CAPACITY BUILDING WORKSHOP ON GLOBAL CHANGE RESEARCH

Proceedings of Workshop
Islamabad, Pakistan. June 8-10, 2004

APN CAPaBLE

Agro- Dev. International

GLOBAL CHANGE IGBP

IHDP

Edited by:

Dr. Amir Muhammed
President
Asianics Agro Dev International
House # 13, Street 49, F-6/4
Islamabad, PAKISTAN
E-mail: amir.muhammed@nu.edu.pk;

Dr. Linda Anne Stevenson
Programme Manager for Scientific Affairs
APN Secretariat- Kobe Japan
Tel: +81-78-230-8017
Fax: +81-78-230-8018
Email: lstevenson@apn.gr.jp

Printed by:

Jupiter Printers
Cell: 0300-5205046

FOREWORD

The capacity building workshop on Global Change was organized in Islamabad pursuant to discussions between Dr. Linda Stevenson, Programme Manager for Scientific Affairs of the Asia-Pacific Network for Global Change Research (APN) and responsible for implementing the CAPaBLE Programme; and Dr. Amir Muhammed Co-Chair of APN Scientific Planning Group, to strengthen research capacity at national level in addition to award of competitive research grants. The presentations during the workshop have been compiled in order to provide information to a larger body of scientists who are interested in global change research, and especially in APN's competitive research grants program. Effort was made to get full text of various presentations but in some cases where the full text was not available, the PowerPoint presentations have been included which give a fair idea of the subject matter. More detailed information on various aspects can be obtained from the resource persons who made the presentations by contacting them at the listed addresses.

Amir Muhammed
Linda A. Stevenson

ACRONYMS & ABBRIVIATIONS

AEZ	AGRO-ECOLOGICAL ZONE
ALGAS	ASIA LEAST-COST GHG ABATEMENT STRATEGY
APN	ASIA-PACIFIC NETWORK for GLOBAL CHANGE RESEARCH
BARC	BANGLADESH AGRICULTURAL RESEARCH COUNCIL
BMD	BANGLADESH METEROLOGICAL DEPARTMENT
CAPaBLE	SCIENTIFIC CAPACITY BUILDING /ENHANCEMENT FOR SUSTAINABLE DEVELOPMENT IN DEVELOPING COUNTRIES
CEEP	COORDINATED ENVIRONMENTAL EDUCATION PROJECT
CNG	COMPRESSED NATURAL GAS
CSIRO	COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION
CSM	CROP SIMULATION MODELLING
DHSVM	DISTRIBUTED HYDROLOGICAL SOIL AND VEGETATION MODEL
DIVSERSITAS	INTERNATIONAL PROGRAMME ON BIODIVERSITY
DSSAT-1	DECISION SUPPORT SYSTEM FOR AGRO-TECHNOLOGY TRANSFER, VERSION-4
EEPP	ENVIRONMENTAL EDCUATION AT SCHOOL AND COLLEGE LEVEL
EGTT	EXPERT GROUP ON TECHNOLOGY TRANSFER
ENERCON	NATIONAL ENERGY CONSERVATIION CENTER
ENSO	EL NINO-SOUTHERN OSCILLATION
ESSP	EARTH SYSTEM SCIENCE PARTNERSHIP
FERTS	FUEL EFFICIENCY IN ROAD TRANSPORT SECTOR
GCISC	GLOBAL CHANGE IMPACT STUDIES CENTER
GCMs	GENERAL CIRCULATION MODELS
GCP	GLOBAL CARBON PROJECT
GEC	GLOBAL ENVIRONMENTAL CHANGE
GECAFS	GLOBAL ENVIRONMENTAL CHANGE AND FOOD SYSTEMS
GEF	GLOBAL ENVIRONMENT FACILITY
Gg	GIGAGRAMS
GLOBE	GLOBLE LEARNING AND OBSERVATION TO BENEFIT ENVIRONMENT
GTZ	GERMAN AGENCY FOR TECHNICAL COOPERATION
GWSP	GLOBAL WATER SYSTEM PROJECT
I/O	INPUT/OUTPUT
IAI	INTER-AMERICAN INSTITUTE FOR GLOBAL CHANGE RESEARCH
ICSU	INTERNATIONAL COUNCIL OF SCIENCE UNIONS
ICTP	INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS
IGBP	INTERNATIONAL GEPS[HERE BIOSPHERE PROGRAM
IGP	INDO-GANGETIC PLAIN
IHDP	INTERNATIONAL HUMAN DIMENSIONS PROGRAMME
IPCC	INTERGOVERBMENTAL PANEL ON CLIMATE CHANGE-
IRS	INTERGATED REGIONAL STUDIES
ISSC	INTERNATIONAL SOCIAL SCIECNE COUNCIL
LBA	LARGE-SCALE BIOSPHERE-ATMOSPHERE PROJECT IN AMAZONIA
MAGICC	MODEL FOR ASSESSMENT OF GREENHOUSE GAS INDUCED CLIMATE CHANGE
MAIRS	MONSOON ASIA INTEGRATED REGIONAL STUDY
NC	NATIONAL COMMITTEE
NCS	NATIONAL CONSERVATION STRATEGY
NEAP-SP	NATIONAL ENVIRONMENTAL ACTION PLAN- SUPPORT PROGRAMME
NGO	NON-GOVERNMENTAL ORGANISATION
NIO	NATIONAL INSTITUTE OF OCEANOGRAPHY
OECD	ORGANIZATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT
PAEC	PAKISTAN ATOMIC ENERGY COMMISSION
PAS	PAKISTAN ACADEMY OF SCIENCES

PCSIR	PAKISTAN COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH
PFI	PAKISTAN FOREST INSTITUTE
PINC	PAKISTAN INITIAL NATIONAL COMMUNICATION
PREAGA	PROMOTION OF RENWABLE ENERGY , ENERGY EFFICIENCY AND GHG ABATEMENT
RAP	RAPID ASSESSMENT PROJECTS
RCM	REGIONAL CLIMATE MODEL
RCPs	REGIONAL CALL FOR PROPOSALS
SSTs	SEA SURFACE TEMPERATURES
START	SYSTEM FOR ANALYSIS, RESEARCH AND TRAINING
SUPARCO	SPACE AND UPPER ATMOSPHERE RESEARCH COMMISSION
UGG	UNIVERSITY OF GEORGIA GRIFFIN
UNCBD	UNITED NATIONS CONVENTION ON BIOLOGICAL DIVERSITY
UNCCD	UNITED NATIONS CONVENTION TO COMBAT DESERTIFICATION
UNFCCC	UNITED NATIONS FARAMEWORK CONVENTION ON CLIMATE CHANGE
WAPDA	WATER AND POWER DEVELOPMENT AUTHORITY
WCRP	WORLD CLIMATE RESEARCH PROGRAMME
WSM;WMM	WATERSHED/WATER MANAGEMENT MODELLING
WTO	WORLD TRADE ORGANISATION
YHDR	YOUNG HUMAN DIMENSIONS RESEARCH

CONTENTS

WELCOMING REMARKS

***Amir Muhammed*[1]**

I would like to extend a warm welcome and sincere thanks to the chief guest Dr. Akram Shaikh, Deputy Chairman of Planning Commission, for kindly sparing time to be with us this morning despite his very heavy commitments with the national budget preparation process that is currently in the final stages. I would also like to extend a special welcome to Dr. Will Steffen, Executive Director of the International Geosphere Biosphere Program (IGBP) and Dr. Linda Stevenson, Programme Manager for Scientific Affairs of the Asia-Pacific Network for Global Change Research (APN) for making it convenient to join the Workshop braving the very hot summer with temperatures touching 50^0C, and the general environment of insecurity due to anticipated terrorist activities in some parts of the country. Their participation in the workshop as resource persons will indeed make a major difference towards the success of this effort.

The prime motivation for the workshop is to develop capacity, especially among mid-career scientist, to be able to participate more effectively in the competitive research projects for global change research awarded every year by APN and other international agencies. Research activity in the general field of global change research is weak in Pakistan despite the overwhelming importance of this research for sustainable development of the country, and the workshop will aim at stimulating such research in various institutions in the country.

Global Change affects all life on Earth and concerns the physical, chemical and biological processes that regulate the total earth system. There have been major disturbances in this system as a result of the unprecedented industrial and agricultural development .especially in the OECD countries during the second half of the last century. The most dramatic culmination of these human activities is the now well established global warming trend which has been observed in all parts of the Globe. Despite initial reservations, there is no doubt now that the increased emission of green house gases has resulted in a steady increase in the average surface temperature of the earth in most places. Last decade of the 20th century was the hottest in human history and record high temperatures have been recorded in some years of the last decade.

Dr. James Lovelock (quoted in the Dawn of 1st June article entitled "Effects of Climate Change" by Gwynne Dyer) stated that:

"Unless we stop now, we will really doom the lives of our descendents. If we just go on another 40 or 50 years faffing around, they'll have no chance at all; it will be back to the Stone Age. There will be people around still. But civilization will go"
James Lovelock *The Independent,* May 24, 2004.

Receding of the Himalayan glaciers, break-up of the polar ice cap and trends in sea-level rise are some of the well known ramifications of global climate change. Lovelock has concluded from the data of melting of the Greenland Icecap that global warming is now moving much faster than most studies anticipated. Changes in atmospheric chemistry, deterioration of air quality from the point of view of human health, reduced availability of fresh water in most parts of the world and rapid deterioration of water quality for human use are some of the other issues concerning most governments especially in developing countries.

[1] ***President, Asianics Agro Dev International, Islamabad-Pakistan***

Besides the biophysical dimension, globalization also has a very significant human dimensions aspect. Major changes have taken place in the economy of most developing countries as a result of the global economic system devised during the second half of the last century. The provisions of the World Trade Organisation (WTO) will affect the international trade and the economies of most people when fully implemented. These and several other issues related to global change which have powerful human dimensions characteristics deserve careful and intensive study. The international global change research community consisting of DIVSERSITAS, IGBP, IHDP and WCRP have a large number of core and joint research projects in association with national scientific communities to study various aspects of global change. START, based in Washington DC, is also a collaborative organisations of the global change community particularly in organising and providing capacity building activities such as training in the developing countries at the global level to stimulate global change research in partnership with the major international programmes. APN in the Asia-Pacific Region and the Inter-American Institute for Global Change Research (IAI) in Latin America are primarily concerned with the promotion of research activities and capacity building in their respective regions. These networks are also working closely together under CAPaBLE in organising and expanding interregional activities in aspects of global change that are common to both regions.

This workshop was sponsored by APN primarily to build capacity among young, mid-career scientists in Pakistan. I am very grateful to Dr. Linda Stevenson, Programme Manager for Scientific Affairs based at the APN Secretariat in Kobe, Japan. Dr. Stevenson who manages the APN/CAPaBLE Programme supported my request to start the major APN effort for capacity building at the national level from Pakistan. We hope the workshop will stimulate interest in the Pakistani scientific community and Pakistan will be able to participate more effectively in future research efforts of the global community in global change issues, and especially in the APN projects.

I would like to acknowledge the invaluable help provided by the Global Change Impact Studies Centre (GCISC) and Pakistan Academy of Sciences (PAS) to make the workshop a success. We are particularly grateful to the Academy to offer the use of this auditorium and associated facilities for the workshop sessions.

In the end I again welcome all the participants and hope you will find the workshop sessions stimulating and helpful in steering you to a research career in global change issues.

ASIA-PACIFIC NETWORK FOR GLOBAL CHANGE RESEARCH (APN) AND ITS ACTIVITIES

Linda A. Stevenson[2]

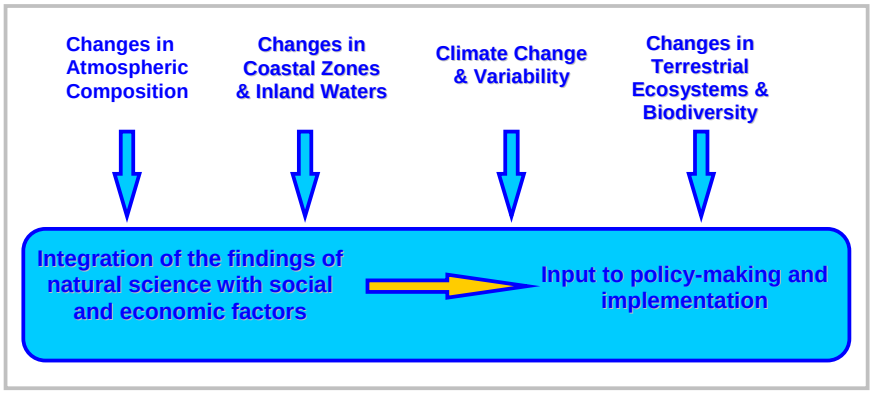
What is Global Change Research?

There are a number of long-term environmental changes taking place on earth. Many of these changes are influenced by human activities, and in response they affect the quality of human life. Examples include climate change and changes in the way land is used, such as deforestation or urbanisation. The attempt to understand the cause, extent and effect of these worldwide environmental changes is called global change research. Global environmental change cuts across national boundaries. Therefore, the cooperation and collaboration of all countries is important to conduct the research necessary to understand its causes and impacts.

