therefore policy makers should implement methods to store any additional water by renovating the existing surface tanks in the north, north central and eastern regions. Further, providing grants for farmers to build their own agro wells will be another option, but it should be planned carefully to maintain at least 200m spacing between the two nearest wells.

Further, agro wells are more suitable for other field crop cultivation as the water in an agro well will not be sufficient to irrigate paddy cultivation. In an Agro well, the major portion of water that can be abstracted during pumping is from the well storage and because of the over burden of hard rock aquifer underneath in many of these regions it results in very low permeability. Further, farmers must learn to use the well water efficiently by using drip and sprinkler irrigation. In addition, researchers must focus on adaptation measures for crops to cope with high temperature and water stress. It may lead to changing crops, varieties and timing of cultivation.

The author is Professor in Agricultural Engineering at Faculty of Engineering Technology, The Open University of Sri Lanka, Nawala, Nugegoda



Impact of Climate Change on Agriculture in Sri Lanka and Possible Response Strategies

by B.V.R. Punyawardena

In spite of the technological advances made on improved crop management, irrigation, plant protection and fertilization; weather and climate remain the key factors of agricultural productivity in any country. Farming systems and agronomic practices in most agricultural regions of Sri Lanka have evolved in close harmony with the prevailing conditions of the respective climatic regions of the island. However, it has been made evident during recent decades that the heritage of farming experiences and accumulated weather lore of centuries are no longer useful in the process of agricultural planning at any level. The climate of the island has undergone a change to such an extent that the expected rainfall does not come at the correct time and severely handicapping farmers during growing season. Variability of both summer and winter monsoon rains and rains of convectional origin has increased significantly during recent decades (Table I). As a result, both extremes, i.e., water scarcity and excess water have become a recurrent problem faced by crop production in Sri Lanka. Meanwhile, increasing ambient temperature has also resulted in several direct and indirect negative impacts on crop growth. However, intensively managed livestock sector of the country is not so vulnerable to climate change compared to the food crops sector. But, the situation is obviously different for extensively managed livestock sector where it is purely dependent on the rain-fed pastoral systems. Meanwhile, additional pressure coming from ever-increasing population, poor terms of trade, weak infrastructure, lack of access to modern technology, and information and civil disturbances will restrict the options available for people to cope with the negative consequences of climate change (Punyawardena, 2002).

Irrespective of the sectoral characteristics, the impact of climate change on any sector depends on how and what intensity the rainfall regime in a given area is variable along with the increasing environmental temperature of the same area. In addition, effects of climate change will be felt in the coastal region when sea levels rise as a result of an enhanced temperature regime - thereby affecting agriculture in low lying areas. This and other impacts of increasing temperature demand our special attention as the average temperature of the country has been rising annually at a rate of 0.01-0.0360C (Fernando and Chandrapala, 1995).

Impact due to Changes on Rainfall Regime

Table 1: Variability of Sri Lanka Rainfall during the Period of 1931-60 and 1961-90

Season	CV (1931-60)%	CV (1961-90)%
First intermonsoon	23	27
Southwest monsoon	21	16
Second intermonsoon	22	23
Northeast monsoon	31	42
Year	11	14

It is a well known fact that annual rainfall in Sri Lanka has not shown a significant increasing/decreasing trend except in a few locations. However, variability of annual and seasonal rainfall have increased during recent decades especially with respect to the

North-east Monsoon which is the life blood of the Maha Season, the major cultivation season of Sri Lanka (Table I). It is also true for the first inter-monsoon rains, especially during April which is the major rain producing month of the season in the Dry and Intermediate Zones. Those two zones are considered to be the major food producing zones of the country.

Increased occurrence of extreme rainfall events due to climate change, droughts and floods, has become a common feature of the climate of Sri Lanka during recent decades. Under such situations, crop losses due to decreased soil moisture and excess water, both in terms of quality and quantity are inevitable. Given the physical conditions of most of the great soil groups that are being used for agricultural activities in Sri Lanka, even a small negative departure of expected rainfall is likely to cause a several-fold decrease in ground water replenishment. It will be extremely detrimental to the intensive agricultural production systems that are being practiced on sandy soils (Regosol) with lift irrigation systems (i.e., Kalpitiya and Jaffna Peninsula). Moreover, increased occurrence of positive rainfall anomalies is likely to cause severe damages to existing irrigation infrastructures and thus, limiting the water availability for crop production that is under irrigation.

Fruit bearing seasons of country's major tree fruit crops are also likely to be affected due to irregularities in rainfall pattern under a changing climate. For example, Rambutan trees in the Wet zone requires 3-4 weeks of dry spell in and around February for flower development and primordial initiation, to give the harvest in June. However, sudden occurrence of rains in February deprives that prerequisite, resulting in a failure to flower in March. Such situations have become a common feature in the climate of the Wet Zone during recent times.

Impact due to Increased Ambient Temperature

Being a tropical island with a uniformly high temperature regime, most of the cultivated crops in Sri Lanka operate at a near maximum of the optimum temperature range of respective crops. Thus, crop injuries due to high temperatures are inevitable in Sri Lankan agriculture under a changing climate. This is of particular importance for the country's major staple food, rice. It is a well established fact that high temperature injuries in rice are inevitable if the plant is exposed to an ambient temperature that exceeds 350 C for 60-90 minutes at anthesis stage (flowering). It used to be a rare event to experience such an environmental temperature regime in major rice growing regions of the country, however recent agro-meteorological observations have confirmed that the frequency of such temperature occurrences have increased significantly in both the Dry and Intermediate Zones, especially during Yala season - resulting in a high rate of un-filled grains due to increased spikelet sterility. The high temperature regime will also increase evapotranspiration losses leading to frequent soil moisture stress conditions in upland crops.

Decreased diurnal temperature regime at almost all locations of the country, especially due to the increasing night time minimum temperature, is likely to cause negative impacts on tube crop production in the country. This is especially true for potato cultivation as the existing environmental temperature regime is sub-optimal for the crop even in the up-country region where the crop is mainly concentrated. In addition, the quality of the harvested crops are also affected negatively due to reasons which can be attributed to climate change. Increased temperature, especially that of night time minimum temperature, tends to decrease the sugar translocations in harvestable fruits and increase the sour taste in fruit crops. This will be true for crops like sugarcane as well, therefore decreasing its brix value. Meanwhile, fibre content of harvestable parts of crops is also likely to increase under an increased temperature regime and thereby reducing their palatability.

Yield of almost all crops grown in the country would also be negatively affected due to increases in insect damages and infestation various pathogens such as bacteria, virus and fungi. Even though higher yield loss due to increased weed infestation is likely to occur with increasing temperature, recent studies have shown that no such trend has been observed under local conditions. However, it is too early to generalize that such threats would not occur in the future.

Apart from the direct impact of increased variability of rainfall and rise of ambient temperature, indirect effects of increased rainfall intensities are of special significance in terms of land degradation which has a significant bearing on the crop production in Sri Lanka. Increased temperatures are likely to enhance the local scale convection and thereby to form more cumulonimbus clouds giving rise to high intensive rains (>25 mm/hr). Such rains invariably wash off the fertile top soil of arable lands. It will lead to subsequent siltation and eutrophication of downstream reservoirs and any other surface water bodies. Moreover, increased temperature and frequent and negative rainfall anomalies are also likely to cause high evaporative demand of the atmosphere. This can cause salinization of agricultural lands in semi-arid parts of the country. The same will lead to rapid drying up of tanks giving rise and an additional pressure to the water available for agriculture. This is of particular importance with country's cascade of minor tanks found in the Dry and Intermediate Zones of Sri Lanka. These tanks possess a high surface/depth ratio and hence, are highly vulnerable for rapid drying up. This will exacerbate the impact of negative anomalies of rainfall on crop production in water limiting regions of the country.

Impacts due to Increased Sea Level

As an island, Sri Lanka is highly vulnerable to increases in sea level with varying degrees of sectoral impacts. It is highly probable that sea water intrusion to agricultural lands is inevitable as a result of the changing climate, which will lead to further reduction of land available for agriculture. Increased sea levels will also exacerbate coastal erosion, piling on additional pressure to the land available for agriculture, directly and indirectly. Also, it may reduce the quality of

both drinking and irrigation water in coastal regions by disturbing the interface between fresh and brackish water. It is highly likely that sea level rise will disturb the Gyben-Herzberg lens of fresh water found underneath Regosol in coastal regions. These fresh water lenses provide the irrigation water for intensive agriculture in those regions.

Response Strategies to Minimize the Vulnerability

Being a developing country, the most appropriate response strategy for climate change is adaptation activities rather than mitigation exercises. However, that does not mean that mitigation measures should be abandoned altogether; instead, the situation calls for a combination of both of measures - as long as they do not curtail development goals. Following is an exhaustive list that may be adapted by different stakeholders within the sector to minimize



their vulnerability to climate change. But, it should be kept in mind that some of these proposed strategies are not new to our farming community and that they are already in practice. However, there is a timely need for implementation in a coordinated and systematic manner. There may also be some opportunities to re-evaluate the existing methodologies and introduce new concepts applicable to agricultural enterprise to cope with the additional pressure that would arise due to climate change. However, it is the responsibility of implementing agency to make sure that revised or new adaptation responses would deliver the goods even if the climate change does not take place to the level of envisaged degree. They should also take necessary precautions to avoid costly involvements on account of climate change. Any strategy that makes substantial negative impact on the socio-economic development of the country should not be considered as a viable option to combat the negative impact of climate change.

Suggested Adaption Strategies – Technical

There are several technical adaptation strategies available to mitigate vulnerability. The promotion of micro irrigation, in the form of drips and sprinklers, for instance will put a minimal amount of water to maximum use, contemporary examples of this system are to be found in moisture sparse agricultural areas in California and the Middle-East. Other water management methods include the harvesting of rain water, the repair and rehabilitation of irrigation tanks and canals, and re-use of drainage water.

Other methods include, upland annual crop cultivation in the Dry Zone to be transformed to perennial fruit crop cultivation with intensive irrigation management practices wherever possible; Crop recommendation based on the agro-ecological suitability; Promote on-farm soil and moisture conservation; use of tail water recovery pits for lift irrigation; implement a programme to improve the water use and conveyance efficiency; breeding for short age varieties and varieties that can withstand drought, high temperature, pest & diseases and salinity; use of long range weather forecasting mechanisms to aid agricultural planning; periodic revision of fertilizer recommendations and soil test based fertilizer application.

Suggested Adaption Strategies – Policy Reforms

There are policy measures that can be taken to ensure that appropriate conservation and coping mechanisms are adapted in to the mainstream agricultural development agenda. The implementation of the Soil Conservation Act of 1996 for instance, would be an excellent first step. In addition strict enforcement of the National Environmental Act and other related ordinances would make sure that resources are utilized in an appropriate manner than ensures longevity instead of short term gain. Adoption of proper national land use policy and easy credit schemes to reward conservation activities such as soil and moisture conservation; micro-irrigation; storage and processing and high quality seeds would help propagate responsible farming practices amongst the agricultural community.

In addition, large scale drainage improvement projects in the low country Wet Zone is absolutely essential to make sure that all arable lands will be put back into cultivation or any other meaningful use without wasting valuable natural resource base. The development of guidelines for rational use of ground water will create an impact in this regard as well. Most importantly however, an effective marketing strategy to get the messages of conservation and adaptation across needs to be developed to ensure the Sri Lankan agriculture sector's response to climate change isn't too little, too late.

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Traditional Rice Farming in Sri Lanka: Still Viable with Climate Change



Sri Lanka has experienced many changes over the last century which has had a significant impact on traditional rice farming in the country. A change in the climate can be seen as the island has faced a reduction of rainfall and an increase in air temperature in certain areas of the country. Furthermore, land used for vegetation has been put to other uses resulting in a loss of 50 per cent of forest cover. The population has also increased by 15 million in a land area of 6.54 million hectares over the last 60 years. Occurrence of natural disasters such as droughts, floods, cyclones, landslides, epidemics, etc., has made life difficult for people to go about with their activities. Traditional sustainable agriculture shifting towards modern technology-intensive mode is partly to be blamed for these natural disasters.

Traditional farmers who gathered experience and skills over centuries, managed to sustain yields under adverse farming conditions using locally available resources. A study conducted by the author with the support of 'Future in Our Hands', during 2007 - 2010 in the Moneragala district, investigated how traditional rice farming and the related ecology faced the challenge of drought and emerging issues of modern farming by tracing coping strategies from the past.

Traditional system practised by farmers includes: i) cultivation of traditional rice varieties; ii) use of organic fertilizers (straw, green manure, cow dung, poultry manure, liquid fertilizer etc.); iii) management of weeds through hand weeding, mechanical weeding, and water management; iv) management of pest and diseases by practising Kem krama (rituals), maintaining bio-diversity, and using bio-pesticides; and v) management of available water without leading to moisture stress.