Asia-Pacific Network for Global Change Research (APN)

The Asia-Pacific Network for Global Change Research (APN) is an inter-governmental network whose mission is to foster global change research in the Asia-Pacific region, increase developing country participation in that research, and strengthen interactions between the science community and policy- makers. The APN believes that international cooperation among governments and scientists will help increase the understanding of the complex mechanisms and impacts of global change on ecosystems and human society in the Asia-Pacific region. This is necessary to identify and address the problems that may arise from that change. The APN also believes that working in partnership with other organisations involved in global change research is essential to maximise the resources available and to deliver the best possible results. In particular, the APN cooperates with DIVERSITAS (Biodiversity Programme), the International Geosphere-Biosphere Programme (IGBP), the International Human Dimensions Programme on Global Environmental Change (IHDP), the World Climate Research Programme (WCRP), the global change SysTem for Analysis, Research and Training (START), and our inter-governmental sister network in the Americas, the Inter-American Institute for Global Change Research (IAI).

Current APN Research Framework



APN's main areas of scientific interest are set out overleaf. *The primary interest of APN is to provide an input to policy-making through the integration of the natural and social sciences.* Accordingly, understanding the human dimensions of global change lies at the core of APN's concerns.

[2] ***Program Manager, Asia Pacific Network***

APN Activities

Global change research is fundamental to the sustainability of the global life support system and the need for expansion of research-linked capacity. Thus, in order to achieve its goals, APN conducts a number of different activities that include:

- Supporting collaborative research and training activities;
- Organising scoping workshops to develop new research projects;
- Disseminating global change information to scientists and policy-makers; and
- Providing opportunities for policy-makers and scientists to discuss regional research priorities and other global change issues.

APN Networking and Capacity Building Programme

At the 5th APN Inter-Governmental Meeting, held in Islamabad, Pakistan in March 2000, a special APN programme that would address regional networking and scientific capacity was adopted. The aim being to target those APN member developing countries that were considered to have the least scientific capacity or the weakest links to the regional research community. Initially, it was agreed to focus on two regional groups, namely South and Southeast Asia and, since 2000 workshops have been held in these two regions allowing participants to gain an overview of global change issues from international organisations, identify regional priorities, and pinpoint promising project proposals for submission to APN and/or other funding agencies. There have also been capacity building efforts in East Asia with one workshop in the Republic of Korea and symposia in Mongolia and the Russian Federation in 2001 and 2002, respectively. And in January 2004, the APN co-sponsored a Central Asian capacity building workshop in conjunction with UNDP in Uzbekistan.

APN CAPaBLE Programme

As the aforementioned activities indicate, a high priority goal of APN is to improve the scientific capabilities of nations in the region, and with this in mind; APN has launched a new five-year programme on "Scientific Capacity Building/Enhancement for Sustainable Development in Developing Countries" (CAPaBLE) under the APN framework. This programme is expected to develop and enhance scientific capacity in developing countries to improve their decision-making in the target areas related to climate change and water and food security that are directly linked to their sustainable development.

Linking Science through Policy

Science has much to offer in the development of policy to cope with issues of global change, and no more where it is truer than in the Asia-Pacific region. Moreover, sound science must under pin good policy. Sound science is needed to build political commitment to take action. Indeed, a key strength of the APN is the recognition of the need for linking policy and science.

The issue of capacity building in global change research has been discussed at several fora, particularly within the Global Change Programmes' activities. APN has especially emphasized this aspect through the launch of its CAPaBLE Programme which is specifically designed to develop scientific capacity through various mechanisms. An important element of this programme is capacity building in less developed countries of the Asia-Pacific region whose scientists have not yet been able to effectively participate in the APN competitive grants programme because there is little emphasis on Global Change research at the national level. Moreover, young scientists are not fully aware of the activities of the international organizations in global change research.

Pakistan is one of the countries in the Asia-Pacific region which has modest capabilities in scientific research mostly directed at the applied problems of the country, but very little by way of education or research in Global Change aspects. We strongly believe that the younger scientists in Pakistan will vigorously participate in Global Change research activities if they are made aware of the importance of this research and the current activities of various international organizations devoted to Global Change research.

Through APN's CAPaBLE Programme[3], this capacity building workshop is the first of its kind and taking place in Islamabad, Pakistan. 40-50 young Pakistani scientists are participating and we intend on having lectures from APN and two of the Global Change Programmes (IGBP and IHDP) who will talk about the activities of their organizations and the kinds of opportunities for young and emerging scientists to actively participate in the research efforts, especially through competition for research projects annually awarded by APN and other similar networks and organizations.

Furthermore, as part of APN's ongoing efforts to disseminate information on global change research and its activities through the CAPaBLE Programme, APN launched a CD-ROM eLearning tool at the Workshop. This tool will enable the participating scientists to learn more about APN, Global Change research, and other global change international programmes and networks. In addition, the eLearning tool (eTool) will provide scientists with more detailed information about the APN's competitive annual Regional Call for Proposals (RCPs) and how to go about writing and submitting a proposal to APN. Future eTools will also focus on the different activities being conducted under the APN including the RCP and CAPaBLE Programmes.

One of the major outcomes expected of this workshop is to build and enhance the capacity of young and aspiring scientists through enhanced sharing of knowledge, experience and scientific information on global change research within the Asia-Pacific region and between regions in the world. I hope that this workshop will also stimulate young scientists to undertake research in global change issues especially relevant to their countries and regions. While Pakistan is the first country under the APN/CAPaBLE Programme to embark on such a capacity building endeavour at the national level, it is expected that, through the support of APN and its member countries, similar activities will take place at the national level throughout the Asia-Pacific region in the future under the CAPaBLE Programme.

[3] One of the aims of CAPaBLE (Scientific Capacity Building /Enhancement for Sustainable Development in Developing Countries) is to promote Capacity Building activities that target specific countries in the Asia-Pacific region; specific topics under climate change and variability; partnership activities with other networks, programmes, APN member and approved countries, and other interested stakeholders; and disseminate information to policy-makers, decision-makers and civil society. Capacity Building activities under CAPaBLE aim to provide researchers (young scientists in particular) with opportunities for scientific capacity building in the area of climate change. Opportunities to develop joint initiatives will be explored by APN in collaboration with regional research networks (such as IAI, EC, MEDIAS, START) and the global change science programmes (DIVERSITAS, IGBP, IHDP, WCRP).

GLOBAL CHANGE AND THE EARTH SYSTEM: IMPLICATIONS FOR PAKISTAN

Will Steffen[4]

"Most Gracious is Allah, who reveals Himself
In the Quran, in man's intelligence
and in the nature around man.
Balance and Justice, Goodness and Care,
Are the Laws of His World"

Summary from Surah 55, the Holy Qur'an

Introduction

The interactions between environmental change and human societies have a long and complex history spanning many millennia. They vary greatly through time and from place to place. Despite this spatial and temporal variability, a global perspective has begun to emerge in recent years and to form the framework for a growing body of research within the environmental sciences. Crucial to the emergence of this perspective has been the dawning awareness of two aspects of Earth System functioning. First, that the Earth itself is a single system within which the biosphere is an active, essential component. Secondly, that human activities are now so pervasive and profound in their consequences that they affect the Earth at a global scale in complex, interactive and apparently accelerating ways; humans now have the capacity to alter the Earth System in ways that threaten the very processes and components, both biotic and abiotic, upon which the human species depends. This paper describes briefly what is known about the Earth System and the nature of the human-driven changes impacting it. It also considers the consequences of these changes in the Earth System for human well-being, with a particular emphasis on the implications of global change for Pakistan.

The Earth as a System

Undoubtedly the most important data set that describes the functioning of the Earth System as a whole prior to the era of human influence is the Vostok ice core data (**Figure 1**). This data was obtained by drilling deep down into the continental glacier over the centre of Antarctica and removing the core. Analysis of the ice and of the gases trapped in the layers of ice give clues about the climate and about atmospheric composition in the Earth's past. Figure 1 shows three parameters of importance for understanding the functioning of the Earth System through time - carbon dioxide (CO_2) and methane (CH_4) in the atmosphere and an estimate of global mean temperature, using the oxygen-18 isotopic concentration in the ice as a proxy. The Vostok record goes back from the present to 420,000 years ago.

The Vostok ice core data give a wealth of insights into the functioning of the Earth System. Three striking characteristics are immediately apparent. Together, they demonstrate beyond any doubt that the Earth is a system, with properties and behaviour that are characteristic of the system as a whole. In particular: The evidence for climate variability, as represented by a proxy for local temperature (δ18O) and the record of changes in the global carbon cycle, as represented by the atmospheric concentration of the trace gases CO_2 and CH_4 trapped in air bubbles in the ice, show largely parallel temporal variations throughout. In fact, the record from Vostok confirms that there has been a close coupling between the climate proxies and both trace gas and aerosol (dust and sulphate) concentrations, all of which are linked in part to biological processes.

[4] ***Executive Director, International Geosphere-Biosphere Programme (IGBP)***

The main maxima and minima of temperature and trace gas concentrations, which mark the alternation between glacial and interglacial conditions, follow a regular, cyclic beat through time, each cycle spanning approximately 100,000 years. The smooth changes in the eccentricity of the Earth's orbit that are believed to be the primary forcing mechanism for this dominant periodicity are too slight and too smooth to generate the changes recorded without strong modulation by internal feedbacks.

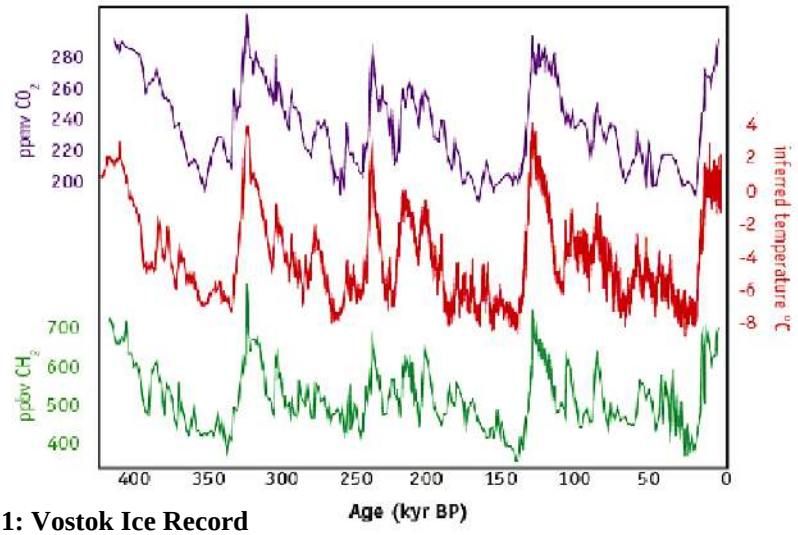


Figure 1: Vostok Ice Record

This is especially so when the abrupt shifts to interglacial conditions at each the end of each glacial period is considered. This highly non-linear response of the Earth System to external forcing must involve interactions among biological, chemical and physical components. The range over which isotopically inferred temperature and trace gas concentrations vary is limited. Throughout all four cycles, each interglacial gives rise to similar peak values; each glacial culminates in comparable minima. This point to a high degree of self-regulation within the Earth System over the whole of the time interval recorded in the Vostok ice core. In summary, the Vostok ice core, plus much other information and data on how the Earth System works (Steffen et al. 2004), shows the self-regulating dynamics of our own planetary life support system. That is, there is strong scientific evidence of the 'balance' in the global environment described in *Surah 55 of the Holy Qur'an.*

The Anthropocene Era

Global change is, in many ways, the ultimate environmental problem facing humanity. The Earth's environment is now undergoing profound change, a transformation owing not to the great forces of nature or to extraterrestrial sources but to the numbers and activities of people. During the last 100 years the population of humans soared from little more than one to six billion and economic activity increased nearly 10-fold between 1950 and 2000. Half of Earth's land surface has been domesticated for direct human use and nearly all of it is managed by humans in one way or another. Most of the world's fisheries are fully or over-exploited and little pristine coastline exists outside of the high latitudes. The composition of the atmosphere - greenhouse gases, reactive gases, aerosol particles - is now significantly different from what it was a century ago. The evidence that these changes are affecting the basic functioning of the Earth System, particularly the climate, grows stronger every year. Humans have clearly become a global-scale geophysical force in their own right, equal to or greater than some of the great forces of nature. This strong rise in the influence of humans on the global environment has prompted the *Nobel Laureate Paul Crutzen* to use the phrase the 'Anthropocene Era' to describe this phenomenon. It is important to understand the magnitude and rate of the evolving 'human enterprise' and its impact on the Earth System.

Figure 2 shows examples of changes in the Anthroposphere over the past few hundred years; it is an attempt to define a few key indicators that show the changing nature of human societies at this

important time in the development of the human-environment relationship. All of the trends shown are global and mask important regional differences. Nevertheless, at the level of the Earth System, global-scale indicators are appropriate and important. One feature stands out as remarkable.

The period since 1950 is unique in the entire history of human existence on Earth. Many human

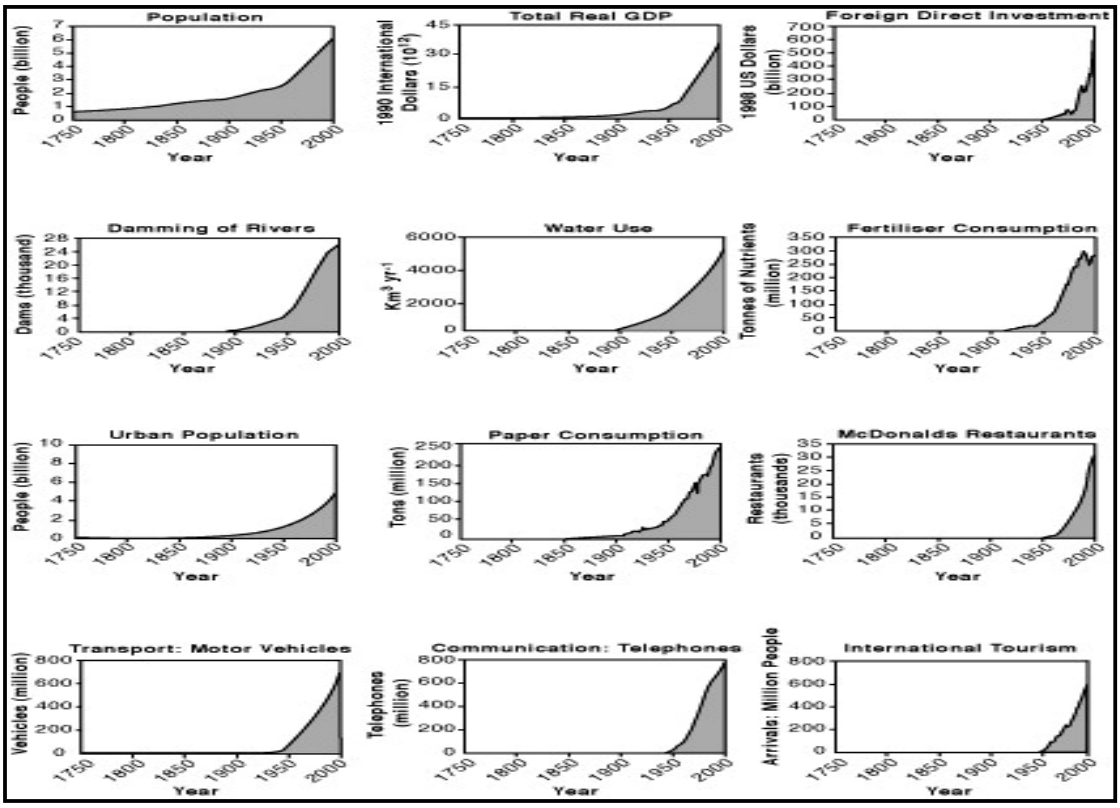


Figure 2: Anthroposphere Changes

-activities reached 'take-off' points sometime in the middle of the 20th century and have accelerated sharply towards the end of the century. The last 50 years have without doubt seen the most rapid transformation of the human relationship with the natural world in the history of humankind.

Figure 3 shows that the impacts of these accelerating human changes are now clearly discernible at the level of the Earth System as a whole. Many key indicators of the functioning of the Earth System are now showing responses that are, at least in part, driven by the changing human imprint on the planet. All components of the global environment - oceans, coastal zone, atmosphere, land - are being influenced. Dramatic though these human-driven impacts appear to be, their rates and magnitudes

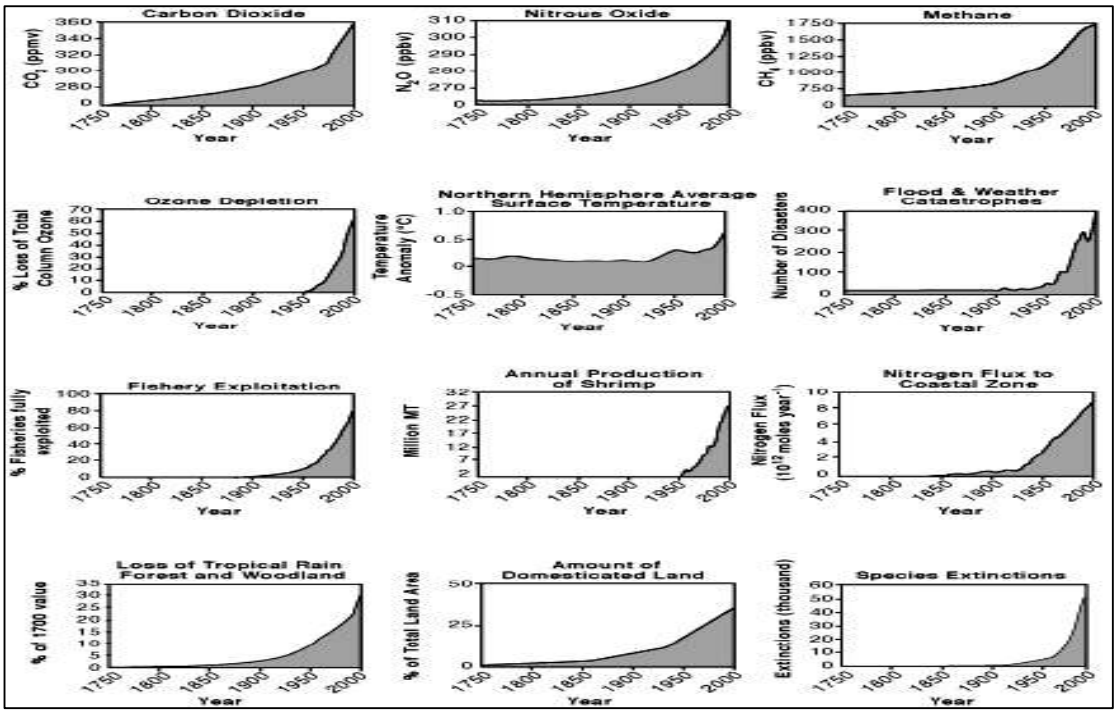


Figure 3: Impacts of Accelerating Human Change

must be compared to the natural patterns of variability in the Earth System to begin to understand their significance. As described in the previous section, the Earth System operates in cycles that have well-defined time scales and set points that limit the magnitudes of its rhythmic changes. From the perspective of the Earth System, how do the recent human-driven changes compare in terms of magnitudes and rates? The increase in atmospheric CO_2 concentration provides a useful measure with which to evaluate the rate and magnitude of human-driven change. Analysis of the Vostok ice core data from Antarctica (Petit et al. 1999) suggests that over the past 420 000 years the atmospheric CO_2 concentration has oscillated in a regular pattern over approximately 100 000 year cycles by about 100 ppmV, between about 180 and 280 ppmV. The human imprint on atmospheric CO_2 concentration is unmistakable. Atmospheric CO_2 concentration now stands at 370 ppmV, almost 100 ppmV above the previous maximum level. Within the limits of resolution of current ice-core records, that new concentration appears to have been reached at a rate at least 10 and possibly 100 times faster than increases of CO_2 concentration at any other time during the previous 420,000 years (Falkowski et al. 2000) (**Figure 4**). In this case, human-driven changes are clearly well outside the range of natural variability exhibited by the Earth System for the last half-million years at least. The research carried out over the past decade gives some first insights into the nature of the

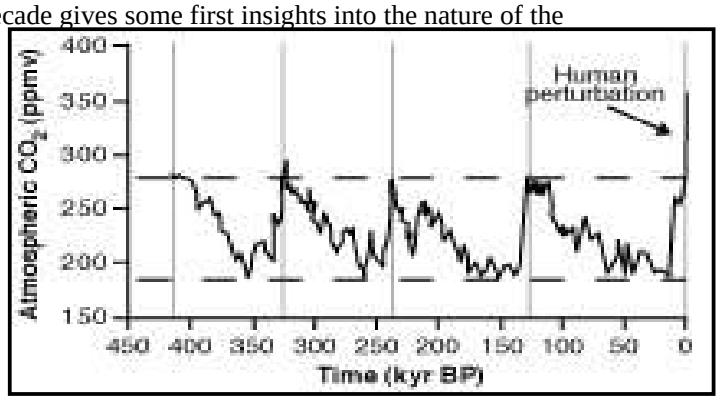


Figure 4: Atmospheric CO_2 concentration over past 420 000 years from the Vostok ice core with the recent human perturbation superimposed

Earth System - how robust and resilient or how fragile it might be - and has given a more complete understanding about the human influences on the functioning of the planetary environment.

It can be clearly said that the human impacts on the Earth:

- are approaching or exceeding in *magnitude* some of the great forces of nature;
- operate on much faster time scales than *rates* of natural variability, often by an order of magnitude or more; and
- taken together in terms of extent, magnitude, rate and simultaneity, have produced a *no-analogue* state in the dynamics and functioning of the Earth System.

To use the words of the Holy Qur'an, the Earth System is now seriously out-of-balance.

Living With Global Change: *THE IMPLICATIONS FOR PAKISTAN:*

There is now compelling evidence that the Earth's environment is changing significantly at the global scale. In fact, there is concern that the Earth System has begun a shift to a fundamentally different state, a shift as profound as the transition between the glacial and interglacial states but at a rate as least an order of magnitude greater. Thus, a certain level of adaptation to global change is required, even if a vigorous mitigation strategy is implemented in the near future.

From the perspective of Pakistan, several issues stand out as being especially important, the first being water resources. In this area the prognosis is not at all clear. For example, the projections of GCMs (General Circulation Models) do not agree on whether rainfall will increase or decrease over Pakistan nor are there any indications of whether rainfall will come in less frequent but more intense events, punctuated by long periods of drought. In addition, water availability is not directly related to rainfall but rather more closely related to runoff. Some models with show increasing rainfall over Pakistan also show decreasing runoff, due to the increasing evapotranspiration with higher temperatures. A complementary approach to GCM projections is to analyse the anomalies in climate that have occurred in the recent, when climate change is known to be well underway. For example, there have been persistent droughts during1998-2002 droughts across the United States, southern Europe, southwest Asia and the mid-latitudes of the southern hemisphere.

These droughts appear to be linked through a common oceanic influence (Hoerling and Kumar 2003). Cold sea surface temperatures (SSTs) in the eastern tropical Pacific and warm SSTs in the western tropical Pacific and Indian Oceans were remarkably persistent during this period and led to the formation and persistence of a belt of high pressure around the mid-latitudes of both hemispheres. The high SSTs in the tropical Indian Ocean and the west Pacific Ocean were unsurpassed during the 20th century, and were likely related to the observed multidecadal warming trend. GCM simulations of these observed conditions show that this warming (roughly 1^{o}C since 1950) is beyond that expected of natural variability and is at least partly due to the ocean's response to increased greenhouse gases.

The water resource issue in Pakistan is further complicated by additional factors that are not directly related to climate. For example, both water quantity (run-off) and quality are related to land-use and land-cover change. Deforestation can increase water yield due to reduced evapotranspiration but almost always leads to a reduction in water quality due to erosion. Intensive agriculture can also affect water quality through leakage of fertilisers and pesticides and herbicides into streams and rivers. Changes in atmospheric composition, particularly increases in aerosol particles, can also affect water resources by decreasing rainfall. This occurs when large numbers of small aerosol particles are injected into the atmosphere, thereby forming a larger number of smaller droplets that are too small to coalesce into rain drops. Furthermore, water resource issues are strongly driven by direct human pressures in addition to the various aspects of global environmental change described above. As a result, the vulnerability of humans to water stress over the coming decades will be determined by a combination of interacting factors, most notably owing to increasing demand due to increasing population and human activities and to climate change. An analysis of changing water resources based on these two factors individually and in combination has been carried out recently (Vörösmarty et al. 2000). The study uses the ratio of aggregate water demand (domestic, industrial and agricultural uses)

to the water supply as defined by river discharge as an estimate of water stress. Projections of population growth and water demand in the three major usage categories to 2025 coupled with two climate change scenarios for the same period were used to estimate future water stress.

The relative change in demand per discharge is shown in **Figure 5.** Although climate change will have discernible impacts on freshwater availability by 2025, it is clear that these changes will be overwhelmed by the increase in demand for water resources due to population growth and economic activity alone. In terms of absolute numbers, the current 2.2 billion people living under moderate or severe water stress will rise to 4.0 billion by 2025. The distribution of water stress by continent is even more striking. Africa, Asia and South America all show sharp increases of 73%, 60% and 93% respectively in the ratio of demand and supply. For Africa and South America, climate change is predicted to exacerbate water stress significantly.

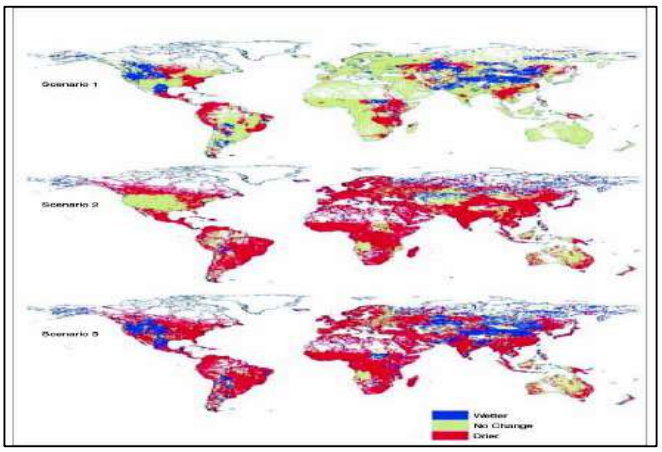


Figure 5: Relative Change in Demand per Discharge

This analysis puts Pakistan in an interesting position. While all of Pakistan's neighbours are predicted to experience increasing water scarcity by 2025, Pakistan will hold its own or even become slightly less water-scarce. This suggests that trans-boundary disputes over water and the resulting political tensions could dominate the water resource issue in Pakistan later this century. Food provision is another issue that is increasingly being impacted by global change. A recent analysis (Shah 2002) of the potential impact of climate change on food security in the 21st century highlights the importance of the current disparities in food production capability and of the differential impacts of climate change. Both work in the same direction. Climate change makes the task of improving the condition of most food-insecure populations of the world even more difficult. The analysis combined the FAO's Agro-Ecological Zone (AEZ) methodology, an analysis of food security by region and country, and three climate change scenarios to estimate changing food security through this century. The projections of climate were obtained from the ECHAM4 model of the Max Planck Institute of Meteorology, Germany; the HadCM2 model of the Hadley Centre for Climate Prediction and Research, UK; and the CGCM1 model of the Canadian Centre for Climate Modelling. All three models predict that the global mean temperature will rise and all suggest that precipitation is likely to come more often in heavy rainfalls and extreme events. The Canadian model projects significantly drier conditions than do the other two, and this has a strong impact on the outcomes of the study.