A study was carried out in 16 villages, where some farmers practised traditional farming and some others adopt modern farming. The main differences seen in modern farming compared to traditional farming were that the farmers used: i) new 'improved' rice varieties; ii) Inorganic fertilizers (urea, muriate of potash and triple super phosphate); iii) Weedicides; iv) Pesticides; and v) pre-scheduled irrigation. These two farming systems were assessed by using various indicators such as productivity of land, labour, capital, and seed, input cost and net return per unit weight of grains.

Results showed that the traditional rice farming when adopted for a few seasons could tolerate drought conditions, reduce soil salinity, and improve soil P, K and organic matter and some physical properties. Moreover, cost of production decreased while labour and capital productivity increased. The system improved its capacity to control pests without any additional measure. Findings are summarized as shown in the table.

Parameter	Modern farming	Traditional farming
Crop Economics		
Machinery cost (Rs./ha)	23,251	27,303
Material cost (Rs./ha)	14,249	7,402
Labour cost (Rs./ha)	63,327	67,015
Total input cost (Rs./ha)	100,827	102,420
Yield (kg/ha)	4,148	3,177
Cost of production (Rs./kg) IFL	24.31	32.24
Cost of production (Rs./ha) EFL	16.47	16.98
Selling price (Rs./kg)	30.00	40.00
Seed productivity	29.6	32.5
Land productivity (Rs./ha)	23,613	24,660
Labour productivity (Rs./day)	664	869
Investment productivity (Rs./Rs.)	1.50	1.52
Net return (Rs./kg) IFL	5.69	7.76
Net return (Rs./kg) EFL	13.53	23.02
Soil Fertility		
EC (mmhos/cm)	0.99	0.06
pH	6.4	6.4
Soil P	10% increase	19% increase
Soil K	33% increase	52% increase
Organic matter	10% increase	8% increase
Compaction (penetrometer reading)	1.3	0.7
Plant Bio-diversity		
Grasses	7.4	4.4
Sedges	9.3	23.1
Broad-leaves	10.3	23.4
Total	27.0	50.0

The overall conclusion from the study is that the management of system ecology, adoption of traditional farming practices and integrated water resources management are the best practices to mitigate the drought effect in rice farming. However, there is a need to mobilize and strengthen communities and investigate the possibility of incorporating modern farming objectives such as high yield, increased production, profitability, etc., into traditional farming systems.

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Combating Adverse Impacts of Climate Change on Tea Production in Sri Lanka with “No-Regret Strategies”

by M. A. Wijeratne

Introduction

The human impact on the environment associated with economic growth and development is believed to be a primary cause of global warming. Such warming has profound impact on living beings and plant life. For instance, photosynthesis, the process by which plants produce organic compounds is largely governed by ambient temperature, carbon dioxide concentration and soil moisture (rainfall). Changes to these environmental factors can incur profound impact on photosynthesis and in turn, affect crop growth and yield.

Temperature rise, enrichment of ambient carbon dioxide (CO_2) and variation of total and pattern of rainfall distribution change crop environments, thus affecting crop growth and yield of non-irrigated plantation crops such as tea. Pest behaviour and disease infestations which are impacted by environmental changes are also closely linked to the productivity of tea land. Moreover, changing environment can adversely affect product quality. In the recent past, scientists have begun to explore climate change and assess its impact on crop growth and yield. Fortunately, such studies have paved the way for scientists to identify appropriate measures in which adverse impacts of climate change on agricultural crops, such as tea, can be mitigated.

Climate Change Impacts On Tea Production

Tea is Sri Lanka's top most agricultural export. It is one of the major plantation crops grown from nearly sea level to around 2200m amsl. The total tea land is estimated to be 200,000 ha of which approximately 60% is managed by smallholders contributing to about 70% of the national production. In 2010, Sri Lanka produced 329 million Kilograms of tea earning an estimated Rs. 155,376 million (Central Bank of Sri Lanka, 2010). The industry is said to employ over 1.5 million people.

Close analysis of climate change impacts on tea production in Sri Lanka shows that tea cultivations at high elevations (>1200 m amsl) are least affected. Rising temperatures are beneficial to tea grown at high elevations as it helps to reach optimum temperature for tea (22 °C). However, it is predicted that rising temperatures and dry weather conditions in warmer regions where the present temperatures are above optimum for tea (low; <600m amsl and mid; 600-1200m amsl elevations) will mask the benefits of CO_2 enrichment and limit tea production. In addition, poor soil conditions and ageing tea bushes make tea lands highly vulnerable to the adverse impacts of climate change. In order to mitigate such adverse impacts on tea lands in Sri Lanka, it is crucial to adopt good agricultural practices that are also known to be “no regret strategies”.

Adaptation Measures

Proposed adaptation measures seek to minimize adverse impacts of extreme (high) temperatures and moisture stress and, ensure that the beneficial effects of CO_2 enrichment is properly



exploited for sustaining tea yield. They are primarily aimed at improving soil conditions, aerial environment, and adaptability of the crop to stress conditions.

Challenges

The adoption and long-term implementation of “no-regret strategies” detailed above hinges on two factors; firstly, the profitability of tea cultivation which in turn, limits the capacity of the tea grower (affordability) to effectively adopt such strategies in the field, and secondly, the availability of labour and other resources and required materials which will facilitate such good agricultural practices that have so far not been fully adopted in tea lands. It is contended that financial assistance to tea growers will markedly improve the rate of adoption of such “no-regret strategies” whilst minimizing the adverse impacts of climate change.



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Potential Impacts of Climate Change on Coconut Crops in Sri Lanka

by Sanathanie Ranasinghe



There is enough scientific evidence to conclude that climate change is taking place. Plantation agriculture is one of the high priority sectors where the impacts of climate change exceed tolerance limits, with implications for the livelihoods of millions of people who are dependent on this sector as well as to the national GDP contribution of coconut. The Coconut Tree, also referred to as the “Tree of Life”, is an important part of the Sri Lankan diet with an estimated per capita fresh nut consumption of 129 nuts per year (including oil).

Coconut provides approximately 15 % of the calories in the daily diet and is the sole source of fat for much of the rural population. The annual national coconut production during 1996-2010 averaged at 2673 million nuts from which about 80 % is locally consumed and the balance, exported as desiccated coconut, copra, oil, mature nuts, milk powder and other processed products (Coconut Development Authority and Department of Census and Statistics, Sri Lanka). The coconut sector makes a substantial contribution of about 1.4% to the GDP (of 2.7% of total plantation crops) and 3.57% of foreign exchange earnings (Central Bank, 2009) to the country. On account of the important role it plays in the country, it is imperative to identify adaptation and mitigation measures to make coconut a sustainable industry even in the event of anticipated climate change.

Coconut is cultivated in all three agro climatic zones (ACZ) of Sri Lanka (30% in the wet zone, 50% in the intermediate zone and 20% in the dry zone), and new planting programmes of coconut are underway mainly in the Northern and Eastern Provinces of Sri Lanka. Coconut performs well under a mean annual temperature of 27°C – 29 °C and rainfall of 1250-2500 mm/year. Therefore, increased temperatures and the scarcity of water predicted as a result of anticipated climate change will be the most critical factors that would affect the yield of coconut.

It has been identified that reproductive development in coconut is more sensitive to high temperature stress and water stress than



vegetative development and the principal harmful effects are reported on nut set. Nut setting is the most important yield determining factor in coconut and reduced nut setting due to heat stress and long dry spells are often experienced in coconut plantations in the dry-intermediate and dry zones, even those under irrigation. This

could be either, due to unfavourable environment conditions during fertilization (pollen germination), or poor pollen quality.

Coconut palms produce approximately one inflorescence per month, leading to about 12-14 inflorescences per year. The stages of inflorescence development such as pollen formation (one month before inflorescence opening) and button nut formation (1-2 months after inflorescence opening) can be very sensitive to prevailing climatic conditions. Continuous exposure to heat or water stress can prevent the accumulation of starch and sucrose in the developing anthers, which is the main source of energy for pollen germination, resulting poor pollen quality.

Further, high temperatures, low relative humidity and a high vapour pressure deficit at the stage of pollination may result in pollen drying - consequently resulting in reduced nut set. This is the situation normally observed in the February / March period of each year, as shown in Fig. 1. The degree of sensitivity to high temperature can vary with the variety, depending on their tolerance to stress. Therefore, studies are underway to identify heat tolerant cultivars based on their reproductive survivability as a major adaptation strategy to climate change.

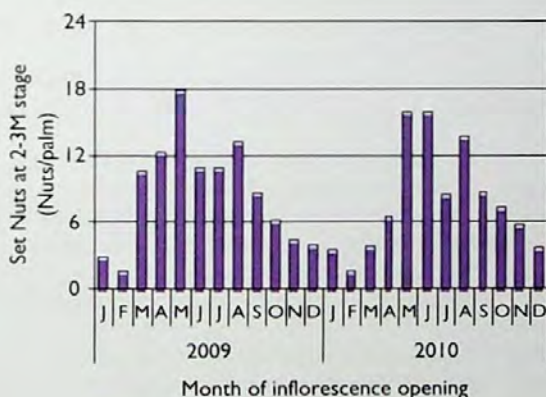
Fig. 1: Monthly variation in nut setting (number of set nuts per palm at 2-3 months stage) of a coconut plantation in the Intermediate Zone in 2009 and 2010.



and soil conditions. If the carbon is marketed at the rate of 11 US\$ / unit, growers can earn about Rs 20,000-96,000 ha-1 yr-1 under CDM (pay for net ecosystem carbon balance of new plantations). The same coconut plantations contain a carbon stock of about 30 - 70 MT ha-1 (plant and soil) depending on the agro-climatic and soil conditions. The carbon sequestration potential in coconut plantations vary with the season of the year, age of plantation, variety and management and the studies at CRI are being strengthened and continue to collect information.

Therefore, it is clear that climate change will have negative effects on coconut plantations due to increased temperature and water stress.

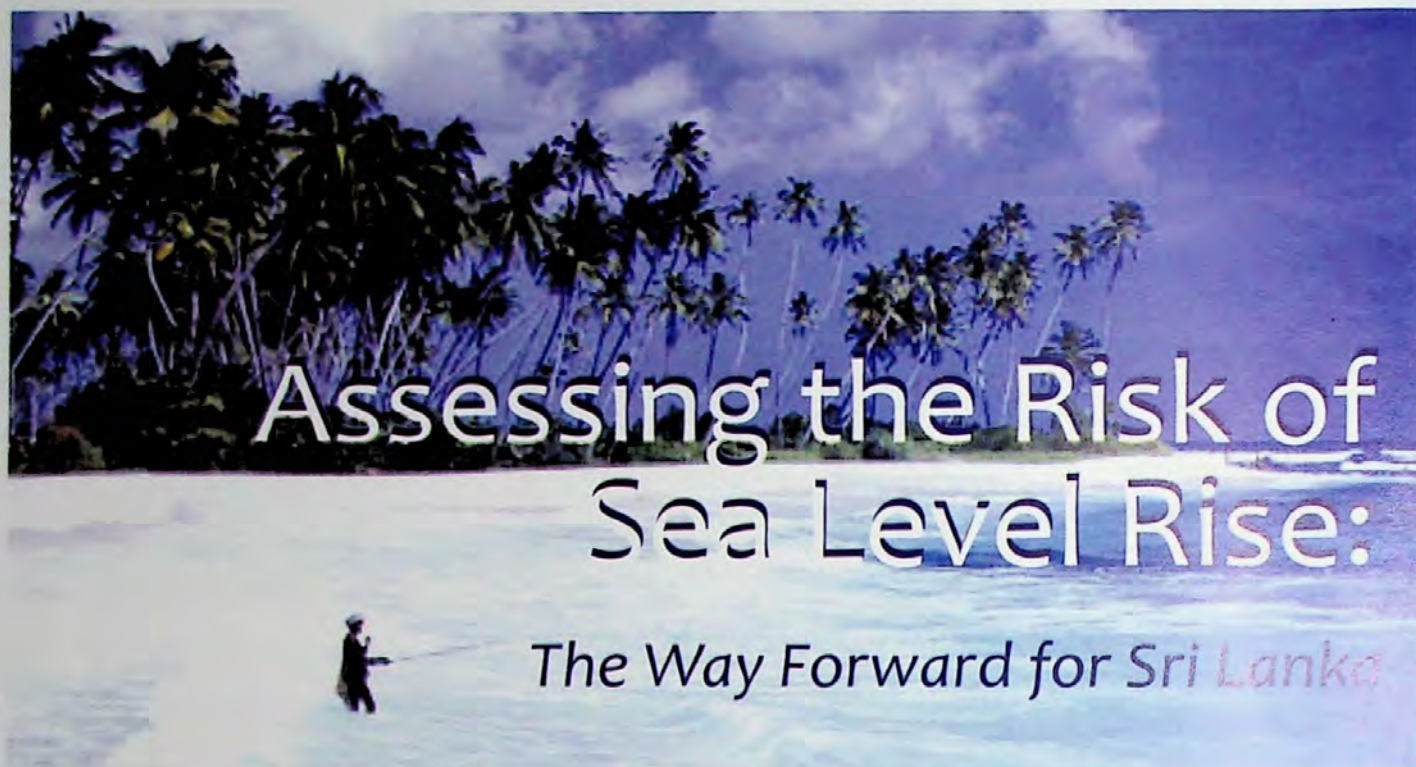
However, coconut plantations can also be used to mitigate climate change which is an environment service by acting as Carbon sinks to absorb CO₂ from the atmosphere and control global warming while giving an additional income to the growers through Carbon trading.