In terms of individual countries, the analysis indicates there will be winners and losers (**Figure 6**). However, when the 78 developing countries that have low per capita incomes and account for about 600 of the 800 million undernourished people are considered, the magnitude of the problem becomes apparent. For all three climate models the number of currently undernourished people in countries whose food production decreases because

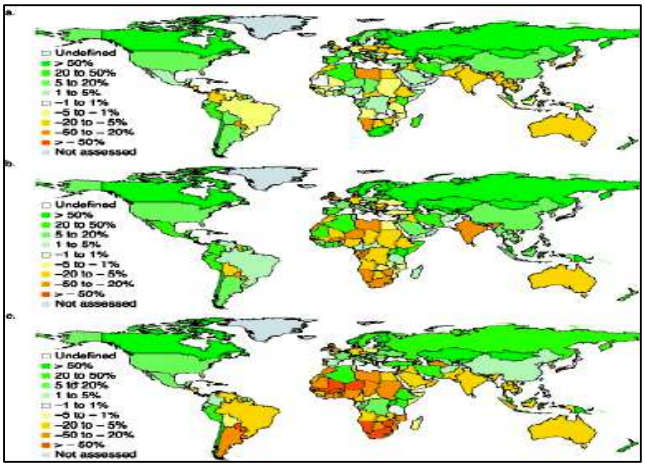


Figure 6: Individual Countries, the Analysis Indicates there will be Winners and Losers

of climate change (about 400 million in total) is greater than the number in countries which gain. In fact, two of the three models project that the current cereal gap of about 10 million tonnes for those 400 million people will rise markedly to around 130 to 150 million tonnes in the 2080s. Here, Pakistan does not fare as well. Food production in Pakistan is predicted to drop significantly (by up to 20%) by the 2080s in two out of the three climate models used, and in the third there is virtually no difference between present-day and projected production. When set in the context of an expanding population until 2050 or so, these projections are caused for considerable concern given the Pakistan is currently a food exporting nation and relies critically on such exports for foreign income.

As for water, there are further factors beyond climate that will affect food production. For example, atmospheric constituents such as tropospheric ozone and aerosols will reduce crop production even further while increasing atmospheric concentrations of CO_2, on the other hand, will stimulate crop production. This latter effect may be especially important for Pakistan as crops in semi-arid or dry systems are generally stimulated more by elevated CO_2 than those in well-watered systems. The analyses of water and food security described above are based on GCM scenarios in which climate changes in terms of mean temperature and precipitation but generally stay with the patterns of present-day climate. However, the climate of Pakistan is critically dependent on the behaviour of the Asian Monsoon, which in turn is linked to other modes of variability, such as the El Nino - Southern Oscillation phenomenon. Records from the past show that both of these climate features have shown different modes of variability in the past. Should significant shifts in the behaviour of either occur now, especially towards drier or more erratic behaviour, the consequences could be severe and would completely swamp impacts due to slow changes in means. Changes in far distant parts of the planet could also affect Pakistan. One of the most well-known abrupt changes in the Earth System is the potential shut-down of the thermohaline circulation in the North Atlantic Ocean. Such an event would cause regional cooling in the midst of global warming, in the form of sharp drops in temperature in the North Atlantic region. Obviously such an abrupt change is of enormous interest to Europe and North America. However, should such a change occur, it would have significant implications all around the globe, including Pakistan.

To help inform policy discussion in the United States, the Pentagon (U.S. Defence Department) recently commissioned an expert report on the implications of an abrupt climate change centred on the ocean circulation in the North Atlantic (Schwartz and Randall 2003). Called 'Imagining the Unthinkable', the report used an actual event in the past, a sudden cold snap that occurred about 8,200 years ago, and traced the probably impacts of such an event in the context of modern-day society. Because of the dire consequences projected in the report, the authors advise that the risk of abrupt climate change should be elevated from a scientific debate to a U.S. national security concern.

The report is based on the premise that there is a possibility that gradual global warming could lead to a relatively abrupt slowing of the ocean's thermohaline circulation in the North Atlantic Ocean, which could lead to harsher winter weather conditions, sharply reduced soil moisture, and more intense winds in regions that currently provide a significant fraction of the world's food production. With inadequate preparation, the result could be a significant drop in the human carrying capacity of the Earth's environment.

As global and local carrying capacities are reduced, tensions would almost surely mount around the world. Nations with adequate resources may build virtual fortresses around their countries, preserving resources for themselves. Less developed nations, especially those with ancient enmities with their neighbours, may initiate struggles for access to food, clean water, or energy. Unlikely alliances could be formed as defence priorities shift and the focus becomes obtaining resources for survival rather than defence or promotion of religion, ideology or national honour. Deaths from wars as well as deaths from starvation and disease will decrease population size, which over time will re-balance with carrying capacity. In terms of Pakistan, it is important to note that the impacts of abrupt climate change will almost surely be greatest in the least resilient nations, those which do not have the capacity built into their social, economic and agricultural systems to absorb significant change. More specifically, the report suggests that dry, intermittent monsoons are predicted for South Asia with an abrupt climate change in the North Atlantic, a change of obvious importance for Pakistan and its

neighbours. As a result, the report states: "Envision Pakistan, India and China - all armed with nuclear weapons - skirmishing at their borders over refugees, access to shared rivers, and arable land." In summary, quick examinations of the implications of global change for issues that seem to be of major concern of Pakistan yield the following main points:

- Impacts of global change (climate, atmospheric composition, land use) on water resources is the most important issue.
- Changing behaviour of the Asian Monsoon is undoubtedly the most important aspect of climate change for Pakistan.
- Teleconnections in the Earth System: abrupt change in the North Atlantic region could significantly affect Pakistan's environment - colder and drier.
- What happens to Pakistan's neighbours under global change may be just as important as what happens within its boundaries for the future of Pakistan under global change.

Towards Global Sustainability

Any analysis of the success of sustainable development must take into account the global scale. From the perspective of the Earth System as a whole, human activities are not sustainable until they are constrained with the regular rhythms of Earth System dynamics. The current evidence from the contemporary period strongly suggests that the Earth is now on an unsustainable pathway.

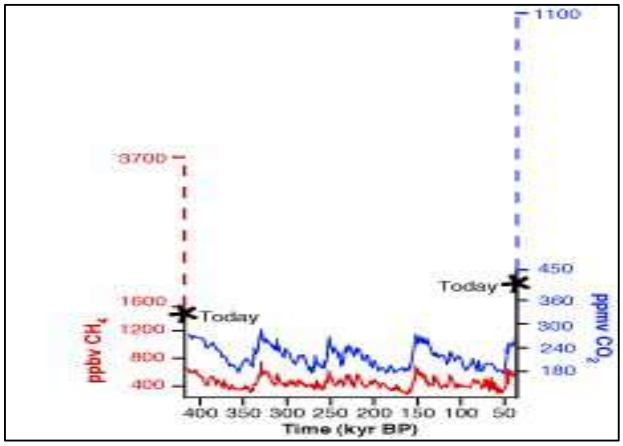


Figure 7: Measurements of the atmospheric concentrations of the greenhouse gases CO_2 and CH_4

Figure 7 is a composite of (i) the CO_2 (and CH_4) records from the Vostok ice core, (ii) the contemporary increase in CO_2 concentration, and (iii) the projections of CO_2 concentration in 2100 by the IPCC (2001). Already the atmospheric composition of CO_2 is already above 370 ppm and continues to rise steadily. The projections for 2100 range from 450 ppm at a minimum to 1100 ppm at the upper bound. More probable values are around 550 ppm or so. Whatever the ultimate value of atmospheric CO_2 concentration at 2100, it is an enormous and rapid increase over the range of values that the Earth System experiences through glacial-interglacial cycling. Given the close coupling between the composition of greenhouse gases in the atmosphere and the Earth's climate, the projected increase of CO_2 and other greenhouse gases will lead to a warmer Earth and other associated changes in climate. The projected global mean temperature at the end of the 21st century is shown in **Figure 8**.

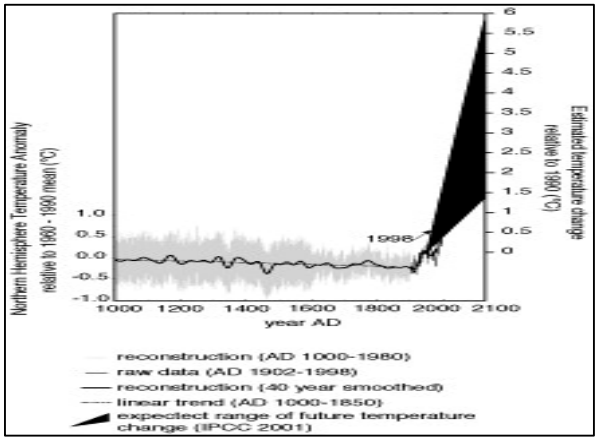


Figure 8: The range of future projections of temperature change

There is large uncertainty in the magnitude of climate change by 2100, from about 1.5°C to 5.8°C. If climate change is limited to the lower end of the range, then it may be possible for human societies to adapt to the new conditions and to achieve some sort of sustainable development.

However, if climate change (and other types of global change) accelerates strongly through the century and the global mean temperature rises towards the 5.8°C level, then sustainability will not be possible and the survival of human civilisations as we know them will be the paramount challenge. There are many perspectives on global change. The bottom line, however, is that there is a risk that the human-driven changes to the planetary environment could propel the Earth System in another a state, a state much less amenable to human civilisations. In such a case, our everyday lives - culture, politics, economics, entertainment, etc. - ceases to have much meaning. The ultimate bottom line is maintaining a global environment that we can live in.

Acknowledgements:

The author is grateful to Dr Amir Muhammed of Asianics Agro Development International and Dr Linda A. Stevenson of APN for their kind invitation to contribute in this workshop, and to Dr Amir Muhammed for his generous hospitality during the author's visit to Islamabad. Parts of this text were abstracted from the IGBP synthesis volume 'Global Change and the Earth System: A Planet Under Pressure', Steffen et al. (2004).

References:

Blunier T, Chappellaz J, Schwander J, Barnola J-M, Desperts T, Stauffer B, Raynaud D, Atmospheric methane record from a Greenland ice core over the last 1000 years. Journal of Geophysical Research **20**, 2219-2222, 1993.

Canning D, World Bank: A database of world infrastructure stocks, 1950–95. World Bank, Washington DC, 2001.

Etheridge DM, Steele LP, Langenfelds RL, Francey RJ, Barnola J-M, Morgan VI, Natural and anthropogenic changes in atmospheric CO_2 over the last 1000 years from air in Antarctic ice and firn. Journal of Geophysical Research **101**, 4115-4128, 1996.
FAOSTAT, Statistical Databases. Food and Agriculture Organization of the United Nations, Rome. Available at: http://www.apps.fao.org; [12 August 2002].

FAOSTAT, Statistical Databases. Food and Agriculture Organization of the United Nations, Rome. Available at: http://www.apps.fao.org; [12 August 2002].

Falkowski P, Scholes RJ, Boyle E, Canadell J, Canfield D, Elser J, Gruber N, Hibbard K, Högberg P, Linder S, Mackenzie FT, Moore III B, Pedersen T, Rosenthal Y, Seitzinger S, Smetacek V, Steffen W (2000) The global carbon cycle: A test of knowledge of Earth as a system. Science 290: 291-296

Fischer G, Shah M, van Velthuizen H, Nachtergaele F (eds) (2001) Global agro-ecological assessment for agriculture in the 21st Century. Summary Report of the IIASA Land Use Project, IIASA, Laxenburg, Austria

Hoerling M, Kumar A (2003) The perfect ocean for drought. Science 299:691-694

International Fertilizer Industry Association, Fertilizer Indicators. Available at: http://www.fertilizer.org/ifa/statistics/indicators/ind_cn_world.asp; [25 Oct 2002].

IPCC (2001) Climate change 2001:The scientific basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change . Houghton JT, Ding Y, Griggs DJ, Noguer M, van der Linden PJ, Dai X, Maskell K, Johnson CA (eds.) Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, U.K. and New York, United States 881pp

Keeling CD, Whorf TP (2000) Atmospheric CO_2 records from sites in the SIO air sampling network. In Trends: A Compendium of Data on Global Change. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, US Department of Energy, Oak Ridge, TN, USA

Klein Goldewijk K, Battjes JJ, One hundred year database for integrated environmental assessments. National Institute for Public Health and the Environment (RIVM). Bilthoven, Netherlands, 1997.

Machida T, Nakazawa T, Fujii Y, Aoki S, Watanabe O, Increase in the atmospheric nitrous oxide concentration during the last 250 years. Geophysical Research Letters **22**, 2921-2924, 1995.

Mackenzie FT, Ver LM, Lerman A, Century-scale nitrogen and phosphorus controls of the carbon cycle. Chemical Geology **190**, 13-32, 2002.

Mann ME, Bradley RS, Hughes MK, Northern hemisphere temperatures during the inferences, uncertainties, and limitations. Geophysical Research Letters **26**, 759-762, 1999.

McDonalds (2002) Homepage. Available at: http://www.mcdonalds.com; [28 Oct. 2002]

Nordhaus, Do real wage and output series capture reality? The history of lighting suggests not. In: Bresnahan T, Gordon R (eds) The economics of new goods. University of Chicago Press, Chicago, 1997.

OFDA/CRED, Emergency Events Database (EM-DAT): The OFDA (United States Office of Foreign Disaster Assistance)/CRED (Center for research on the Epidemiology of Disaster) international disaster database. Louvain Catholic University, Belgium. Available at: http://www.cred.be, 2002.

Petit JR, Jouzel J, Raynaud D, Barkov NI, Barnola J-M, Basile I, Bender M, Chappellaz J, Davis M, Delaygue G, Delmotte M, Kotlyakov VM, Legrand M, Lipenkov VY, Lorius C, Pépin L, Ritz C, Saltzman E, Stievenard M (1999) Climate and atmospheric history of the past 420,000 years from the Vostok ice core, Antarctica. Nature 399:429-436

Pulp and Paper International, PPI's international fact and price book. In: FAO forest product yearbook 1960-1991. Food and Agriculture Organization of the United Nations, Rome, 1993.

Richards J, Land transformation. In: Turner II BL, Clark WC, Kates RW, Richards JF, Mathews JT, Meyer WB (eds) The Earth as transformed by human action: Global and regional changes in the biosphere over the past 300 years. Cambridge University Press, Cambridge pp163-201, 1990.

Schwartz P, Randall D (2003) An Abrupt Climate Change Scenario and Its Implications for United States National Security. Report to the Pentagon.

Shah M (2002) Food in the 21st century: Global climate of disparities. In: Steffen W, Jäger J, Carson D, Bradshaw C (eds) Challenges of a changing earth: Proceedings of the Global Change Open Science Conference. Amsterdam, Netherlands, 10-13 July 2001. IGBP Global Change Series. Springer-Verlag Berlin Heidelburg New York pp31-38

Shiklomanov IA, Global water resources. Nature and Resources 26(3), 1990.

Steffen W, Sanderson A, Tyson P, Jäger J, Matson P, Moore III B, Oldfield F, Richardson K, Schellnhuber H-J, Turner II BL, Wasson R (2004) Global Change and the Earth System: A Planet Under Pressure. IGBP Global Change Series. Springer-Verlag, Berlin Heidelburg New York, 336 pp.

UN Center for Human Settlements, The state of the world's cities, 2001. United Nations. Available at: http://www.unchs.org; [4 Oct 2002]

UNEP, Global environmental outlook 2000. Clarke R (ed) United Nations Environment Programme, 2000.

US Bureau of the Census , International Database. Available at: http://www.census.gov/ipc/www/worldpop.htm; Data updated 10 May 2000

Vörösmarty CJ, Green P, Salisbury J, Lammers RB (2000) Global water resources: Vulnerability from climate change and population growth. Science 289:284-288

Wilson EO, The diversity of life. Allen Lane, the Penguin Press, 1992.

World Bank, Data and statistics. Available at: http://www1.worldbank.org/economicpolicy/globalization/data.html; [4 Oct 2002]

World Commission on Dams, Dams and development: A new framework for decision-making. The Report of the World Commission on Dams. Earthscan Publications Ltd, London and Sterling, VA, 2000.

World Tourism Organization, Tourism industry trends. Industry Science Resources. Available at: http://www.world-tourism.org; (22 Oct 2002).

WRI, Forest and rangelands. In: A Guide to the Global Environment. World Resources Institute, Washington DC pp101-120, 1990.

WRI, A guide to world resources 2002-2004: Decisions for the Earth. A joint publication with UN Development Program, UN Environmental Program, World Bank and World Resources Institute. Washington DC, 2003.

Figure Captions

Fig 1. The 420 000-year Vostok (Antarctica) ice core record, showing the regular pattern of atmospheric CO_2 and CH_4 concentration and inferred temperature through four glacial-interglacial cycles (adapted from Petit et al. 1999).

Fig. 2. The increasing rates of change in human activity since the beginning of the Industrial Revolution. Significant increases in rates of change occur around the1950s in each case and illustrate how the past 50 years have been a period of dramatic and unprecedented change in human history. (US Bureau of the Census 2000; Nordhaus 1997; World Bank 2002; World Commission on Dams 2000; Shiklomanov 1990; International Fertilizer Industry Association 2002; UN Centre for Human Settlements 2001; Pulp and Paper International 1993; MacDonalds 2002; UNEP 2000; Canning 2001; World Tourism Organization 2001).

Fig. 3. Global-scale changes in the Earth System as a result of the dramatic increase in human activity: (a) atmospheric CO_2 concentration (Etheridge et al. 1996); (b) atmospheric N_2O concentration (Machida et al. 1995); (c) atmospheric CH_4 concentration (Blunier et al. 1993); (d) percentage total column ozone loss over Antarctica, using the average annual total column ozone, 330, as a base (Image: J.D. Shanklin, British Antarctic Survey); (e) northern hemisphere average surface temperature anomalies (Mann et al. 1999); (f) natural disasters after 1900 resulting in more than ten people killed or more than 100 people affected (OFDA/CRED, 2002); (g) percentage of global fisheries either fully exploited, overfished or collapsed (FAOSTAT 2002); (h) annual shrimp production as a proxy for coastal zone alteration (WRI 2003; FAOSTAT 2002); (i) model-calculated partitioning of the human-induced nitrogen perturbation fluxes in the global coastal margin for the period since 1850 (Mackenzie et al. 2002); (j) loss of tropical rainforest and woodland, as estimated for tropical Africa, Latin America and South and Southeast Asia (Richards 1990; WRI 1990); (k) amount of land converted to pasture and cropland (Klein Goldewijk and Battjes 1997); and (l) mathematically calculated rate of extinction (based on Wilson 1992).

Fig. 4. Atmospheric CO_2 concentration over past 420 000 years from the Vostok ice core with the recent human perturbation superimposed (Petit et al. 1999; Keeling and Whorf 2000).

Fig. 5. Maps of the change in water reuse index (defined as the quotient of the combination of domestic, industrial and agricultural sectors water demand to the mean annual surface and subsurface runoff accumulated as river discharge) as predicted by the CGCM1/WBM model with climate change alone (Scenario 1), population and economic development only (Scenario 2), and the effects of all drivers of change (Scenario 3) (Vörösmarty, et al. 2000). Changes relative to contemporary conditions are shown and a threshold of +/-20% is used to highlight areas of substantial change.

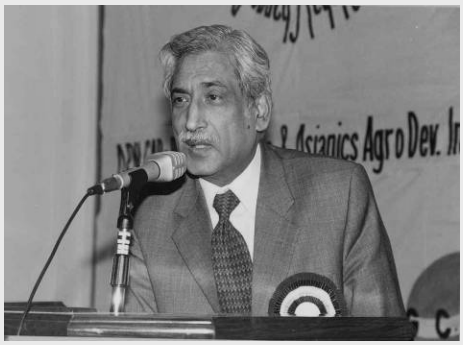
Fig. 6. Country-level climate change impacts for the 2080s based on cereal production potential on currently cultivated land (Fischer et al. 2001).

Fig. 7. Measurements of the atmospheric concentrations of the greenhouse gases CO_2 and CH_4 over the last four glacial-interglacial cycles from the Vostok ice core record, combined with current measurements and projections of future CO_2 and CH_4 levels based on IPCC 2000 scenarios (Petit et al. 1999; IPCC 2001). Dashed lines along the y-axis indicate the IPCC range of projections for CO_2 and CH_4 concentrations in 2100.

Fig. 8. The range of future projections of temperature change lie far outside the range of historic global average temperature for at least the last millennium (Mann et al. 1999; IPCC 2001).

INAUGURAL ADDRESS

***Akram Sheikh*[5]**



Dr. Amir Muhammed, Chairman, Pakistan Global Change Research Committee, Dr. Will Steffen, Executive Director, International Geosphere Biosphere Program, Dr. Linda A. Stevenson, Program Manager, Asia-Pacific Network for Global Change Research, Workshop participants, ladies and Gentlemen,

I am very pleased to be invited as the Chief Guest .to the inaugural session of the Workshop on Networking and Capacity Building in Global Change Research sponsored by the Asia-Pacific Network for Global Change Research (APN) based in Kobe, Japan, and organized by Asianics International Islamabad in collaboration with the Global Change Impact Studies Centre and the Pakistan Academy of Sciences, I would like to complement the sponsors and organizers for holding a capacity building workshop on the very important subject of global change research.

All of us feel the impact of global change, especially the climate change during the last two decades. This has resulted in unusually hot summers and an overall warming trend coupled with a crippling draught in southern parts of our country which lasted for 3-4 years-much longer than past draughts that were milder and of much shorter duration. The monsoon which is the lifeline of our agriculture, and indeed the whole economy, has also been erratic lately. While we broadly understand the reasons for this change which is due to unusually high release of greenhouse gases as a result of unprecedented industrial development in the North countries during the post-World War II period, we are also painfully conscious of the fact that in spite of a better understanding of the causes of this phenomenon that is having a major effect on the lives of all human beings on the Earth, not much has been done to arrest these damaging changes mainly because of the political compulsions of some of the industrialized countries.

Rise in sea level which is also a reality is another ramification of global climate change that will affect life in many countries especially small islands and coastal zones. I therefore believe that this workshop is timely for Pakistan and hope it will serve as a major stimulus to accord high priority to research on global change issues especially those particularly relevant to Pakistan.

I am pleased to learn that a beginning in this direction has already been made. The Global Change Research Committee of the Pakistan Academy of Sciences with support and encouragement of IGBP has already made some efforts to stimulate global change research in Pakistan. Global Change impact Studies Centre, established under the able guidance of Dr. Ishfaq Ahmed, Special Advisor to the Prime Minister, is already engaged in research on several important aspects of global change, especially climate change and its impact on food systems. I am pleased to note that APN is active in the Asia-Pacific region and is making efforts to develop capacity in global change research especially through award of research grants to scientists in the region to work on priority areas affecting several countries.

I have been informed that Dr. Amir Muhammed is the Principal Investigator of an APN project entitled "WATER RESOURCES IN SOUTH ASIA-An Assessment of Climate Change-associated Vulnerabilities

[5] ***Deputy Chairman, Planning Commission, Govt. of Pakistan***

and Coping Mechanisms" that was awarded as a result of keenly contested open competition for annual awards of APN research projects. I have no doubt that this is a very important topic for the whole South Asia region since the region is experiencing water shortages which are aggravated by the climate change phenomenon. Pakistan is already in the midst of water crisis and we are according very high priority to harnessing of additional water resources to meet our increasing demand. I am sure the results of this study would be of major interest to the planners of water resources in all the countries of the region, especially Pakistan. Another Pakistani scientist, Dr. Arshad Mohammed Khan Executive Director of GCISC has been awarded an APN/CAPaBLE comprehensive research project entitled "Enhancement of National Capacities in the Application of Simulation Models for the Assessment of Climate Change and its Impacts on Water Resources and Food and Agricultural Production" as Principal investigator with participation of scientists from Bangladesh, Nepal, Australia and USA. This project is obviously of great importance to the South Asia region.

I am glad to learn that this workshop is mainly aimed at developing capacity in the relatively young mid-career scientists to enable them to identify and develop suitable research projects in APN priority areas in global change research and compete in the APN process for competitive grants. I hope simultaneously the workshop will also stimulate education in global change aspects from junior to advanced level so that the students get a good idea of these changes, the factors causing them and measures to mitigate the harmful changes to save humanity from a possible disaster as a result of uncontrolled global changes.

Ladies and Gentlemen!

Our main concern in Pakistan is sustainable economic development especially to ameliorate the lot of a large segment of our population who are suffering from abject poverty and low quality of life index. While we are planning to take measures that will result in generation of more employment opportunities especially for the educated youth , and sustainable increase in national and family income, we have to be mindful of the global changes that are taking place regardless of whether we like them not. We have to understand these changes, mitigate the harmful effects as far as possible, and adjust to live with them if we cannot change them.

As rightly pointed out, the global changes are not only in the bio-physical environment but also in the social, economic and cultural dimension which affects all human beings on the earth, especially those in developing countries like ours. We have already seen the impacts of global economic order which has resulted in creation of unbearable debt burden on the developing countries mortgaging their future generations to debt. Globalization of international trade in the context of the provisions being worked out by the World Trade Organization will also have far –reaching consequences for the economies of all countries. We have to understand these changes and take measures so that we benefit from these changes instead of being hurt..

I would once again like to complement the organizers of this stimulating workshop. I do hope the workshop will achieve its main objective of stimulating global change research in Pakistan so that Pakistan could play its due role in contributing to an understanding of the selected global change phenomena and measures to mitigate their harmful effects. I wish the participants, especially those who have come from abroad a very pleasant and enjoyable stay in the Nation's Capitol inspite of the very hot weather.

Thank you and Pakistan *Paindabad!*!

INTERNATIONAL PROGRAMMES

TOWARDS AN HOLISTIC APPROACH TO GLOBAL CHANGE RESEARCH: *THE EARTH SYSTEM SCIENCE PARTNERSHIP (ESSP)*

Will Steffen [6]

There is a growing recognition within the research community that global change must be studied in a more holistic and integrated way. Crucial to the emergence of this perspective is the increasing awareness of two aspects of Earth System functioning. First, that the Earth itself is a single system within which the biosphere is an active, essential component. Second, those human activities are now so pervasive and profound in their consequences that they affect the Earth at a global scale in complex, interactive and apparently accelerating ways. This implies that future studies of the changing Earth System must go beyond the more traditional emphasis on the physico-chemical aspects of the System and embrace more fully the additional complexity of the biological and anthropogenic aspects. In the international context, this challenge has been recognised by the four global change research programmes - DIVERSITAS, IGBP, IHDP and WCRP - through the formation in 2001 of the Earth System Science Partnership, ESSP. The ESSP recognises that the expertise embodied in the four programmes spans the many disciplines required for a more holistic approach to Earth System science but that a more formal platform is needed to foster collaboration on scientific questions at the level of the Earth System as a whole, that is, on questions that go beyond the remits of any one or two of the individual programmes. The formal goal of the ESSP is "to facilitate collaborative activities for the integrated study of the Earth System, the changes that are occurring to the System and the implications of these changes for global sustainability". Since its formation in 2001, the ESSP has a developed a portfolio of three different types of activities.