On the other hand, Coconut - as a perennial tree crop with 50-60 years of economic lifespan, has a great potential as a Carbon Sink for mitigating climate change. The Clean Development Mechanism (CDM) is presented as an opportunity for developing countries to get certified in order to negotiate subsidies from the Carbon (C) market. Productivity and net carbon balance of types of land used for coconut are key issues for the CDM. The potential role of coconut plantations in mitigating global warming is not adequately addressed by researchers. The first study on carbon sequestration potential of coconut in Sri Lanka was initiated at the Coconut Research Institute (CRI) in 2009.

The preliminary information revealed that a 25-26 yr old Sri Lanka Tall (commercially grown) plantation can sequester about 17-80 MT of Carbon dioxide ha-1 yr-1 depending on the agro-climatic

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Assessing the Risk of Sea Level Rise:

The Way Forward for Sri Lanka

by S. S. L. Hettiarachchi and S. P. Samarawickrama

Climate Change and Sea Level Rise

Climate change will have significant impacts on the oceans and on the coastal zone on a global scale. It will introduce new hazards and increase existing hazard potential, both with respect to magnitude and frequency of occurrence, in coastal regions. The hazards would be both chronic (e.g., sea level rise) and episodic (e.g., storm events). Sea level rise is one of the more certain responses to global warming and presents a major challenge in the administration and management of coastal zones, including that of Sri Lanka. A large percentage of Sri Lanka's population is located in coastal regions and these regions play a vital role in the economic growth of the country.

Sri Lanka is one of the few countries which have a fully operational National Coastal Zone Management Plan, and the Government's Coast Conservation Department has full responsibility for its implementation. In Sri Lanka, the Coast Conservation Act has defined the coastal zone on geo-physical considerations using linear dimensions. This narrow and geographically defined coastal zone does not recognize the interconnections within coastal ecosystems, its resources, and the human interactions. This limitation in the definition of the coastal zone could become a critical constraint when implementing action plans to respond to a sea level rise in the country.

Analyzing the Impacts of Sea Level Rise

Investigations conducted in Sri Lanka have revealed that climate change will result in changes to critical forcing parameters of the coastal zone which would affect the physical condition of the shoreline. Rising sea levels, change in wave patterns arising from changes in wind pattern and water depth, increased rainfall and the occurrence of extreme events more frequently, are some of these. Sea level rise on its own would lead to several issues:

- (i) Inundation and displacement of low lying coastal areas and wetlands
- (ii) Coastal erosion and degradation of shorelines
- (iii) Salinisation of estuaries and freshwater aquifers, and
- (iv) Changes to and migration of coastal eco-systems and habitats.

Assessing Risk for Sea Level Rise in the Coastal Zone

In order to develop a strategic approach towards planning and management of the impacts of this sea level rise, it is necessary to conduct a detailed risk assessment. This assessment should be done within a broad framework for multi-hazard coastal risk assessment framework. The risk assessment will comprise hazard, vulnerability, and capacity assessments. The superimposition of these components will lead to an overall risk assessment.

Hazard Assessment

For the hazard assessment component of the risk assessment, the impact on the coastal zone for three credible scenarios should be assessed. These scenarios will cover low, medium, and high states of sea level rise which can be developed with due consideration to existing sea level data along the coast and global predictions for the region. The primary impacts to be assessed are inundation and forecasts on increases in coastal erosion.

In the longer term, an assessment should also be done on the impact of global climate change on the wind patterns and the resulting impact on coastal erosion. The analysis could also accommodate the projected sea level rise. This assessment has to be achieved by using numerical models.

Vulnerability Assessment

Vulnerability represents the proneness of society, infrastructure, and natural resources to the impact of hazards. Critical parameters to be incorporated are identified under the six broad categories of human, physical, environment, socio-economic, functional and administrative. In this context, it is necessary to prepare a Vulnerability Database for the coastal zone, which will enable an assessment of vulnerability to sea level rise along the coastal area of the country and estimate the economic cost for different scenarios.

Capacity Assessment

Capacity assessment is carried out to assess the ability of society to respond to the impacts of sea level rises and to also assess whether critical infrastructure would be able to withstand potential impacts. The ability of those engaged in low lying agriculture to move into other types

of agriculture or trade in the event that their land cannot be protected, is a typical example. Another example is the relocation of fresh water intakes of heavily populated urban cities which are highly vulnerable to sea level rise.

Risk Assessment

Risk assessment can be achieved by the superimposition of the hazard, vulnerability, and capacity assessments and can be achieved through a number of methods. Scenario-based approaches for hazards are frequently used, together with weighted methods for vulnerability. Of course, such methods must be developed in consultation with all stakeholders.

Modelling and Geo-information

The success of assessing risk will depend heavily on the use of reliable mathematical models for simulating the physical processes and the availability of geo-information. Good quality bathymetric and topographical data are essential for successful implementation of a risk assessment study. The vulnerability data base will comprise a wide range of relevant information. It is important that risk assessment is a dynamic process which has to be regularly upgraded. Therefore, data acquisition, storage, and management are of vital importance.

Proposed Actions and Investigation for the Coastal Zone

Based on risk assessment, it is possible to identify a series of measures to mitigate the impact of sea level rise. Arising from preliminary investigative studies undertaken along the coastal zone of Sri Lanka, some of the actions identified are listed below. These actions would be refined after the completion of risk assessment studies.

Inundation

Incorporate climate change concerns in town and country planning and wetland conservation programmes.

Salt water intrusion

Assess the increase in salt water intrusion in important water bodies.

Evaluate engineering interventions needed to counter threat based on the potential impact on agriculture.

Fresh water intakes

Review the performance of existing intakes taking sea level rise into account.

Design new water intakes giving due consideration to climate change impacts.

Groundwater

Prepare groundwater extraction regulation policy.

Introduce monitoring systems for groundwater extraction and water quality assessment in vulnerable areas.

Irrigation and Low lying Agriculture

Study impact on existing irrigation structures.

Introduce salinity tolerant varieties of crops, alternative land use or engineering interventions to maintain the existing regime.

Fishery Industry

Conduct sectoral assessment on climate change impacts on fishery development including fishery harbours, fishery settlements and sustainable use of fishery resource as a basis for long term planning.



Sea defence structure, near-shore infrastructure and land reclamation

Assess vulnerability and prepare plans for improvement as well as plans for emergency response/contingency.

Accommodate sea level rise in the design of new coastal structures.

Screen near-shore reclamation against sea level rise impact.

Incorporating Sea Level Rise and Coastal Zone Management

Coastal zone management involves management and decision-making regarding activities of the coastal zone including physical measures for coastal and flood protection and development works. It has been identified that the three principal objectives of coastal zone management related to sea level rise are to:

1. Avoid development in areas that are vulnerable to inundation.
2. Ensure the continued function of critical natural systems.
3. Protect human lives, essential properties, and economic activities against the adverse impacts of the sea.

In this respect, the following recommendations are made with respect to the management of the coastal zone:

Prepare set back limits to take account of sea level rise.

Delineate critical areas and prepare special area management plans.

Formulate coastal database incorporating information on hazards and vulnerability for implementing integrated coastal area management.

Incorporate greater consideration of climate change impacts in the next revision of the Coastal Zone Management Plan (CZMP).

Conclusion

Almost all the possible responses to sea level rise are best addressed within a broader context of coastal zone planning and management. Responses to climate change must be seen as a part of a broader coastal management policy which incorporates non-climatic issues. If considered in isolation, the effectiveness of such responses would be reduced mainly due to incompatible policies and/or actions taken by other coastal sectors. Many responses to sea level rise are very similar to those required to address existing coastal zone management problems, therefore, there is a clear need for integrating the planning of sea level rise with coastal zone management practices.



Professor S.S.L. Hettiarachchi



Professor S.P. Samarawickrama

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Climate Change and Coral Reefs in Sri Lanka

by Sandeep Jayawardena

The mention of coral reefs generally brings to mind images of warm climates, clear waters, and bright marine life. Some people associate coral reefs with scuba diving, snorkeling, and holiday resorts; whilst to others they are a source of livelihoods, food, and income. Many people however do not realize the significant socio-economic role played by reefs in the lives of millions of people around the world.

Coral reefs are incredibly diverse and productive ecosystems that are home to more than 25% of all marine species, despite covering less than 1% of the marine environment⁽¹⁾. Coastal populations in a developing country like Sri Lanka, depend heavily on many of the services provided by these reef systems. They provide food and income; act as nurseries for the fish that end up in a fisherman's net; provide ornamental fish for the export market; and attract divers and snorkelers from around the world. They protect coastlines from storms and erosion, and when illegally mined, provide material for the cement, ceramic, and construction industries.

Imminent Dangers

Though coral reefs are colloquially known as the 'Rainforests of the Sea,' many of the reefs fringing Sri Lanka – especially off the heavily populated southwest coast – are considerably more desolate, as they are heavily degraded and are in poor condition (6). A healthy coral reef should be teeming with life and full of vibrant colour; yet many of our reefs are bare expanses of empty white skeletons. Local stress factors such as pollution, overfishing, destructive fishing methods, and coral mining, have played a part in their degradation. However, reef scientists have now identified climate change induced coral bleaching, and ocean acidification, as the primary threats to the future of the world's coral reefs⁽²⁾.

Global warming means warmer oceans, and unfortunately, corals are highly sensitive to changes in water temperature⁽²⁾. Coral bleaching occurs when higher temperatures cause the 'coral polyps,' the organisms that build coral, to lose the microscopic algae known as 'zooxanthellae,' that live within their tissue. The algae provide corals with food, oxygen, and energy, as well as their beautiful colour. Coral without algae look pale white and are exposed to harmful ultraviolet radiation without food or oxygen. Depending on the level and duration of temperature stress, corals can either die or be severely weakened, resulting in reduced growth and reproduction. Recent

years have seen an increase in the frequency and intensity of 'mass bleaching' events, where many coral species over a large area are bleached simultaneously. The mass bleaching event in 1998, which killed an estimated 50-90% of all corals in the Indian Ocean⁽²⁾, is the most infamous such event on record, and many reefs in Sri Lanka are still struggling to recover from its effects.

In addition to warming oceans, the rise in atmospheric carbon dioxide (CO_2) is changing the very chemistry of the water. The surface layers of the ocean absorb around one third of our CO_2 emissions. This may help moderate carbon in the atmosphere; however the CO_2 reacts with water to form carbonic acid, which reduces the pH value of seawater. Ever increasing emissions of CO_2 lead to increasing acidification, and this can have a disastrous effect on coral and other marine ecosystems that have adapted to live within a narrow pH range. In addition, it can halt coral growth and even dissolve coral structures. There is evidence that ocean acidification may even increase the likelihood of coral bleaching⁽²⁾, further aggravating the impacts of climate change.

The Case for Conservation:

Coral reefs are an exceptionally valuable resource to coastal communities. They offer a wide variety of economic goods and services, yet often their benefits are taken for granted – as is commonly the case with environmental goods and services. It would be wise to realize that the cost of replacing the services provided by reefs, in the event of Sri Lanka losing or destroying them, is likely to be significant. A 2003 study funded by the WWF, estimated the potential net benefits of intact coral reefs for fisheries, shoreline protection, and tourism, are in the region of US\$ 30 billion a year worldwide⁽³⁾. Sri Lanka's own reefs have been valued at between US\$ 140,000 and US\$ 7.5 million per km⁽²⁾, over a period of twenty years depending on where they are located⁽⁵⁾. The poorest fishing communities depend on their nearby coral reefs for subsistence level food and income, and it is they who will be most at risk if reefs are ruined. The value of coral reefs as natural breakwaters is undeniable and a study conducted in 1998, estimated that the Sri Lankan government would have spent some US\$ 30 million on coastal protection structures along the southwest coast to prevent erosion⁽⁵⁾. As it happens, coastal erosion is most severe along the southern and western coastlines where coral reefs happen to be among the

most degraded. Reefs help prevent erosion, and the cost of replacing the shoreline protection provided by reefs in Sri Lanka was projected at US\$ 246,000 - 836,000 per km^(5,7). In terms of tourism, our coral reefs may not be extensive or unique enough to draw tourists in on their own accord, however the presence of healthy reefs lend a definite edge to the tourist experience, and is a selling point for resorts located in their vicinity.

It is clear that there is a strong case for conserving coral reefs. A properly managed reef can contribute tremendously to the economy, while a degraded reef will incur costs of its own. How do we move forward, when the greatest challenge facing coral reef conservation is climate change? The impacts of climate change can only be resolved through concerted international efforts to reduce emissions from burning fossil fuels (and we all know how well that is going!). The important question then is to ask ourselves, what short-term measures we can take to reduce the severity of coral bleaching until the world can get its act together. At a national level, it is important to build reef resilience by reducing local scale stresses such, as overfishing, pollution, and direct physical damage. This will help reefs recover faster from bleaching events, increasing their likelihood of surviving climate change. It may also be possible to improve reef resistance by identifying and protecting reefs and coral species that show a natural resistance to bleaching and acidification. The existing Marine Protected Areas (MPA) should be reassessed in line with new research and a system of well enforced and well connected MPA's put in place, targeting critical areas such a fish nurseries and sites that supply coral larvae, which will help replenish other reefs.

Today coral reefs around the world face a troubling future. The pressures posed by local human activities have been compounded by climate change, and current estimates predict that in the next 25-50 years coral bleaching may become an annual event⁽⁴⁾. Ultimately the future of coral reefs depends on the success of reducing greenhouse gas emissions. Addressing climate change however is of paramount concern for the future of humanity as a whole, and not only for coral reefs. Until then we have the knowledge and understanding required to buy some time for the reefs. We know the threats, and through science, we are learning methods to keep reefs safe. We have seen that policies to protect reefs make good social and economic sense, and there is a growing awareness and acceptance of these facts. There is still hope that concerted international action to mitigate climate change, and quick policy implementation at a national level to relieve local pressure on our reefs, will help ensure that coral reefs are not to be yet another lost treasure.



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POST-COPENHAGEN AND



The much awaited Climate Change conference (COP15) concluded in Copenhagen on the 18th of December. While the Kyoto Protocol is set to expire in 2012, the COP15 was expected to come up with necessary arrangements for the post-Kyoto period. The conference was expected to deliver an internationally agreed solution for the problem of global climate change. The key issues which were discussed at the COP15 included reductions of green house gas (GHG) emissions, climate aid for poorer countries, forest issues, monitoring of pledges, and details of a legal framework to govern the above.

Has Copenhagen been able to deliver the anticipated goals? Expectations were high, considering the task of coming to agreement on the management of the most complex of global commons – the climate. As things turned out, the COP15 created more disappointments than solutions, among a number of groups, expecting a meaningful solution to combat global climate change. What has COP15 really achieved? What would be the way forward for vulnerable countries, specially the developing economies like Sri Lanka?

What has COP15 achieved?

The final outcome of the COP15 was the Copenhagen Accord, which is not a legally binding agreement, scheduled to be operational immediately in January 2010. This is expected to be signed by all the participating countries, although some countries are reluctant to do so at the moment. The Accord does not include commitments to quantitatively defined emission reduction targets. However, the Accord stipulates that by 31st January 2010, Annex I countries (developed nations) must submit and then implement self defined emission reduction targets for 2020. Non-Annex I countries (developing nations including Sri Lanka) have no such obligation, but they are required to identify self defined climate change mitigation actions by January 31st 2010. Non-Annex I countries can also specify which mitigation actions will require international support (in terms of finance, capacity building, technology, and so on). The Accord also commits developed countries to act collectively to provide new and additional resources for adaptation and mitigation needs of developing countries. The stated amount is US\$ 30 billion for the period of 2010 – 2012, and thereafter US\$ 100 billion per year by 2020.

The Copenhagen Green Climate Fund has been proposed to make the financial mechanism operative. The Fund is expected to provide support for projects, programmes, policies and other activities in developing countries related to mitigation, adaptation, capacity building, technology development and transfer. The most vulnerable

states, namely the least developed countries, small island developing states, and Africa will be the principal recipients of funds.

What has COP15 not achieved?

The key problem with regard to the Copenhagen Agreement is that it did not include the previously expected multilaterally agreed quantitative targets for emission reductions by individual countries, and deadlines for action. As it stands, the targets will be decided unilaterally by individual countries and are thus less likely to be as ambitious as what would have resulted from a multilateral decision. This is because it is not in each country's interest to set a high target given the fact that there is no guarantee that competing countries will set an equally high target – a classic case of 'Prisoner's Dilemma'. The quantitative targets set by the Kyoto Protocol will not be operational beyond 2012, hence the Copenhagen Accord has failed to provide the expected follow up to Kyoto – that is a binding global agreement that transparently defines individual country responsibilities in reducing global carbon emissions with a view to averting a temperature rise of over 2 degrees Celsius.

Failure to generate a legally binding agreement in COP15 highlights how difficult is to find a common line of action among countries with different national interests. Like on many occasions, substantive action, i.e., a legally binding treaty, has been passed over to a future event, this time to the meeting to be held in Mexico, in 2010. However, will Mexico be another face-saving exercise with no real outcome?

Implications for Sri Lanka

In the absence of a legally binding agreement in place, the historical polluters and fast-growing economies with high pollution levels, have no commitment to take necessary actions to reduce their emissions. In such a context, the vulnerable countries would continue to face adverse effects of global climate change in the years to come. Belonging to the low-emitting group of countries, climate change will be a significant challenge for Sri Lanka's development too. Adaptation remains the way out!

Adaptation necessarily requires financial and non-financial resources which the country is lacking at present. The Copenhagen Accord includes provisions for the mobilization of funds to support such adaptation measures defined by developing countries. Thus, more than ever, there is an urgent need for Sri Lanka to develop a national level agenda that identifies necessary actions for climate change adaptation, including the requirements for external support in implementing such measures. Regardless of the hazy outcomes of Copenhagen, Climate Change has to be an integral focus in Sri Lanka's future development activities.

Rio+20: Towards a 'Green Growth' Path

by Kanchana Wickramasinghe

Rio +20 Conference is now underway and is being considered a landmark event which takes place 20 years (+20) after the first Earth Summit held in 1992. The Conference is the second opportunity to revisit the issues of "sustainable development". It will be based on two major themes – a) 'green' economy in the context of sustainable development and poverty eradication, and b) the institutional framework for sustainable development. The seven areas identified as needing prioritized attention include; decent jobs, energy, sustainable cities, food security & sustainable agriculture, water, oceans and disaster readiness.

At the end of the proceedings the Rio+20 aims to: secure renewed political commitment for sustainable development; assess the progress to date and the remaining gaps in the implementation of the outcomes of the major summits on sustainable development; and address new and emerging challenges.

There has been some degree of expectation and also doubt about the actual outcome of the Rio+20. Therefore, at the onset of the Rio+20, it is vital to revisit the progress that we have made following the first 'Earth Summit' in 1992. Most of the Rio+20 arguments are aimed the fact that the world has not seriously included "sustainable development" in their ongoing development agendas. In addition, the definition of 'green economy,' has been an issue raised to be tackled as one of the two major themes of the conference.

Sri Lanka's 'Green' Efforts

Sri Lanka has taken a number of initiatives in order to 'green' its development activities. Sri Lanka has launched the 'National Action Plan for Haritha Lanka Programme', which includes short, medium and long term targets for the period of 2009 -2016 along with performance indicators. The ten thrust areas which are covered by the programme include; clean air, saving the fauna, flora and ecosystems, meeting the challenges of climate change, wise use of the coastal belt and the sea around, responsible use of the land resources, doing away with the landfills, water for all and always, green cities for health and prosperity, greening industry and knowledge for right choices.

After having identified the need to account for the contributions made by the natural environment, the Ministry of Environment, with the collaboration of relevant stakeholders is in the process of developing a 'green' accounting system for Sri Lanka. The process

is aimed at providing estimates that would lead to sustainable policy options at a national level. The contributions of the forestry sector are currently being assessed as part of this effort.

In addition to government initiatives, there is an increased trend within private sector to adopt 'green' business approaches. The



RIO+20
United Nations
Conference on
Sustainable
Development

booming tourism industry, following the end of civil war, also shows interest in taking significant 'green' steps. The ongoing Greening Sri Lanka Hotels is an important example of the private sector encouraging the adoption of 'green' options in their businesses.

A recent IPS study showed that the relevant stakeholders have very minimal knowledge on the concept of 'green jobs,' which includes both decent work and environmental sustainability. Internationally, there have been no criteria set for identifying and quantifying 'green' jobs. Several research initiatives are ongoing in this regard and it is important to develop criteria specific for the context under consideration as well as for different sectors.

High dependence on imported fuel and escalating fuel prices have highlighted a need to look into alternative "local" energy sources and to instigate renewable energy projects. The government envisages

increasing the contribution of renewable energy sources to national energy supply to 10% from the current level of 7%.

Private sector involvement in this regard is highly essential as the private sector is expected to be the engine of growth in Sri Lanka for the future. Therefore, in addition to political commitment, effective private sector involvement has to be encouraged in order to meet these goals.

Meeting the Challenges

Balancing growth and sustainability is itself a challenge, especially for developing countries. Also, such initiatives are largely constrained due to high priority being given to growth related aspects, which do not necessarily concern environmental sustainability and social equity. Besides human, financial and other resources, technology is a must for taking a 'green' approach to development, which is a major constraint in the developing world.

The South Asian region, including Sri Lanka, is aiming for faster growth in order to bring subsequent benefits to a number of prioritized areas in human development. In particular, Sri Lanka has entered an era which focuses on accelerated growth following the end of civil war. Apart from other development challenges this raises, environmental sustainability and social implication aspects remain additional challenges.

The poverty levels have significantly dropped in the case of Sri Lanka, but inequality still remains a problem. The country should take meaningful measures to reduce inequality while assuring environmental sustainability. Minimizing regional disparities should be a target – while assuring minimal damage to the environment, as natural resources can be under increased threat due to the anticipated accelerated growth in Sri Lanka.

Also, with the impacts of global climate change there can be implications on increasing disparities. For instance, increased frequency and intensity of natural disaster incidents due to global climate change can push people towards poverty. The poor populations who are primarily dependent on natural resource-based livelihoods such as agriculture are highly vulnerable in this regard. Climate change remains a serious cross cutting issue in the seven key areas which are to receive a great deal of attention in the forthcoming Rio +20 conference.

Also, as a developing country with a number of development goals to achieve, financing sustainable development also remains a major issue. Financing will mainly be required for research, technological development and implementation of greening initiatives.

Sri Lanka should stay up for the outcomes of the Rio+20 and take the event as a milestone in making strides in greener development.

There will also be new avenues opening up that the country can make use of. Particularly the private sector should be mindful to take full advantage of the emerging 'green' opportunities. Measures will have to be taken to encourage effective private sector involvement in 'green' activities.

Expected Outcomes of Rio+20

Sri Lanka and other developing countries are expecting several positive outcomes of Rio+20 to enable the country to pave a 'green' path for growth. Rio+20 is anticipated to bring the issues into meaningful discussion and bring in sustainable solutions for developing countries as well as the rest of the world. As Sri Lanka, and the South Asian region, are likely to experience an array of issues due to global climate change, the Rio+20 will have to specifically consider the cross cutting issues and possible solutions to help these countries adapt to and effectively mitigate these impacts. Rio +20 should not be a mere endless discussion, but one that would offer up tangible inputs which would help 'green' development initiatives across the globe. Existing gaps and emerging challenges are yet to be explored during the Conference. Getting the political commitment of all the members to share the responsibilities would be the most desired result at the end.

National Climate Change Policy and the Role of Citizens in the Post-Durban Era

by L. Padmini Batuwitige



The Intergovernmental Panel of Climate Change (IPCC) has confirmed that climate change is already occurring, mostly as a result of human activities.

Many natural systems are being affected by regional climatic changes, particularly temperature increases, changes of rainfall patterns, and extended draughts, which are different from what we have been experiencing before.

As a response to climate change, the global community adopted the United Nations Framework Convention on Climate Change (UNFCCC) twenty years ago on 9 May 1992. The Convention entered into force on 21st March 1994 and it now has 197 State Parties, making the Convention one of the most universally-supported/agreed Multilateral Environmental Conventions.

The ultimate objective of the Convention, and any related legal instruments that the Conference of Parties may adopt, is "to stabilize greenhouse gas (GHG) concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system". It was further stated that such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened, and to enable economic development to proceed in a sustainable manner.

The Fourth Assessment Report of IPCC (2007) illustrated that "continued GHG emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21st century that would very likely be larger than those observed during the 20th century".