Joint Projects on Issues of Global Sustainability

These projects are designed to address the global change aspects of a small number of critical issues for human well-being: carbon cycle/energy systems; food systems, water resources, and human health. The aim is to build a global change-oriented research agenda of direct relevance for societies, with particular emphasis on fundamentally important issues for developing regions - food, water, energy and health. In brief, these projects aim to elucidate the additional challenges caused by global change for these topics, and, importantly, to understand the implications of human-driven changes in these systems for the functioning of the Earth System, *vis*. that is, the two-way interaction between global change and global sustainability issues.

Regional Activities

The pressure for more emphasis on the regional scale of Earth System science has been growing for a number of years. The ESSP sponsors two specific activities that are focused on regional approaches to global change: START and Integrated Regional Studies (IRS). The Global Change System of Analysis Research and Training (START) is the capacity-building and regional networking activity of IGBP, IHDP and WCRP, and now has formally been recognised as an activity under the auspices of the ESSP.

A proposed set of Integrated Regional Studies has arisen as an attempt to respond to this need in a way that both relies strongly on the input and collaboration from the regional scientific communities themselves and also addresses regional-global linkages. Given the broad scope of such studies, they are clearly beyond the scope of any one of the four GEC programmes and thus logically should be coordinated under the auspices of the ESSP. The Integrated Regional Studies are currently at the discussion stage with the well-known LBA (Large-scale Biosphere-Atmosphere project in Amazonia)

[6] *on behalf of the ESSP: DIVERSITAS, IGBP, IHDP, WCRP*

already acknowledged as an Integrated Regional Study, and a second such study under active development in the Monsoon Asia region.

Global Change Open Science Conferences

Challenges of a Changing Earth, held in Amsterdam in July 2001, was officially co-sponsored by IGBP, IHDP and WCRP (with a number of Asia-Pacific participants funded by APN), and represents the first major public event sponsored by the ESSP. At the 2001 meeting of the Chairs and Directors of the four ESSP programmes, it was agreed that Open Science Conferences will be held at 5-6 year intervals and will be formally sponsored by the ESSP.

Following are examples of ESSP activities that are of directly relevance to the Asia-Pacific region.

Monsoon Asia Integrated Regional Study (MAIRS). START and its regional networks in East Asia, South Asia and Southeast Asia are developing a project on integrated regional studies of global change in Monsoon Asia (MAIRS). The long-term objectives of MAIRS, which may ultimately combine field experiments, process studies, and modelling components' are:

- To better understand how human activities in regions are interacting with and altering natural regional variability of the atmospheric, terrestrial, and marine components of the environment;
- To contribute to the provision of a sound scientific basis for sustainable regional development; and
- To develop a predictive capability of estimating changes in global-regional linkages in the Earth System and to recognise on a sound scientific basis the future consequences of such changes.

The key issues in MAIRS will include considerations of what the region be like in another two to five decades; what will be the consequences of global changes for the region; and what will be the consequences of regional changes for the global Earth System. MAIRS-related studies will consider:

- Major demographic, socio-economic, and institutional drivers for change, including scenarios of change related to urbanisation and industrialisation, energy production and biomass burning, land use/cover change and water resources harvesting, including dam construction;
- Effects on regional atmospheric composition/pollution, regional water cycle and coastal systems, and local ecosystem structure and function;
- Impacts on biogeochemical cycles and the physical climate system, including its variability at different scales;
- Potential impacts of global and other feedback effects on the regional biospheric life support system, including food systems, water resources and health.

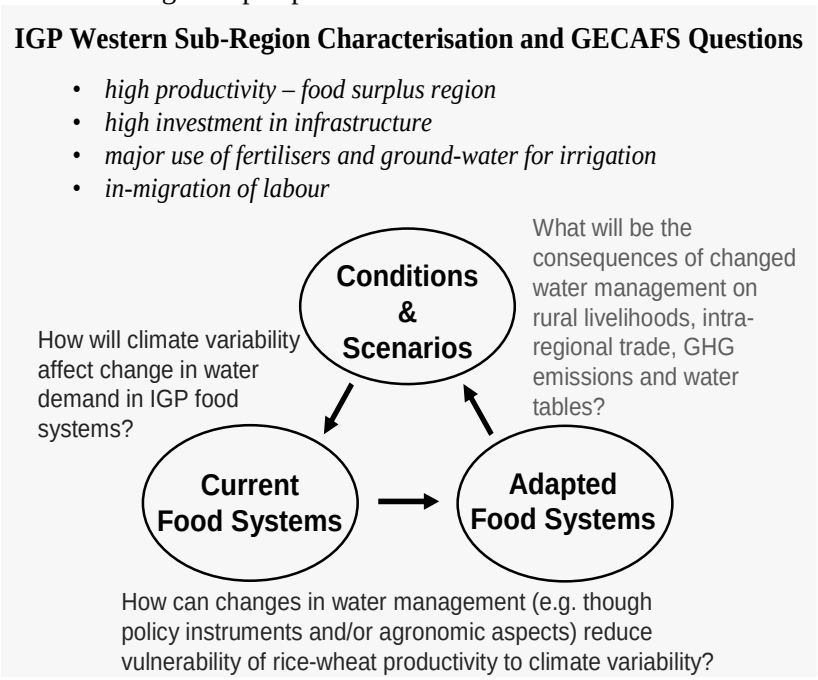
The initial phase of MAIRS is a set of sub-regional scoping/rapid assessment studies, undertaken jointly by START and SCOPE and which is co-sponsored by the APN. Three ongoing sub-regional Rapid Assessment Projects (RAP) for China/East Asia, South Asia and Southeast Asia are systematically reviewing current knowledge regarding regional aspects of global change in Monsoon Asia. These assessments will be published in a series of books during 2005. Financial support for these assessments is being provided by ICSU and APN. The Chinese Academy of Sciences has offered to host and fund an international project office for MAIRS. More information on MAIRS is available at the START website **<http://www.start.org>.**

Global Environmental Change and Food Systems (GECAFS). Food security in the Indo-Gangetic Plain (IGP) is threatened by global change (especially increased climate variability) and current food systems contribute to further Earth System "forcing" though, for instance, the production of greenhouse gases and by causing significant changes in ground- and surface-water dynamics. A regionally-based research project is being developed by the ESSP Joint Project "Global Environmental Change and Food Systems (GECAFS; www.gecafs.org) to bring together global change science and the biophysical and socioeconomic dimensions of the IGP's food systems. The project will deliver scientific outputs aimed at helping identify policy and technical options for improved water resource management, a central issue in the global change-food debate. Recognising the marked socioeconomic and biophysical differences across

the region, and the related major policy issues, sets of key research questions based on the GECAFS conceptual framework have been developed for both western and eastern sub-regions (see Figure 1)
One of the contributing projects to this effort is an APN-supported project on the carbon cycle implications of development pathways in Indochina. The objective of the project is to quantify carbon emissions from economic sectors in the transition economy of Indochina in order to improve knowledge of current patterns, mechanisms and future projection of carbon sources and links in the region.

Three major expected outputs of the project are:

- I/O (input/output) compilation: review of national I/O tables and construction of I/O framework for linking economic and environmental issues in each country with respect to carbon.
- Construction of Economic-Environmental Coefficients on carbon emissions from at least 45 economic sectors.
- Modelling the socio-economic and biophysical links and implication for policy makers at national level and regional perspectives.



Global Carbon Project (GCP). The GCP coordinates a broad spectrum of carbon cycle research internationally, encompassing both the biophysical and human dimensions. In terms of the APN region, perhaps the most important high-priority activity of the GCP is an international set of projects examining regional development pathways 'through a carbon-eye lens'.

The project integrates the two components of research and training in order to improve the capacity in each country for carbon cycle/energy system research as well as for global change research in general. The project will be carried out in Vietnam, Laos and Cambodia with contributions from qualified experts or resource people from the Philippines and Japan to assist with both research and training activities.
Global Water System Project (GWSP). The central tenet of this project is that 'human-induced changes to the global water system are now globally significant and are being modified without adequate understanding of how the system works'. The wide range of human interventions is shown in Figure 2 and Table 1, together with the conceptual framework of the global water system. The various human impacts are clearly most significant in regions with areas of high population density such as occur in parts of the Asia and the Pacific region. GWSP seeks collaboration with scientists in the region and has already initiated valuable contacts with Indian, Japanese, and Chinese scientists. The level of activity of the ESSP programmes and their joint projects in the Asia-Pacific region demonstrates the high priority placed on the region and its importance for the future evolution of the global environment.

The ESSP and APN have rapidly developed a close and productive partnership to support global change research in the region. The specific activities outlined above, many of which have benefited from APN input into project formulation and some of which are already supported by the APN, are built on this partnership, which is set to strengthen over the coming years.

IHDP and Global Environmental Change Research: Expanding the IHDP Network to Pakistan

Amin Ur Rehman[7]

The International Human Dimensions Programme on Global Environmental Change (IHDP) was initially launched in 1990 by the International Social Science Council (ISSC) as the Human Dimensions Programme (HDP). In February 1996, the International Council for Science (ICSU) joined ISSC as co-sponsor of the Programme. At this time, the name of the Programme was changed to IHDP, and the Secretariat was moved to Bonn, Germany, through a generous grant from the German government.

IHDP is an international, interdisciplinary, non-governmental science programme dedicated to promoting and co-ordinating research. Its aims are to describe, analyse and understand the human dimensions of global environmental change. IHDP's programme is designed around its three main objectives of research, capacity building and networking.

Increasingly these activities are carried out in collaboration with the international partner programmes on global environmental change: the International Geosphere-Biosphere Programme (IGBP), the World Climate Research Programme (WCRP), and the International Programme on Biodiversity (DIVERSITAS). IHDP is also a scientific sponsor of the Global Change System for Analysis, Research and Training (START) and collaborates with intergovernmental bodies, such as the Asia-Pacific Network for Global Change Research (APN) and the Inter-American Institute for Global Change Research (IAI).

The harmonization of national and regional research activities on global environmental change within the international global change programmes is gaining more and more importance. The global network of social scientists represented in its **National Committees** and **National Contact Points** is one of IHDP's leading strengths and driving forces of research activities, connecting international research agendas to national and regional research agendas. Not only does this network bring together leading scientists to work on human dimension-related issues in their countries or regions, but they also play a leading role in naming participants to IHDP Core and Joint Science Projects as well as influencing the identification of research themes for the Programme as a whole.

In order to support research in the human dimensions field, IHDP places high priority on balancing representation of all regions of the world. To-date, 61 nations are actively linked to our research community. IHDP has 30 National Committees (14 are Global Change Committees with representation from two or more GEC Programmes) and 31 National Contact Points. Out of these countries, more than half are located in developing countries transition economies. IHDP does not enforce a strict set of guidelines for the creation, structure, scope and functions of National Committees. National Committees vary in terms of structure/composition, modes of operation, capabilities, and levels of activities. While some committees have identified their key research areas and themes and are carrying out extensive

[7] *Associate Professor, Independent University of Bangladesh*

programmes of research, others are in their initial stages. Each National Committees develops its own terms of operation depending on specific needs, priorities and resources.

IHDP National Committee (NC): an organized group of national HDGEC researchers acting as the national focal point for IHDP within their country. NCs help to raise the visibility and capacity of the national HDGEC research community, engaging representatives from NGOs and policy-makers in its activities. They set research priorities and foci at the national level and contribute to the regional and global body of knowledge and research on these issues. Members participate and contribute to research agendas of IHDP Core and Joint Science Projects as well as to IHDP research priorities.

Global Change Committee (GCC): a Committee which is linked to two or more of the Earth System Science Partnership (ESSP) Global Change Programmes (IHDP, IGBP, WCRP and DIVERSITAS).

National Contact Point (NCP): independent efforts by a group of committed HDGEC research scientists to promote HDGEC research within their countries and increase visibility of the IHDP. Many National Contact Points develop into National Committees over time.

How can IHDP Representatives (NC and NCP) better connect themselves – on common research themes, to IHDP Core and Joint Science projects, to each other in offering assistance and advice?
This question was raised at the Montreal meeting of NC and NCPs in 2003. The role of National Committees and Contacts is increasing within the IHDP framework. National representatives can serve a leading role in connecting IHDP projects to national researchers in specific fields of interest not yet connected or aware of IHDP. This could be facilitated by increasing the occurrence of national and regional workshops or conferences on key IHDP themes. Lack of funds is a clear obstacle in developing countries. It is clear that researchers working independently without interaction are no longer effective. National Committees are needed for communications with one another, compare research strategies and work towards collaborative research goals. Both natural and social scientists alike need to address national, regional and global scale issues, also taking local considerations/stakeholders into account. 'Learning and Sharing' from one another and the benefits.

IHDP has played a strong role in building interdisciplinary networks and capacities, aiding in the organisation of multiple capacity building workshops, which brought in hundreds of interested young scientists to the Young Human Dimensions Research (YHDR) network. National Committees could also start to take an active role in this. IHDP could also write general support letters in support of national or regional capacity building efforts, which would help some countries in initiating inquiries for funding of such workshops.