It has been predicted that in the 21st century, average global temperatures could increase up to nearly 6 degrees centigrade (6°C). To avoid catastrophic impacts due to climate change (with 50% probability), it is necessary to keep the temperature rise below 2°C. To achieve a 2°C target, industrialized countries will have to

cut emissions as much as 30% below 1990 levels by 2020 and 80% by 2050 (UNDP/HDR 2008). Most countries vulnerable to climate

change demand that industrialized countries reduce the 2°C target to 1.5°C in order for them to be within safety levels.

Carbon dioxide (CO₂) is the most important anthropogenic GHG. The largest share of CO₂ emissions is due to fossil fuel combustion. Energy generation, industry, forestry, agriculture, transport, residential and commercial buildings, and waste and waste water are considered the main anthropogenic activities that cause global GHG emissions. All these sectors are directly associated with the strategies used and are being used for human development. Today, climate change has been universally recognized as a fundamental human development challenge of the 21st century.

UNFCCC specifies that developed countries need to take the lead in addressing the climate change problem as they have a better capacity and have a historical responsibility. Therefore, the principle of taking 'common but differentiated responsibilities' was included into the Convention, thereby making all countries responsible to address the climate problem at different scales. Also, the Convention requires developed country Parties to assist developing country Parties by way of financial resources and technology transfer taking into account the need for economic and social development and poverty eradication as overriding priorities of developing countries.

However, the trends of the negotiating strategies at the Conferences of the Parties (COPs) have significantly changed since COP15 in Copenhagen in 2009. At COP15, it was expected that the Parties to UNFCCC would "seal the deal" and agree to a common position on ambitious emission reduction targets to fall in line with the IPCC's predictions. However, the asymmetric interventions due to a lack of commitment to reduce GHG emissions by powerful economies resulted in an outcome that was far from what was expected. There was no legally-binding and meaningful action adopted, with firm



commitments to fulfill the ultimate objective of the convention. Additionally, most of the delegates had complaints about deviating from the formally accepted UN negotiating process at COP15 to arrive at a consensus.

The COP16, which was held in Cancun in 2010, reflected another dimension of the international environmental negotiating process in contrast to the COP15. Initially, rebuilding trust was the key element during the negotiating processes of interim ad-hoc meetings held between COP15 and COP16. However, a significant change in the trend of the negotiating process was seen at COP16. It seemed that the focus was on resolving disagreements among countries by indirectly encouraging Parties either to be silent or neutral as a strategy to continue the UNFCCC process by accepting to establish the 'Green Climate Fund'. The 'Green Climate Fund' was a positive outcome of COP16. Most Parties were sceptical about its effective implementation to achieve the desired outcome. Nevertheless, it was a strategic bargaining tool which was used to merge many disagreements which resulted in many provisions being kept open that was critical to achieve the objectives of the Convention. There were no legally-binding measures agreed upon and the future of the Kyoto Protocol was kept uncertain.

Unlike the Kyoto Protocol, in which the developed country Parties are under obligation to reduce emissions taking the lead, the Cancun Agreement required both developed and developing country Parties to share the commitments by declaring their voluntary reduction of emissions below business-as-usual scenarios. It was further decided that these reductions would be subject to international measurement and verification to secure financial and technical assistance. This means that the process would be difficult to begin with, in the absence of baseline data in most of the developing countries, especially for the agriculture and forestry sectors. Even though the Parties agreed to commit to a maximum temperature rise of 2°C above pre-industrial level at COP16 to avoid dangerous impacts (with 50% probability), the pledges put forward by the Parties were grossly inadequate to fulfill this target. The final outcome of COP16 was basically the reaffirmation of the Copenhagen outcome in a different way.

Following intense debates at COP17 held in Durban, South Africa in 2011, a decision was taken to continue the second commitment period of the Kyoto Protocol up to 2020 subject to conditions, one of which is on a new legally binding agreement that would effectively replace the Kyoto Protocol. The Green Climate Fund proposed at COP16 was further elaborated and adopted at COP17. However, there are many significant issues to be resolved to ensure good governance in the implementation mechanism of the Fund where developed country Parties should focus on assisting developing countries to address the issue of climate change within the framework of sustainable development and poverty alleviation rather than promoting profit-oriented businesses. It is also important that this Fund is made accessible to small developing countries with minimal bureaucracy.

The increasing attendance of the recent climate change conferences shows the increasing global attention to climate change talks and has become the centre of focus of the global community amidst multiple global crises. The policy decisions taken by the international community at climate change talks have a tremendous bearing on the socio-economic conditions of all countries. Around 115 Heads of States attended the high-level segment of COP15 reflecting the highest political attention placed on the issue of climate change. More than 40,000 people representing governments, non-governmental organizations, inter-governmental organizations, faith-based organizations, media and UN agencies have applied for accreditation for COP15 (www.unfccc.int). Therefore, it is an urgent necessity to look back at the full negotiating processes at previous COPs and related subsequent working groups by all the countries, and identify the real deficiencies in the negotiating process and make collective efforts to resolve conflicting issues in the negotiating texts via collaboration to achieve the objectives of the UNFCCC and its Kyoto Protocol, because the final decisions at COPs have a





tremendous bearing on the survival of all the living beings on the planet, including humans.

National Climate Change Policy of Sri Lanka and the Role of Citizens

In Sri Lanka, the National Climate Change Policy has been developed by the Ministry of Environment with a view to provide guidance and direction for all the stakeholders in the country to address the adverse impacts of climate change efficiently and effectively. The policy contains a vision, mission, goal and a set of guiding principles, followed by broad policy statements under Vulnerability, Adaptation, Mitigation, Sustainable Consumption and Production, Knowledge Management and General Statements. Needless to say, collaborative action at all levels is necessary to transform this policy into a meaningful set of actions to meet the challenges of climate change.

The goal of the National Climate Change Policy has been set as 'Adaptation to and mitigation of climate change impacts within the framework of sustainable development' with a mission of 'Addressing climate change issues locally while engaging in the global context', to secure 'a future where climate change will have no adverse consequences on Sri Lanka' which is the Vision of the policy.

The citizens should be sensitive and attentive to be aware of and knowledgeable on the vulnerabilities of climate change on their lives and livelihoods. Citizens can demand such knowledge, and be involved in the development and implementation of adaptation strategies of the government and other partners, as climate change is happening and the global attempts at present are not adequate to sufficiently address the problem. At the same time, as responsible citizens, collective efforts should be made for mitigation activities as well to secure a sustainable future for the present and future generations. In this process, it is very important to be mindful of the multifaceted issues related to climate change and identify nationally appropriate and socially inclusive prudent choices with clear understanding of the expected outcomes. In this context, 'Education, Awareness creation and Capacity building'; 'Co-operation and Partnerships'; and 'Creation of a climate change sensitive generation'; are basic prerequisites to create and manage knowledge, enabling the citizens to make right choices. The government, too, has the responsibility of being mindful of the consequences of climate change in planning and executing its development programmes.

It is necessary to adopt multiple approaches to enhance knowledge, skills and positive attitudes of different stakeholders at all levels to address multifaceted, current and emerging issues of climate change. To fulfill this objective 'availability, accessibility, and sharing of climate change related information across all sectors at all levels' are

necessary. Encouraging strategic partnerships and sharing knowledge among partners to address the multifaceted issues of climate change will eventually create a dialogue within and among various citizens groups and individuals, whose contribution will be vital for the implementation of the national policy and enhance resilience to climate change in the country. Provisions have been included in the National Policy to facilitate citizens to play their role collectively to address the climate change challenges. Effective implementation of these provisions with monitoring and feedback systems is therefore critically important in this endeavour.

The Way Forward

To address the climate change problem, sustainable production as well as consumption strategies should be adhered to. Action should be taken to narrow the wide income differences of the rich and poor in the national development strategies as both over-use and under-use of resources make the development unsustainable and eventually create unlimited demands for resources for human development. Therefore it is necessary to avoid both affluence and abject poverty in the process of economic development. "The Middle Path" is encouraged by our ancient culture and it is no way antagonistic to physical well-being. Adhering to sustainable lifestyles, focusing on simplicity and non-violence, leading to credible satisfaction of results is the key to achieve sustainable development worldwide. For that, it is necessary to move away from the perspectives that were designed and controlled based on the philosophies of 'bigger-is-better', 'more-is-better', 'richer-is-better' paradigms.

The country needs a skilled human resource base which can adequately provide environmental-friendly knowledge and technical facilities/services to support implementation of the National Policy. This is not currently available at required levels and quality. Provisions to develop such a skilled human resource base are already included in the National Policy and it is time for all stakeholders and citizens to join hands to implement these provisions and to achieve the objectives of the policy.

It is also necessary to take cognizance of technological advances being made in developed countries to harness inexhaustible renewable energy resources such as solar, thermal and wind energy systems which are expected to replace fossil fuels altogether in the foreseeable future. Sri Lanka has to accept the challenge of developing a mix of several sources of renewable energy available to the nation.



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The Rio+20 Conference on Sustainable Development

by W. L. Sumathipala

Background

The Stockholm Declaration of the United Nations Conference on the Human Environment which was adopted in Stockholm on the 16th June 1972, recognized the importance of protecting the environment. Afterwards, at the first summit in 1992, also held in Rio de Janeiro, a historic set of 27 principles on Environment and Development - the Rio Declaration; as well as Agenda 21, a detailed plan of action was adopted. This was also the occasion for the opening for signatures of the UN Framework Convention on Climate Change, Convention on Biological Diversity and the United Nations Convention to Combat Desertification.

Prior to Rio+20 (in Rio de Janeiro, Brazil, 20-22 June 2012) Rio+10 was held in Johannesburg in 2002 where the Rio Declaration and related Millennium Development Goals (MDGs) were discussed and a platform for implementation (Johannesburg plan of implementation) was agreed upon.

RIO +20

The United Nations General Assembly (A/RES/64/2) established the United Nations Conference on Sustainable Development (Rio+20) and one of the themes set up was, "a green economy in the context of sustainable development". Since the aim of the summit was to agree on a draft decision, the co-chairs of the Bureau prepared and released "zero draft" as an initial working document in January 2012. There were several meetings in different parts of the world, held in order to negotiate the text and a Preparatory Committee (PrepCom) meeting held to finalize the document. This was hosted at the same venue as Rio+20 a week prior to the summit, where world leaders met from 20-22 June.

Apart from these negotiation sessions, there were many side events that disseminated information on various subjects related to sustainable development. For example, there were seven sustainable development dialogues organized by the Brazilian Government.

The topics under discussion were: 1) Food and Nutrition Security, 2) Global Financial Crisis, 3) Unemployment, 4) Energy, 5) Oceans, 6) Cities, 7) Forests, and 8) Production and Consumption Patterns.

Under the Food and Nutrition dialogue, the right of all people to good nutritious food and need to support small farmers and promote ecologically sound agricultural methods was accepted. In addition, the need for ecological farming was also highlighted. It was agreed that in order to achieve this, small and developing countries with special emphasis on women, were key to both the present and the future of agriculture. Access to land, credit, subsidies, storage facilities and transport were identified as being most important. It was recognized that chemical-based water-intensive agriculture had been a mistake as this led to climate change in part as well as excessive expenditure on fertilizer, pesticides, and seeds. Calculations reveal that that energy spent in producing is more than the energy stored in the produced food. It was also argued that subsidies offered by Developed Countries to their farmers have made food unreasonably cheap and as a result small farmers in developing countries are badly affected. Other dialogues of this nature have made similar proposals that will be included in the report when the Brazilian Government was asked to finalize the report.

At the summit a 53 page document, 'The Future We Want,' was adopted by the heads of state, ministers and official delegates who attended the summit. The sections included in it were: Our Common Vision, Renewing Political Commitment, Green Economy

in the context of Sustainable Development and Poverty Eradication, Institutional Framework for Sustainable Development, Framework for Action and Follow-up, and Means of Implementation.

In section I of the document, 'Our Common Vision,' high level delegates declared that they will renew their commitments to sustainable development and to ensure the promotion of an economically, socially and environmentally sustainable future for our planet for present and future generations. It also stated that the eradication of poverty is the greatest global challenge facing the world today and that it was an indispensable requirement for sustainable development.

Since most of the actions and the success of progress depend on the political commitment of all parties- especially that of Developed Countries, it is important to analyze what happened under this section.

As a whole, it was seen that most Developed Countries displayed a weak political will to fulfill their obligations to provide necessary support (finance and technology) to Developing Countries. One of the aims of the summit was to reaffirm 27 Rio Principles that were agreed upon at the 1992 Earth Summit. However the 7th Rio Principles which deals with common but differentiated responsibilities was not agreed to by Developed Countries at the PrepCom meeting. The main problem for them was the differentiation of responsibilities, which suggested that Developed Countries have a bigger responsibility.

At the end of PrepCom, the document was handed over to the Brazilian Government to finalize after discussions with relevant stake holders. Finally, the document, including principle 7 with its common but differentiated responsibilities, of Rio Principles was adopted as the outcome of the summit.

Brazilian President, Dilma Rousseff, in her speech at the closing session of the summit on the 22nd July, said that the outcome document was a starting point for implementing the path to sustainable development. There are many important points in the document that will have a bearing on the development path of Developing Countries.

In relation to changing sustainable patterns of consumption and production which was agreed to at Rio+10, it was agreed that all countries should promote sustainable consumption and production patterns. It was emphasized that developed countries need to take the lead for the benefit of all, taking into account the Rio Principles, including the Principle of Common but Differentiated Responsibility.

A significant achievement of the summit was the adoption of a ten year framework of programmes on sustainable consumption and production patterns that was finalized at the 19th session of the Commission on Sustainable Development in 2011.

Other major achievements of Rio+20 are that it has implications not only for the UN Sustainable Development Agenda but also for the negotiations on the UN Framework on Convention of Climate Change (UNFCCC) which operates on the principle of Common but Differentiated Responsibility (CBDR). Developed Countries opposed to the references made to CBDR in the paragraphs on the Rio conventions, but agreed to urge all parties to fully implement their commitments under the conventions in accordance with their respective principles and provisions, as well as to make efforts and create actions and measures at all levels and to enhance international cooperation.

There was a decision taken to work on a Sustainable Development Goals (SDGs) in the next few years and there were concerns, especially among Developing Countries, that this could undermine

the implementations of the MDGs whose target deadline is 2015. Technology transfer for sustainable development was finally agreed as having input in finance, debt, trade and technology transfer as mutually agreed, and innovation, entrepreneurship, capacity – building, transparency and accountability.

The agreed text on Climate Change states that combating climate change requires urgent and ambitious action, in accordance with the principles and provisions of the UNFCCC.

Political commitment was renewed, complete with broad statements, calling for holistic and integrated approaches to sustainable development that will guide humanity to live in harmony with nature and which would lead to efforts to restore the health and integrity of the Earth's ecosystem.

Other major topics in the report included Green Economy in the context of Sustainable development and poverty eradication. It was concluded that policies for a green economy should be guided by and be in accordance with all the Rio Principles, Agenda 21, and the Johannesburg Plan of Implementation.

It must be noted that in addition to these agreements to bear fruits there should also be legally binding instruments (protocols) or genuine efforts by all parties especially Developed Country members. From the voices of big powers in the developed world it could be inferred that the progress will be slow and actions will be limited and biased. Developing Countries should, therefore, move forward steadily on agreed principles and binding agreements at least to strive to achieve whatever possible as early as possible.



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Human Development Report 2011

Sustainability & Equity: A Better Future for All

Reviewed by Saman Kelegama

Introduction

According to projections of the 2011 Human Development Report (HDR), the growth and development in the world's poorest countries could be halted or even reversed by mid-century unless bold steps are taken now to slow climate change, combat further environmental damage, and reduce deepening inequalities within and among nations. Titled "Sustainability and Equity: A Better Future for All", this UNDP publication argues that urgent global challenges of sustainability and equity must be addressed together and identifies policies at the national and global level that could spur mutually reinforcing progress towards these interlinked goals. The Report argues that if the recent human development progress for most of the world's poor majority — as shown in previous HDRs — is to be sustained for the benefit of the future generations as well as for those living today, bold action would be needed in both fronts of sustainability and equity.

Environmental degradation intensifies inequality through adverse impacts on already disadvantaged people. Likewise, inequalities in human development amplify environmental degradation. Thus, sustainability is intrinsically linked to equity. The report acknowledges however that environmental sustainability and equity are not always mutually reinforcing and there are instances of possible trade-offs. Understanding the links between environment sustainability and equity is thus crucial if we are to design policies to upkeep the human development indicators (HDI) trends of developing countries as in the past.

The Report identifies pathways for people, local communities, countries, and the international community to promote environmental sustainability and equity in mutually reinforcing ways. In other words, the Report emphasizes that promoting human development requires addressing sustainability at all levels and this can and should be done in ways that are equitable and empowering.

Environmental Impact

The Report analyses the changes in the HDI for the next 40 years under two different scenarios, namely, "environmental challenge" and "environmental disaster". Under the former, when some of the environmental factors such as global warming on agriculture, access to clean water and improved sanitation and pollution are incorporated, the HDI would be 8 per cent lower by 2050 when compared with the baseline. Under the latter, when vast deforestation and land degradation, declines in biodiversity and accelerated extreme weather events are incorporated, the global HDI would be 15 per cent below the projected baseline.

It is shown that the burden of environmental degradation and climate change is likely to be disequalizing across groups. For instance, people living under subsistence near forests amounts to 350 million. Deforestation and restrictions on access to natural resources can hurt these people. The Report shows that power imbalances and gender inequalities at the country level are linked to reduce access to clean environment amplifying the effects associated with income disparities. Gender inequality also interacts with environmental outcomes and makes them worse.

Another trend observed is that increasing HDI is associated with environmental degradation, through economic growth. For instance, countries with higher incomes have higher carbon emissions. Moreover, adverse environmental factors in countries with higher income will enhance world food prices by 30-50 per cent in real terms with volatility in the coming decade and with harsh repercussions for poor households living in low income countries. The projections add to the current understanding that the most disadvantaged people would bear most of the cost of environmental deterioration, although their contribution to the problem is relatively less.

The HDR 2011 takes a step forward from the multi-dimensional poverty index (MPI) presented in the HDR 2010 to include environmental deprivations. It takes into account the access to modern cooking fuel, clean water and basic sanitation. According to the findings, 60 per cent of people in developing countries and 40 per cent of people in developed countries are faced with environmental deprivations. The deprivations are acute among the multi-dimensionally poor. So the world's most disadvantaged people suffer the most from environmental degradation and disproportionately lack political power, making it all the harder for the world economy to reach an agreement on the needed global policy change.

Policy for Sustainability

The Report outlines greater potential for positive synergies in the quest for greater equality and sustainability, especially at the national level. The Report looks at the approaches which can integrate environmental sustainability and equity to promote human development, to create win-win solutions. Some countries, like Costa Rica have been able to show significant progress in the HDI, equity and environmental sustainability.



UN Resident Coordinator and UNDP Resident Representative in Sri Lanka Subinay Nandy handing over the Report to Hon. Anura Priyadarshana Yapa, Minister of Environment, who delivered the keynote address.

The report highlights the fact that the effective solutions must be context-specific. And the possible win-win strategies, for instance, investments that improve equity — in providing access to renewable energy, water and sanitation, and reproductive health care — could advance both sustainability and human development.

Environmental degradation can be reduced by ways of expanding reproductive choice, supporting community management of natural resources and conserving biodiversity while promoting equity. Successful approaches rely on community management, broadly inclusive institutions and attention to disadvantaged groups. The key policy directions for addressing climate change risks would be equitable and adaptive disaster responses and innovative social protection. A clean and healthy environment is a right and not a privilege. Constitutionally recognizing equal rights to a healthy environment promotes equity by no longer limiting access to those who can afford it. And embodying the right in the legal framework can affect government priorities in resource allocation.

In a nutshell, the key policy priorities for the win-win strategy to work are: (1) ensure that the installation and regulatory framework for governments are in place to enable scaling up private investments in developing countries; (2) sustainable/equality objectives should be reflected in budgetary allocation priorities; (3) mobilize additional resources to narrow the gap of environmental deprivation; and (4) ensure that local level/community based participants have the capacity to define policies and budgets, and implement programmes — to support sustainability and equity.

Financing

The finances needed for sustainability and equity is large and many times greater than the current official development assistance. Today's spending on low-carbon energy sources, is only 1.6 per cent of the need but spending on climate change and adaptation and mitigation is around 11 per cent of estimated need. Global allocation on social protection is close to 17 per cent of GDP but much of this by-passes the most needy/disadvantaged. The high income countries spend on average 20 per cent of their GDP on social protection while low income countries spend about 4 per cent. The Report argues that there is enormous potential to increase this spending in low income countries and it is needed for financing the new sustainability and equity agenda highlighted in the Report. The Report shows that 2 per cent of GDP can provide the world's poor with minimum package social benefits with basic health care, education, basic income transfer, etc., and if the package is broadened to include climate change adaptation, it will lead to 2.5 per cent of GDP. The report shows that approaches which integrate equity into policies and programmes and those that empower people to bring about change in the legal and political areas, hold enormous promise.

Market mechanism and private funding will be vital, they must be supported and leveraged by pro-active public investment. Public investment, the Report says, can catalyze private investment, emphasizing the increasing public funds and supporting a positive investment climate and local capacity. Closing the financial gap requires innovating thinking, which the Report articulates.

The Report suggests a currency transaction tax which was first mooted in the 1994 HDR, as a prime candidate to tap on. It says that the idea is increasingly accepted as a practical policy option and the recent financial crisis has revived interest in the proposal. It has high level endorsement, including from a leading group of Innovating Financing with 63 countries. Moreover, the UN High Level Advisory Group on Climate Change Financing recently proposed that 20-25 per cent of the proceeds from such tax collection should be directed to climate change adaptation and mitigation in developing countries. Estimates show that 0.005 tax on financial transactions can yield US \$ 40 billion in revenue. And a tax of 0.05 per cent on

domestic and international financial transactions could yield US \$ 600-700 billion. The Report says: "Not many other options could satisfy the new and additional funding needs stressed in international debates". The Report shows that most G-20 countries have already implemented a financial transaction tax, and the IMF has confirmed the administrative feasibility of a broader tax.

The other financing option articulated in the Report is using the IMF's SDRs for innovative financing and climate change adaptation. Monetizing part of IMF's surplus it is shown, could raise US\$ 75 billion with little costs to any government. SDR as seed capital for a new global green fund, issuing additional SDRs and other reserve assets could mobilize US\$ 100 billion a year by 2020.



Several public and private sources could also be tapped to close the financing gap. Already, innovative financing instruments — such as Clean Technology Fund and the Strategic Climate Fund — are blending funding from multilateral development banks, governments, climate finance instruments and the private sector. They have raised an additional US\$ 3.7 billion for development and can leverage substantial additional funds.

The Report argues that the new financing need to be allocated to meet the challenges of inequity and unsustainability and not to exacerbate existing disparities.

Way Forward

The Report calls for a bold new approach to global development financing and environmental controls, arguing that these measures are both essential and feasible. Moreover, beyond the MDGs, the world needs a post-2015 development framework that reflects equity and sustainability and the Report has laid the foundation for this. In June 2012, World leaders meet in Rio to discuss a new consensus on global action to safeguard the future of the planet. The conference, known as Rio+20, will focus on two themes, namely, a green economy in the context of sustainable development and poverty eradication, and the institutional framework for sustainable development. Also, the 17th Conference of the Parties (COP17) to the United Nations Framework Convention on Climate Change (UNFCCC) is scheduled in 2012 in Durban, South Africa. These conferences stand out as key opportunities to reach a shared understanding on the global development agenda and build on the just completed 4th High Level Forum on Aid Effectiveness (in Busan, Korea) where a new Partnership for Development Cooperation was articulated. The new knowledge contribution of the HDR 2011 will certainly go a long way in enriching the discussions of both these conferences and formulating a new global development agenda for the 21st century.

(Courtesy: *The Island*, 04 December, 2011)

Human Development Report 2007-2008

Fighting Climate Change: Human Solidarity in a Divided World

Reviewed by Athula Senaratne

The year 2007 became a 'year of climate change' not only for the reason that IPCC and Al Gore were jointly awarded the Nobel Peace Prize but also due to a number of important publications and conferences that came out on the subject. In a sense, it can be considered as a 'year of awakening' to this global threat, which is involved with numerous uncertainties. The year commenced with the still ongoing dialogue opened by the Stern Review, which was released in the last quarter of 2006. From February onwards, IPCC series of Fourth Assessment Reports began to flow creating a hitherto unprecedented voice on the issue. The year ended with the much publicized UN conference on climate change at Bali, Indonesia. While scientists captured the limelight, which was duly recognized with the joint award of the Nobel Peace Prize of 2007 to IPCC, the shock waves created by the Stern Review and IPCC series was strong enough to keep policy makers, economists and other social researchers on alert. No evidence would support this observation strongly as the dedication of the main theme of the Human Development Report 2007-2008, one of the key publications that draw the wide attention of policy makers and economist alike, to this important global issue. The above mentioned reasons also justify the selection of this theme as a timely move.

South Asia, being one of the worst poverty stricken areas in the world, houses nearly a quarter of the global population in a relatively small stretch of land area and therefore is one of the most densely populated regions in the world. It is a vulnerable region in the world for impacts of climate change in terms of both physical as well as socio-economic consequences. Despite their close geographical location and commonly shared burden of widespread poverty, countries in South Asia represent a highly diverse scenario. It has large sub-continental mainland nations with significant coastlines (India, Pakistan and Bangladesh), island nations (Sri Lanka), archipelagos (Maldives) and land-locked mountainous countries (Nepal and Bhutan). Climatic diversity found in the area ranges from arid tropical deserts to mild temperate montane climates.