IHDP PRESENTATION

International Human Dimensions Programme on Global Environmental Change

IHDP

Mission

- Generate scientific knowledge on coupled human-environment systems
- Achieve comprehensive understanding of global environmental change processes and their consequences for sustainable development
- Make scientific contributions to explore:
  - the anthropogenic drivers of global environmental change
  - the impact of such change on human welfare
  - human responses to global environmental change

1

International Human Dimensions Programme on Global Environmental Change

IHDP

Research Foci Global Environmental Change and Human Security

- Environmental change, resource use & human security
- Resources, conflict & co-operation
- Modelling regions of environmental stress and human vulnerability
- Institutions & policy development in environmental security

Flagship Activities

- Mekong Delta Region
- Russia
- Southern Africa
- Index of Human Insecurity

http://www.gechs.org/

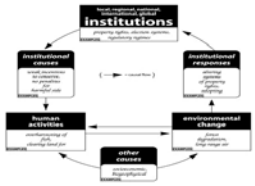
2

International Human Dimensions Programme on Global Environmental Change

IHDP

Research Foci Institutional Dimensions of GEC

- Roles of institutions in causing and responding to GEC
- Effectiveness of institutional innovations in responding to GEC
- Prospects of (re)designing institutions to confront environmental challenges



Flagship Activities

- Carbon management
- Fisheries
- Forestry

http://fiesta.bren.ucsb.edu/~idgec/

3

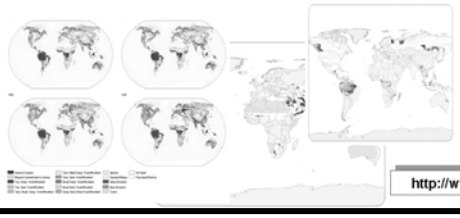
International Human Dimensions Programme on Global Environmental Change

IHDP

GLOBAL CHANGE

Research Foci Land-Use and Land-Cover Change

- Land-Use Dynamics (Comparative Case Study Analysis)
- Land-Cover Dynamics (Empirical Observations & Diagnostic Models)
- Regional and Global Integrated Models



http://www.geo.ucl.ac.be

4

International Human Dimensions Programme on Global Environmental Change

IHDP

Research Foci Industrial Transformation

- Energy and Material Flows
- Food (Production and Consumption)
- Cities and Industrial Transformation (Focus on Water and Transport in Urban context)
- Information and Communication
- Governance and Transformation Processes (Future development trajectories; technological institutional innovation)

Industrial Transformation

http://www.vu.nl/ivm/research/ihdp-it/

5

International Human Dimensions Programme on Global Environmental Change

IHDP

ICSU | ISSC

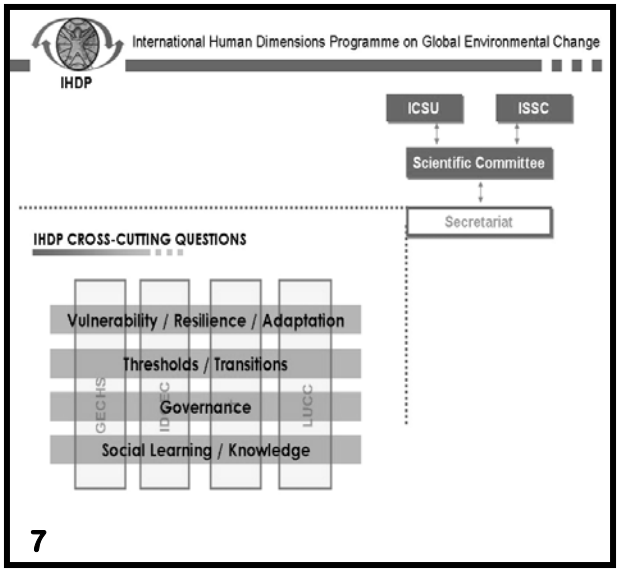
Scientific Committee

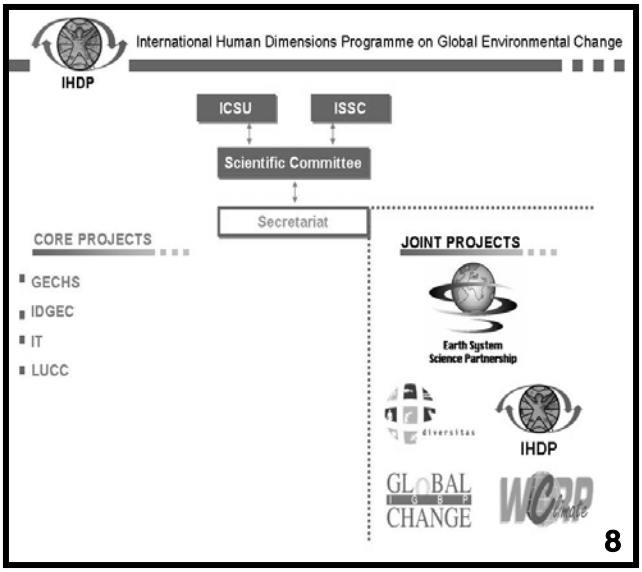
Secretariat

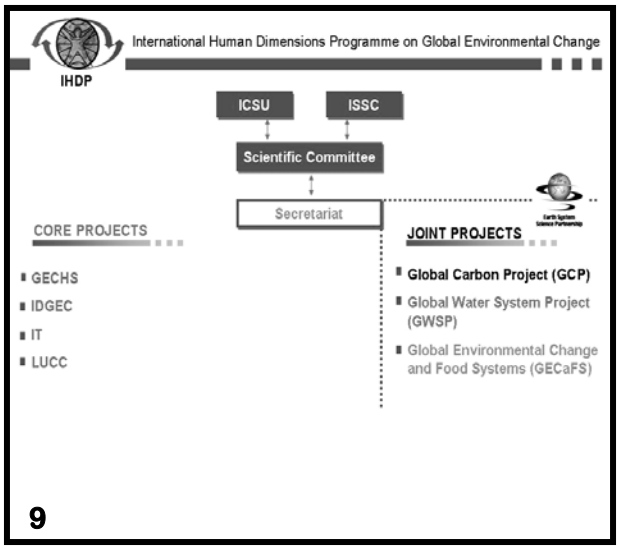
NEW CORE PROJECTS (in development):

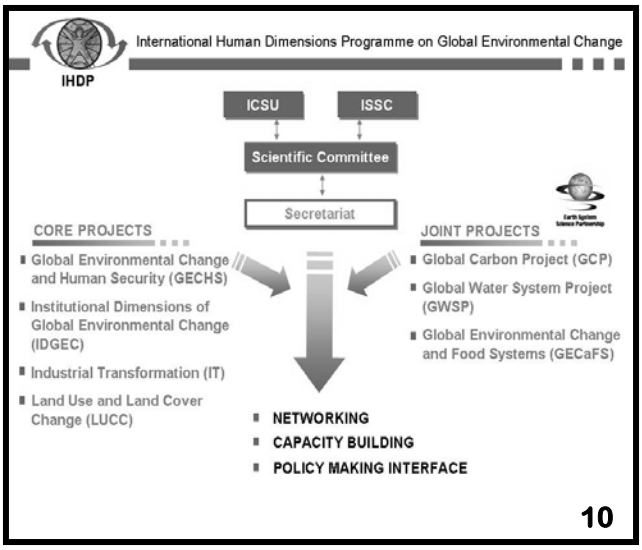
- URBANIZATION (as IHDP Core Science Project)
- LOICZ: Land and Ocean Interactions in the Coastal Zone (scientific partnership of IHDP/IGBP)
- LAND (currently being developed IHDP/IGBP)

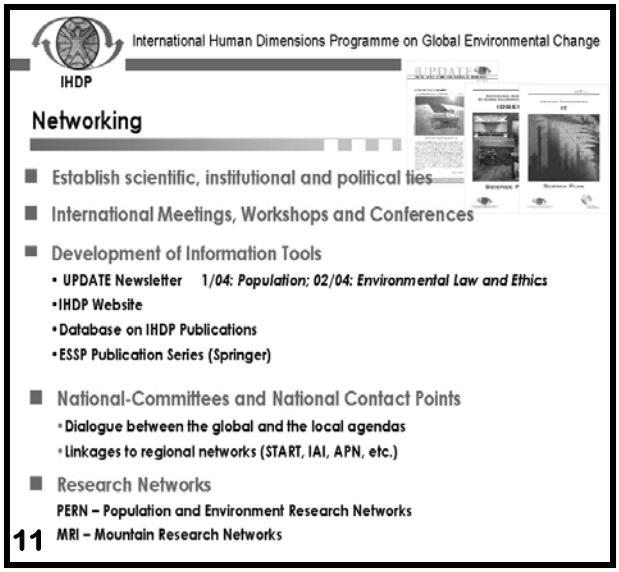
6

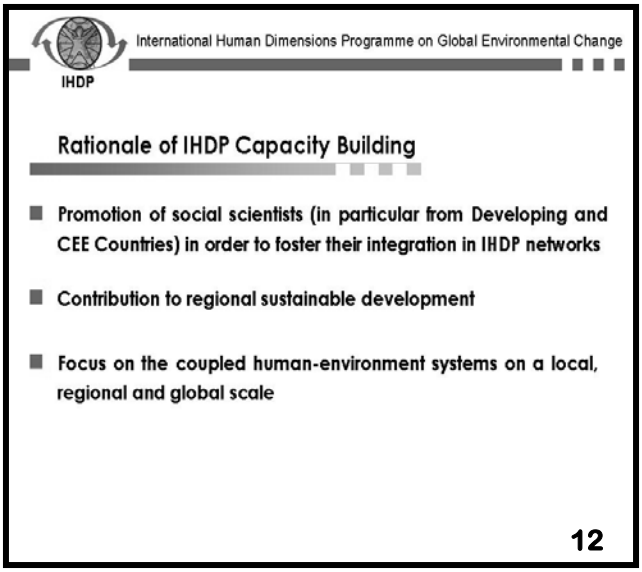

International Human Dimensions Programme on Global Environmental Change
IHDP
ICSU
ISSC
Scientific Committee
Secretariat
IHDP CROSS-CUTTING QUESTIONS
Vulnerability / Resilience / Adaptation
Thresholds / Transitions
Governance
Social Learning / Knowledge
GECHS
IDGEC
LUCC
7

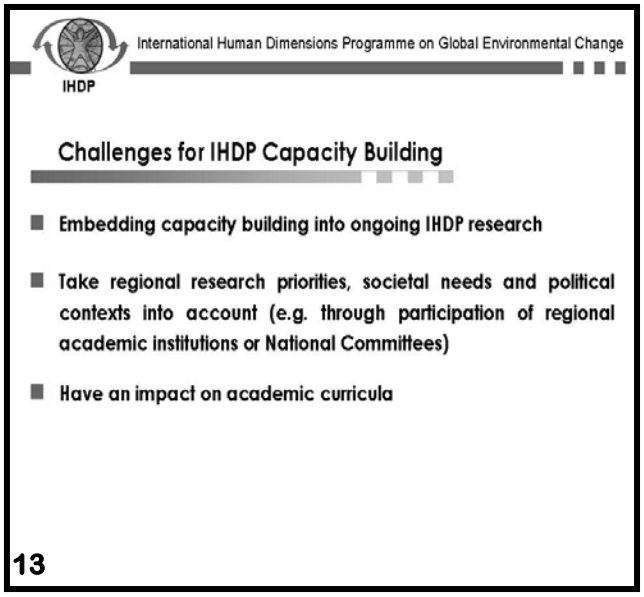

International Human Dimensions Programme on Global Environmental Change
IHDP
ICSU
ISSC
Scientific Committee
Secretariat
CORE PROJECTS
GECHS
IDGEC
IT
LUCC
JOINT PROJECTS
Earth System Science Partnership
diversitas
IHDP
GLOBAL CHANGE
8

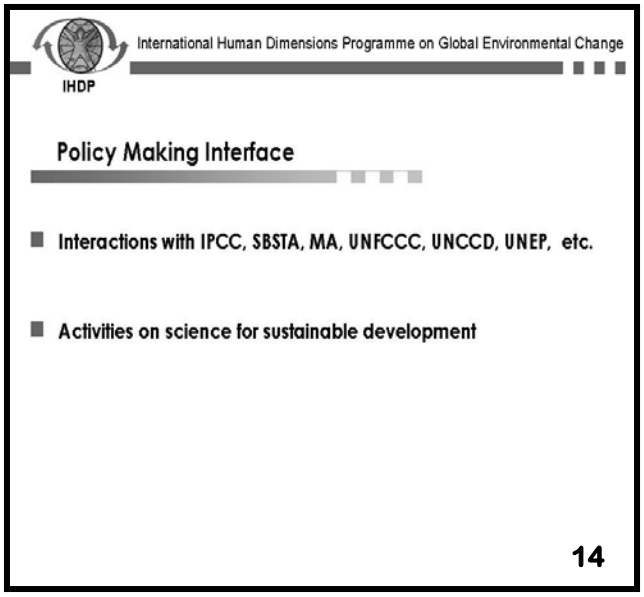

International Human Dimensions Programme on Global Environmental Change
IHDP
ICSU
ISSC
Scientific Committee
Secretariat
CORE PROJECTS
GECHS
IDGEC
IT
LUCC
JOINT PROJECTS
Global Carbon Project (GCP)
Global Water System Project (GWSP)
Global Environmental Change and Food Systems (GECaFS)
9