As far as impacts of climate change are concerned, predictably, island nations are more susceptible to sea level rise. A significant population of the mainland sub-continent is dependent on glacial mountain flows for their main supply of water and therefore is vulnerable to future water shortages as well as to extreme events of floods. Generally, the region is located in a drier area of the tropics and future increases of atmospheric temperature are likely to generate problems of desertification, adverse impacts on major crops and outbreaks of vector borne diseases. Weather patterns in the region involve frequently occurring disaster prone weather extremes such as droughts, floods and cyclones under the influence of strong seasonal monsoons and turbulent weather areas such as Bay of Bengal. Predictions by global studies on climate change suggest that such extreme events would increase in intensity and

frequency in the future. As significant masses of 'poorest of poor' in all countries are dependent directly on weather-reliant livelihoods such as agriculture, fisheries, forestry etc., any adverse change in the already volatile weather patterns are likely to create chaotic situations. Hence, South Asia's position in the face of global climate change is highly unenviable in terms of vulnerability to potential harmful impacts. It leaves a quarter of global population at the risk of large scale victimization to the vagaries of increased climate hazards unless carefully planned local, national, regional and global action is brought into effect without delay.

In this backdrop, Human Development Report 2007-2008 brings in a wide coverage of issues relating to this important global phenomenon in an accessible manner. Even though it does not have any special focus on the South Asia Region, there are many areas of interest that merit the attention of policy makers and scholars in the region. The report covers the climate change under 04 dedicated chapters and 34 boxes, which provide substantial information on this important global issue. In addition, 08 dignitaries including the Secretary General of UN, President of Brazil and Rev. Desmond Tutu have made special contributions to the volume. The specific chapters provide lengthy treatments on respective issues, namely; scientific projections and climate change scenarios (Chapter 01), risks and vulnerability (Chapter 02), strategies for mitigation (Chapter 03) and adaptation (Chapter 04), which can be considered as the key interest areas for policy makers' attention. Boxes cover specific aspects on these major topics informing readers with useful details.

Chapter one provides a broad overview of 'the 21st century climate challenge' summarizing and highlighting scientific information and predictions extracted from various scientific sources. It covers important topics such as climate science and future scenarios, measuring carbon foot prints, sustainable and unsustainable climate pathways to the future and the necessity of global action to avoid dangerous climate change outcomes. While the facts presented in this section are mostly available from other sources also, the important contribution here is policy oriented presentation that lays the foundation for analysis in the forthcoming sections.

The second chapter deals with the important topic of 'Climate shocks: risks and vulnerability in an unequal world'. Among the wide scope of climate change issues covered in the report, this section merits special attention of policy makers and social scientists due to its systematic focus on poverty and climate change, providing an explicit analysis of the impacts of climate shocks over poor communities. Among other issues discussed in the report, this is a subject area where the Human Development Report is more authoritative and therefore the value of contribution is high. The



section on 'climate shocks and low human development traps' is particularly informative about the plight of the poor in the growing threat of climate disasters. It highlights climate as a powerful force in shaping the life chances of poor people and intimately linked with agriculture and other weather dependent livelihoods such as fisheries and forestry, using empirical evidence available on climate hazards world over. It argues that risk and vulnerability for climate shocks are two different phenomena. Even though many communities around the globe are under continuous risk of exposure to climate hazards, not all of them are equally vulnerable to the consequences. It argues that although residents in lower Manhattan as well as residents of Ganges Delta both undergo the risk of floods, the vulnerability of the two communities are not equal. Sometimes repeated or multiple exposures to climate hazards as observed in certain areas of the African continent and in countries such as Bangladesh can lead to complex human disasters. However, in many societies (or among societies), inequality in human development situation makes the difference in levels of vulnerability. The section explains using the recent data on climate disasters and their consequences, how climate shocks could leave permanent damages over communities which fall under certain critical values of human development levels. It further argues that climate shocks can be instrumental to low human development traps (which are somewhat similar to poverty traps) that pull down the most vulnerable groups along a downward spiral.

Section two of the chapter attempts to convert broad IPCC climate projections over selected major climate risks into potential human development outcomes. The selected major risks are: agriculture production and food security, water stress and food security, rising seas and exposure to extreme weather risks, ecosystems and biodiversity and human health and extreme weather events. For each of these risks, the report summarizes IPCC projections and describes potential development outcomes highlighting the most vulnerable areas and countries for them.

The recently released Fourth Assessment Report of IPCC (AR4) and a number of other global surveys have identified the following major strategies to confront the challenge of climate change impacts. They are:

- Avoiding the unmanageable by mitigation strategies aimed at controlling emissions,
- Managing the unavoidable through adaptation measures against potential impacts,
- Increased vigilance through enhanced monitoring of climate for early detection of hazardous events.

Activities pertaining to these broad strategies have to be adopted at global, regional, national and local levels in appropriate manner and the major policy challenges involved are finding the correct balance of these measures and effective implementation of them with the cooperation of local, national and international stakeholders. Chapters 3 and 4 of the report are dedicated to these major policy strategies and challenges to be faced and effective implementation of them.

As far as the South Asia Region is concerned, not only in terms of vulnerability but also in terms of its contribution towards global warming, the region bears some importance. Despite widespread poverty, some parts of the region are fast emerging as economic growth centres thereby gradually assuming a role as a contributor to the global warming too. India is the 5th largest contributor to the GHG emissions in the world even though per capita emissions are by far lower than those of developed countries. This includes CO₂ from fossil fuel burning as well as CH₄ (methane), another major GHG, from agricultural lands. India's position as a major GHG producer has already been a subject of controversy in international politics of climate change negotiations too. On the other hand, the high rate of deforestation taking place throughout the region is also a contributing factor to the global warming. Therefore, the region has to play some role in terms of mitigation of climate change also.

Mitigation strategies are the subject matter of Chapter three, which is titled 'Avoiding dangerous climate change: strategies for mitigation'. The basic objective of the chapter is to explore the strategies for transition towards a low carbon economy in the 21st century. The chapter commences with the critical topic of carbon budgeting that makes the foundation for controversial emission control targets. While acknowledging the crucial importance of carbon budgeting for international cooperation on emission control agreements, the section highlights the difficulties associated with current target setting exercises for generating credible global emission targets. Credible global targets are an essential pre-condition for successful international cooperation as the challenge of negotiations lies with aligning national targets with global targets.

The chapter goes on to emphasize the important role of markets and governments in emission control. Among the major alternative paths for emission reduction are taxation and cap-and-trade systems. The section describes some of the important issues associated with the prominent carbon market available today, the EU emission trading scheme. While stressing the importance of overcoming various barriers that presently plague the carbon markets thereby reducing their effectiveness as emission control strategy, the chapter goes on to highlight the important role of government regulation and standards also. It touches on four major areas, namely; energy generation, residential sector, vehicle emission standards and research and development (R&D) for deployment of low-carbon technologies. The final section of the chapter highlights international cooperation for mitigation and emission control. It argues that the international community has overlooked and thus underexploited the important prospects for a win-win solution in cooperation for climate change mitigation in areas such as technology transfer for raising energy efficiency in developing countries, reduction of deforestation and land use change. As a whole, the chapter brings in some important topics of interest to policy makers and policy designers and which should be taken into serious consideration when it comes to designing national mitigation policies and negotiating for international agreements. The main points raised in the chapter can be summarized that success towards the goal of low carbon economy lies in three fundamental facts, namely: establishing correct price on carbon emissions, achieving broad behavioural changes of consumers and investors for shifting demand towards low-carbon energy sources and facilitating international cooperation of global actions.

Many climate change studies seem to imply that some degree of climate change impacts are unavoidable given the already accumulated and ongoing GHG emissions even if humanity will be successful in controlling future emissions to an acceptable level. Therefore, countries all over the world have to prepare for living with these inevitable impacts. To this effect, countries have to adopt suitable adaptation measures wherever necessary and increase the alertness over climate hazards through enhancing the climate monitoring capacity. Such measures may include protection of low lying coastal areas from sea level rise, development of disaster resilient crop varieties, relocation of the most vulnerable communities, improvement of building designs to face weather extremes and many other forms of adaptive action.

The final theme chapter of the report (Chapter 04) takes the important topic of adaptation into the discussion under the title 'Adapting to the inevitable: national action and international cooperation'. The chapter is divided into two broad sections on adaptation at the national and international level. The section on adaptation at the national level begins with a comparative account on climate adaptation in developed and developing countries highlighting the influence of disparity of human development levels of respective countries on national adaptation efforts. Probing further into the subject of national adaptation, the report identifies four major areas of adaptive action. They are: enhancing the availability of information on climate change, infrastructure for climate proofing, insurance for

social protection and institutions for disaster risk management. All these aspects are discussed with examples from developed as well as developing countries. The point stressed throughout the section is the necessity and challenges of building the capacity of developing countries to meet the challenge.

This inevitably leads to the question of international cooperation and development assistance for adaptation to climate change. The core question is how affluent countries can help to meet the adaptation requirements in poor developing nations. The report argues that developed countries cannot overlook their responsibility on the grounds of historical responsibility of industrial countries to global warming, moral obligation, and human rights as well as enlightened self-interest. Climate change is a global threat and you have to care for your neighbours' problems not only for the sake of goodwill to them but for your own wellbeing too. Report goes on to highlight that existing international cooperation for climate adaptation is too late, too little and too fragmented to meet the challenge. This is a result of a combination of reasons that include lack of national agendas on adaptation in developing countries, donors' failure to honour their pledges for past commitments, lack of dedicated mechanism to deliver support for adaptation and slow progress in integrating climate adaptation into donors' aid portfolios. The key areas to be concentrated in overcoming these issues are ways of financing adaptation insurance and mainstreaming assistance on adaptation to national development and poverty reduction strategies. Adaptation should be placed on the centre of partnership between developed and developing countries. The report argues that the obvious vehicle to attain these objectives is concentration on poverty reduction strategy papers (PRSP).

Overall, the report provides an authoritative coverage of the important global problem of climate change, particularly targeting an audience that could play an important role in formulating policies to confront the challenge. The subject matter, which is usually the domain of climate scientists and environmental experts, has here been presented in quite an accessible fashion for readers without any expert knowledge on the subject. Given the large number of other authoritative literature that have appeared on the subject recently, the real contribution of the HDR 2007-2008 comes not in facts and new ideas generated in the volume but in its organization and presentation of facts from a policy oriented perspective in an accessible manner for the target audience of policy makers, economists, and policy planners. Even though the economics of climate change has gradually emerged as an important area of specialization among environmental economics circles, it is a subject largely unfamiliar to economists and planners who are usually dealing with macroeconomic policy and planning. Policy briefs and executive summaries of IPCC and other major reports are usually more popular among technocrats in environmental ministries and research institutes rather than in finance ministries, planning departments or central banks. Hence, the real contribution of this important theme report is to carry the message to this important group of stakeholders who are indispensable when it comes to designing and implementation of climate change policies.

Despite numerous recent contributions on climate change policy, a dubious character still surrounds the subject. It is no secret that the huge uncertainties involved with the entire phenomena of climate change are responsible for this situation. For developing country policy makers who have access to limited local information to act upon while confronted with numerous other urgent interests to be addressed with scarcely available resources, climate change policy could still be seen like fighting with a shadow enemy. As a result, an interest has recently emerged over the subject of adaptive policy making under uncertainties. We observe that adaptive policy on climate change to face unanticipated conditions is an important subject area missing in the volume and the opportunity could well have been used to introduce this all important subject to policy

oriented target groups of the HDR 2007-2008. This is one area that contributions in the future should be contemplated.

One cannot overemphasize the importance of national action for fighting the global warming/climate change as many mitigation and adaptation measures have to be undertaken essentially at the national level and below. Not only that, unless national actions also fall in line with the global agenda, achieving the desired outcomes of international actions too would be impossible. Despite the critical importance of national level actions, however, few developing countries have so far taken tangible actions to mainstream climate change in their national development strategies and the South Asia Region is not an exception. Regardless of chaotic implications that are pending, the region's preparedness to the global calamity can hardly be considered as satisfactory. Situation of national and sub-national information on climate change in South Asia is none better than those of other developing regions. Besides, the region's current drive towards a high rate of economic growth has, in many occasions, a tendency to over-determine environmental concerns, overlooking long-term consequences of development activities. Hence, coupled with the absence of essential information also, policy makers seem to have placed a lesser priority for climate change problems in the national agendas in many countries in South Asia. In the backdrop, we appreciate the commendable effort undertaken by the authors of HDR 2007-2008 to inform the influential target group of policy makers and planners on this all important subject.

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Athula Senaratne, Research Fellow - Athula

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He has researched and published in areas such as sustainable agricultural systems, supply and demand analysis of fish, economic utilization of non-timber forest products (NTFP), deforestation and land use planning and institutional analysis of community-based aquaculture. His major current research interests are climate change economics, economics of rural institutions and environment and macroeconomic policy. He jointly authored the Sinhala language text book on Natural Resource and Environmental Economics which is being used at undergraduate level in Environmental Economics at universities in Sri Lanka.

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IPS RESEARCH STUDIES ON CLIMATE CHANGE

Role of ICTs in Early Warning of Climate-Related Disasters: A Sri Lankan Case Study

Information and Communication Technologies (ICTs) have increasingly been recognized as innovative ways of managing environmental challenges, including climate change. In this regard, it is an important development that ICTs are used as an adaptation tool in disaster early warning in Sri Lanka. Being an island nation, located in the lower latitude of the India Ocean, Sri Lanka is particularly vulnerable to acute impacts of climate change. As the country has been experiencing increased intensity and frequency of extreme weather events such as storms, cyclones, floods etc., there is an essential need for having an effective early warning system to disseminate timely and important information to vulnerable groups to enable them to take immediate response measures and thereby to minimize potential negative impacts. In this background, the case study aims to assess the Disaster Early Warning Network (DEWN) of Sri Lanka, in terms of ways of ICT application, role of DEWN in adaptation and coverage, stakeholders involved, costs and benefits to the stakeholders, success factors, constraints and issues in scaling up the system to form an all-hazard approach and to cover all vulnerable geographical regions. The case study will be developed based on the information gathered through key informant interviews with relevant officials from the mobile companies, ICT sector, disaster management and climate change agencies, and secondary information, which will be gathered from various sources.

Team: Kanchana Wickramasinghe
Funded by: IDRC

Mainstreaming Climate Change for Sustainable Development in Sri Lanka: Drafting a Strategic Plan to Coordinate National Action

The fact that climate change poses economic, social and environmental threats to the world, and that developing nations are more at risk than the developed, are no more the matters in discussion around the world when it comes to the issue of climate change. The focus is now on clarifying whom, how and when to mitigate and adapt to the threats of climate change. Sri Lanka being a tropical island, with a majority depending on weather-reliant livelihoods and located in a disaster prone region, makes it extremely vulnerable to the effects of climate change and thus, calls for immediate measures to confront climate change at national level in line with the global agenda.

This study was carried out by IPS with the funding support of UNESCO Participation Programme 2008-2009. The findings of the study were published as "Mainstreaming Climate Change for Sustainable Development in Sri Lanka: Towards a National Agenda for Action". It proposes a broad conceptual framework, covering a national vision, a national

policy, a strategic action plan, coordinating mechanism, climate change information system, and a mechanism for resource mobilization, to facilitate the formation of a comprehensive national agenda. This website, another major outcome of the project, will act as an online virtual network to facilitate the implementation of the national agenda and free flow of information to public/decision makers

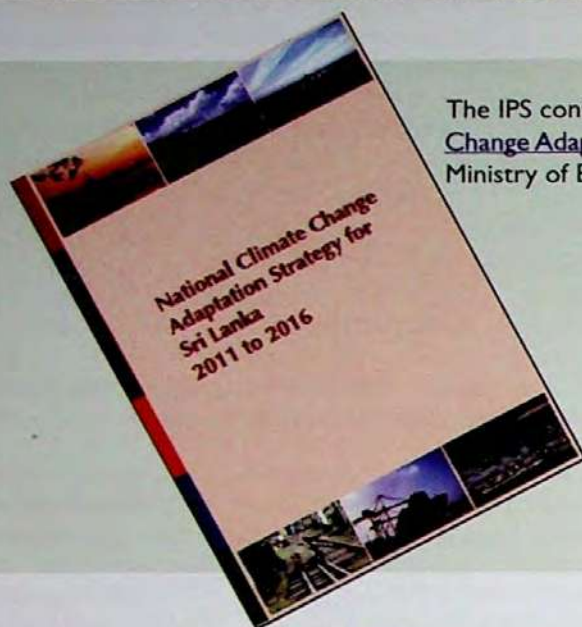
Research Team: Athula Senaratne, Kanchana Wickramasinghe and Nethmini Perera

Commons vs. Commons: Managing Scarce Water Resources in Dry Zone Village Tank Systems in Sri Lanka

Rising water scarcity has become a significant challenge for in the Dry Zone where a significant share of the population under village tank systems. They represent one of the most vulnerable community groups in the country. This study attempts to identify institutional and policy solutions that can provide sustainable answers for the problems faced by village tank farming community due to rising scarcity of water in the face of pending uncertainties relating to the climate change. Study was conducted in the Anuradhapura district of the North Central Province in Sri Lanka, using participatory methods of focus group discussions and key informant interviews and secondary sources. The study reveals that physical scarcity is only one aspect of the problem and it is closely involved with more contentious issue of institutional limitations. Findings of the study revealed that temporal scarcity of water and associated problems of managing local resources has been the major challenge that shaped the evolution of local farming systems and water management strategies. Traditional system evolved to overcome this challenge had a strong arrangement of CPR which was governed by the local institutions and social customs. Recent changes of population growth, government policies, commercialization of local economies and modernization of agriculture technology radically altered traditional system favouring privately oriented, resource intensive commercial farming system. The collapse of governance over local resources, especially upland component of farming system led to major environmental problems affecting local water resources. This situation demands solution strategies that include technical, institutional and policy interventions applied over the integrated system of local resources. Implementation of technical solutions has to be facilitated by the modified system of local institutional arrangements spearheaded by Farmer Organizations, which needs to be strengthened by appropriate policy measures.

Research Team: Athula Senaratne, Kanchana Wickramasinghe

CONTRIBUTION TO MAKING



The IPS contributed to the formulation of the National Climate Change Adaptation Strategy for Sri Lanka: 2011 to 2016, by the Ministry of Environment, Sri Lanka

Climate Change Related External Publications

Wickramasinghe, K. (2011) Review of Climate Finance: Regulatory and Funding Strategies for Climate Change and Global Development (Eds) R.B. Stewart, B. Kingsbury, B. Rudyk, New York University Press, New York and London, 2009, in *Trade Insight* Vol.7, No. 2, 2011

Wickramasinghe, K. (2011), Role of ICTs in Early Warning of Climate Related Disasters: A Sri Lankan Case Study, Published electronically at the "Notes on ICTs, Climate Change and Development" (<http://www.niccd.org/>). Downloadable from www.niccd.org/ICCD_Disasters_Case_Study_EarlyWarning.pdf

Wickramasinghe, K. (2011), Review of Twenty-first Century Macroeconomics Responding to the Climate Challenge (eds) J.M. Harris and N.R. Goodwin, Cheltenham: Edward Elgar Publishing Limited, 2009 in *South Asia Economic Journal*, 12, 1 (2011): 148 – 155

Senaratne, A. and K. Wickramasinghe (2010). Climate Change, Local Institutions and Adaptation Experience: The Village Tank Farming Community in Dry Zone Sri Lanka. In Evans, A., Jinapala, K. (Eds.). 2010. *Proceedings of the National Conference on Water, Food Security and Climate Change in Sri Lanka*, BMICH, Colombo, Sri Lanka, 9-11 June, 2009. Vol 2: Water quality, environment and climate change. Colombo, Sri Lanka: International Water Management Institute (IWMI).

Conference Presentations Related to Climate Change

- Kanchana Wickramasinghe made a presentation on "Role of ICTs in Early Warning of Climate-Related Disasters: A Sri Lankan Case Study" at the International Forestry and Environment Symposium 2011, organized by the University of Sri Jayewardenepura, on 28 - 29 October, 2011 at Golden Rose Conference Centre, Boralesgamuwa.
- Kanchana Wickramasinghe made a presentation on "Climate Impacts on Performance of Agricultural Exports of Sri Lanka: Analysis Based on the Tea Sector" at the "Third Annual Research Forum of the Sri Lanka Agricultural Economics Association (SAEA)", Colombo, Sri Lanka, 2 October, 2009.
- Kanchana Wickramasinghe made a presentation on "Adaptation to Impacts of Climate Change on Agriculture, Forestry and Water: Major Gaps and Key Policy Challenges", at the Conference on "Global Climate Change and its Impacts on Agriculture, Forestry and Water in the Tropics", organized by the University of Peradeniya, Kandy, Sri Lanka, 10 – 11 September, 2009.
- Athula Senaratne made a presentation on "Mainstreaming Climate Change for Sustainable Development" at the National workshop on "Mainstreaming Climate Change for Sustainable Development" organized by the IPS in collaboration with Ministry of Environment and Natural Resources and UNESCO, Sri Lanka Commission on 19-21 August, 2009, Dambulla, Sri Lanka.
- Athula Senaratne made a presentation on 'Climate Change, Local Institutions and Adaptation Experience: The Village Tank Farming Community in Dry Zone Sri Lanka' at the Water and Food Conference of International Water Management Institute (IWMI), Colombo, Sri Lanka, on 9-11 June, 2009.

IPS CLIMATE NEWS



The launch of the UNDP Human Development Report 2011 titled, "Sustainability and Equity: A Better Future for All," took place on November 22, 2011 at the IPS Auditorium in the presence of Hon. Anura Priyadarshana Yapa, Minister of Environment, who delivered the keynote address.



The IPS in collaboration with the Ministry of Environment & Natural Resources, and Sri Lanka National Commission for UNESCO organized a workshop on 'Mainstreaming Climate Change for Sustainable Development in Sri Lanka: Drafting a Strategic Plan to Coordinate National Action', at Hotel Amaya Lake, Dambulla, during 19-21 August, 2009. The Welcome & Introductory Address was delivered by Dr. Saman Kelegama, Executive Director, IPS. Dr. Nimal Sanderatne, Former Senior Visiting Fellow, Postgraduate Institute of Agriculture, University of Peradeniya was the Chief Guest. Athula Senaratne, Research Fellow & Head, Environmental Economic Policy Unit, IPS, made a presentation on the introduction to the workshop. W.L. Sumathipala, Director, Climate Change Division & National Ozone Unit, Climate Change Secretariat, Ministry of Environment & Natural Resources made a presentation on 'Science of Climate Change Adaptation'.

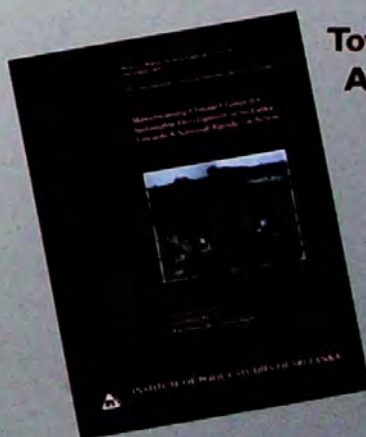


A Regional Seminar on "Emerging Issues on Trade, Climate Change and Food Security: Way forward for South Asia" organized by IPS, South Asia Watch on Trade, Economics, and Environment (SAWTEE) and Oxfam Novib took place on 31 May - 1 June 2012 at the IPS Auditorium. Minister for Environment, Hon. Anura Priyadarshana Yapa, Chief Guest at the Seminar, reiterated the impact climate change is having in South Asia.



IPS launched a new publication on climate change titled 'Mainstreaming Climate Change for Sustainable Development Towards a National Agenda for Action' on 14th December 2009 at the Ministry of Environment and Natural Resources. The report was handed over to the Hon. Patali Champika Ranawaka, Minister of the Environment and Natural Resources, before his departure to the Copenhagen Summit on Climate Change. The Chairman of the IPS, Prof. Buddhadasa Hewavitharana, handed over the report to the Minister. The publication was authored by Athula Senaratne, Nethmini Perera and Kanchana Wickramasinghe, researchers attached to the Environmental Economics Policy Unit of the IPS.

Mainstreaming Climate Change for Sustainable Development in Sri Lanka: Towards a National Agenda for Action



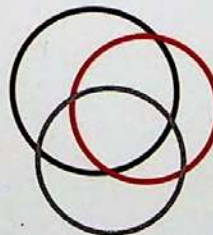
By Athula Senaratne, Nethmini Perera and
Kanchana Wickramasinghe
Research Studies: Working Paper Series No. 14,
December 2009

“ An integrated approach is needed to *mainstream climate change adaptation into to national planning and development*, and improve the climate resilience of Sri Lanka's economy and its people. This includes cross-cutting interventions that impact across multiple strategic thrusts and sectors in the economy. Given the scale and significance of potential impacts, climate change adaptation must be considered from the early stages of development planning through the implementation of major projects and programmes. Sri Lanka's society also needs to have more access to information on climate change related threats they may face, and what they can do at household or community levels to adapt and protect themselves.”

*National Climate Change
Adaptation Strategy for
Sri Lanka
2011 to 2016*



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