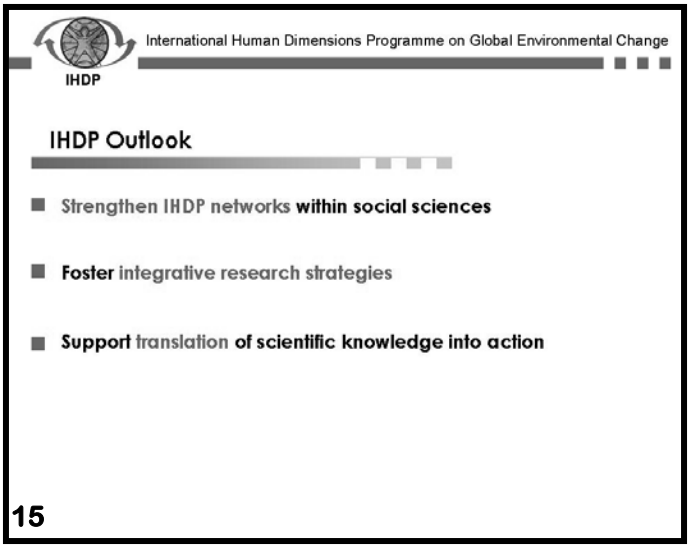

International Human Dimensions Programme on Global Environmental Change
IHDP
ICSU
ISSC
Scientific Committee
Secretariat
CORE PROJECTS
Global Environmental Change and Human Security (GECHS)
Institutional Dimensions of Global Environmental Change (IDGEC)
Industrial Transformation (IT)
Land Use and Land Cover Change (LUCC)
JOINT PROJECTS
Global Carbon Project (GCP)
Global Water System Project (GWSP)
Global Environmental Change and Food Systems (GECaFS)
NETWORKING
CAPACITY BUILDING
POLICY MAKING INTERFACE
10


International Human Dimensions Programme on Global Environmental Change
IHDP
Networking
Establish scientific, institutional and political ties
International Meetings, Workshops and Conferences
Development of Information Tools
• UPDATE Newsletter 1/04: Population; 02/04: Environmental Law and Ethics
•IHDP Website
•Database on IHDP Publications
•ESSP Publication Series (Springer)
National-Committees and National Contact Points
•Dialogue between the global and the local agendas
•Linkages to regional networks (START, IAI, APN, etc.)
Research Networks
PERN – Population and Environment Research Networks
MRI – Mountain Research Networks
11


International Human Dimensions Programme on Global Environmental Change
IHDP
Rationale of IHDP Capacity Building
Promotion of social scientists (in particular from Developing and CEE Countries) in order to foster their integration in IHDP networks
Contribution to regional sustainable development
Focus on the coupled human-environment systems on a local, regional and global scale
12


International Human Dimensions Programme on Global Environmental Change
IHDP
Challenges for IHDP Capacity Building
Embedding capacity building into ongoing IHDP research
Take regional research priorities, societal needs and political contexts into account (e.g. through participation of regional academic institutions or National Committees)
Have an impact on academic curricula
13


International Human Dimensions Programme on Global Environmental Change
IHDP
Policy Making Interface
Interactions with IPCC, SBSTA, MA, UNFCCC, UNCCD, UNEP, etc.
Activities on science for sustainable development
14


International Human Dimensions Programme on Global Environmental Change
IHDP
IHDP Outlook
Strengthen IHDP networks within social sciences
Foster integrative research strategies
Support translation of scientific knowledge into action
15

PRIORITES FOR HUMAN DIMENSIONS REARCH IN PAKISTAN

Nasim Akhter[8]

"Priorities for Human Dimensions Research in Pakistan"

APN,IGBP, IHDP, CAPaBLE
Workshop on Networking and Capacity Building in Global Change Research
Islamabad ,
June 08-10, 2004

By Dr. Nasim Akhtar,
Chairman, IHDP
National Committee for Pakistan /
Deputy Director General
Animal Sciences Institute
National Agricultural Research Centre, Islamabad

1

Challenges For the Future

Much much more attention is needed to be given to;

- Consideration of RISK of living with global changes
- Question of vulnerability
- And the need to provide the scientific basis for the sustainable development of the earth and its people

2

CAUSES OF POPULATION MOVEMENT

- The UNHCR identified 4 root causes:
  - Political instability
  - Economic tensions
  - Ethnic conflicts
  - Environmental degradation
- Environmental Refugees have become the single largest class of displace person in the world. (Reports from Dixon 1989, Bick 1996 & Willamsons 1996) claimed.

3

PAKISTAN'S CASE

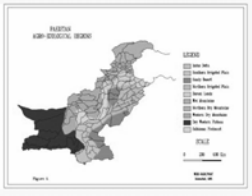
PHYSICAL & ECOLOGICAL LANDSCAPE and FEATURES HAS ENGENDERED A DYNAMIC and MULTI-FECETED SOCIO-ECONOMICS

- Vast diversity of physiological and ecological areas.
- Climate varies from cold tundra to hot arid tropical.
- With annual precipitation ranging from 2000 mm to almost none.
- Erratic rainfalls; *El Nino . La nina,,,* (FLOODS AND DROUGHTS)
- Thermal regime ranges from several degrees below O°C to 50°C.

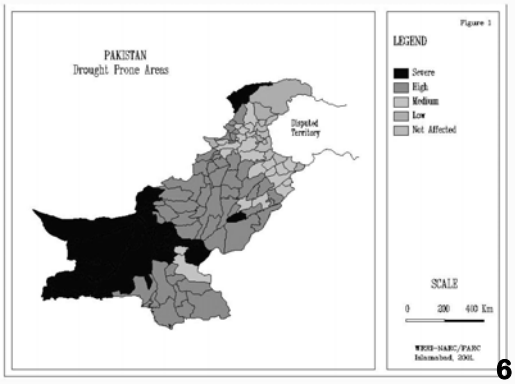
4

PAKISTAN'S CASE Contd.....

- Bulk of land is classified as rangelands and only 20% fit for agriculture and 5% under forest.
- Human population is unevenly distributed over 56% of;
  - Population lives in irrigated plains of Punjab (44% area).
  - Primarily arid, Balochistan has lowest population.
- Indus basin and its Development/ development plans
- Highly productive Arabian Sea , long Coast and Vast EEC



5



6

[8] ***Chairman, IHDP National Committee for Pakistan,/DDG Animal Sciences Institute NARC, Islamabad***

National Committee of IHDP/GEC-Pakistan

BACKGROUND

- It started its first set of activities in 2002 by establishing a National Contact Point (NCP) in Pakistan with encouraging support of IHDP Secretariat located in Bonn, Germany.
- Attempts continued to bring together a cohesive group of people to initiate the creation of National Committee.

7

NC of IHDP/GEC

- IHDP National Committee (NC)of Pakistan intends to be an organised group of national HDGEC researchers acting as the national focal point for IHDP within the country.
- NC will help raise the visibility and capacity of the national HDGEC research community, engaging representatives from NGOs and policy-makers in its activities.

8

Immediate Plans

In order to promote the development for supporting capacity building efforts in this region

AND

strengthening of National Human Dimensions Committees in Pakistan

INAUGURAL meeting of IHDP NC-Pakistan is scheduled for

3rd week of July -2004 at PARC, Islamabad

under the IHDP Initiative (towards the establishment of National Committees in Developing Countries and Transition Economies)

9

Scope of Study

- To enlist research institutions /projects of Pakistan focused towards issues related to HD of GEC
- Institutional leaders and their strengths
- Institutional conditions (finance, human resource, integration with co-operation network)
- Participation of Government and NGO's
- What research results are expected

10

OBJECTIVE

The Synopsis of research activities will show Main issues which have been addressed in the country that potentially relates to HD research

11

Cont'd...

Research orientation:

Distribution of research project & research activity as per their dominance of;

Human security related projects

- Food-related projects
- Projects in the area of resource use
- Vulnerability
- Environmental stress

Land use and cover changes

Forestry sector-research

Rangeland

Land degradation

Land-use changes

Human settlements

12

Vision

- Regarding the national committee of the IHDP for GEC in Pakistan vision is to integrate as far as possible persons from different cities and regions of Pakistan to activate research activities regionally and have more accurate information available about the interested institutions within the region

13

Needs for Pakistan

- Draft a National Human Dimension program in the perspective of GEC
- Convening a national workshop for Pakistan's Human Dimension Program with international participation
- Specific national Human Dimension research initiatives
- National climate change action plan

14

Needs for Pakistan

- **Need to prepare methodological guidelines for preparation of environmental assessment of irrigation and drainage system**
- **Studies on Public perception of global change;**
- **How cultural and economic characteristics affect perception of climatic change considering the developing economy of Pakistan and to**
- **See how society will affect policies concerning the use of resource to ensure human security**
- **Invest more in the Global climatic observing system which are currently underperforming**

15

Needs for Pakistan

- **Capacity building for Pakistan's Human Dimension Program**
- **Creation of a National Centre for Global change**
- **Goals**
- **To unify the forces of all governmental and non governmental organizations as well as scientists and specialists**
- **Studies on CEC on Nature and Society**
- **Realizing contacts with international organizations and assuring participation in international projects in the arc G.E.C and its consequences**

16

Key Human Dimensions Research Areas in a Random Order

- Information assistance of the problems related to the Hd/GEC
- Knowledge of Intensive agriculture ,food security and precision farming
- Ecosystem management and biodiversity degradation and habitat loss
- Air, water and pollution and HD/GEC
- Human security/conflicts/settlement of refugee

17

Contd…..

- Sustainable development of Agricultural system and the Global Change
- Unemployment/poverty/deprived children/juvenile delinquency
- Demography/rural-urban migration/urbanization
- Diseases in humans and livestock/human health

18

Contd…..

- Vulnerability and assessment of the impacts of HD/GC on the social and economics system
- Unemployment/economic mismanagement
- Mapping regions of ecological stress and human vulnerability using a set of index of vulnerability.
- Household economics and vulnerability
- Climate change

19

Contd…..

- Impact of dams on fisheries
- Assessment of the regional change on the scale of the global change (Mountain, Coastal zones and Towns)
- Ethical, political and legislative aspects of GEC
- Industrial transformation/energy
- Desertification/deforestation

20

Cont'd…

- Drought ; setting Parameters of Change in natural economic and social processes and Risk assessment
- Drought related research could serve as an analogy for future climatic change and could support the development of efficient adaptive concepts and this will require integrated research in the areas of;

21

Cont'd…

- Geographic aspects,
- climatic features of drought, sun-earth interaction , population dynamics of birds, fishes and mammals in natural ecosystem , water quality and Water resource management in the drought period,
- ROLE OF AQUATIC ECOSYSTEMS IN THE FOOD AND LIVELIHOOD SECURITY IN THE INDUS BASIN - PAKISTAN

22

Cross-cutting Themes

(Joint research initiatives 0f IGBP, IHDP and WCRP)

Food and Fiber
Carbon
Water

Emerging Themes within IHDP
Vulnerability
Global sustainability
Earth System Science
Governance and Institutions

Opportunities for HDGEC research
Research- priority setting
Quality research Proposal
Collaboration: IHDP science Projects
Collaboration: other national committees

23

Opportunities To Carry Out Research

- Three pronged strategy is needed to cope with researchable problems
  - **Leading universities in Pakistan such as FAST_NU etc., should take lead in launching the first Ph.D program in Pakistan to supply environmental research. This could provide impetus for environmental related research**
  - **We need more public awareness & political will**
  - **Some problems can be addressed within the research community by creating a new research culture using publications**

24

Cont'd…

- Co-operation
- Participation
- Key to success is in more rational and sincere interrelation with the government and civil society
- More diffusion of information and activities are necessary within the research community about the objective and structure of human dimension program so that researchers can cooperate with additional information

25

New Inputs Required For Local And Global Sustainability

AS IDENTIFIED BY GLOBAL CHANGE OPEN SCIENCE CONFERENCE (The Netherlands) – 2001

- **Fully integrate social and economic considerations with environmental ones, which also implies different mechanisms to achieve this integration at the national level.**
- **Define strategies, priorities, quantitative and qualitative specific goals, timetables, objective indicators of compliance, economic instruments such as ecological footprints, green accounting systems and follow-up and assessment mechanisms.**
- **Enhance and integrate the presently dispersed financial resources to support national and regional agendas and define a new generation of cooperation mechanisms.**

26

Cont'd…

- **Display alternatives and natural resources use that favor equity and alleviate poverty.**
- **Articulate an active participation in international meetings and agreements with definitions of internal policies and priorities.**
- **Implement innovations for a decentralized and efficient public policy.**
- **Link the knowledge generated in academia with public policy and the productive sector.**
- **Promote economic incentives to open the path for clean and sustainable technologies, in green and brown production.**

27

Synergies

- **Each of these international instruments has its own objectives to solve one crucial environmental problem.**
- **Unfortunately, the links and interactions between the problems and,**
- **Moreover the possible solutions need to be explored,**
- **And the advantages of the synergies that the different instruments could provide needs to be felt.**
- **Establishing synergies among the conventions would allow for significant advances in the resolution of these problems.**

28

REGIONAL AND NATIONAL PROGRAMMES AND ACTIVITIES

CLIMATE CHANGE PERSPECTIVE IN PAKISTAN

Anjum Bari Farooq*[9] *& *Azmat Hayat Khant

Abstract

The objective of the study is to assess the past climate changes and compute the projected changes in different Agroclimatic regions of country for next half century using Regional and Global Climate models. In view of these changes, vulnerabilities of different regions may be accessed and suitable coping mechanisms/ adaptation strategies be proposed. Analysis of past depicts that our climate is changing. The rate of change and the nature of the resulting impacts will vary over time and across the country, affecting all aspects of our life. In conjunction with efforts to reduce greenhouse gas emissions, it will also be necessary to adapt to the impacts of a changing climate. Understanding what climate change will mean for Pakistan is only one step in that process.

Future changes in climate of the magnitude projected by most global climate models would cause a major impact on our water resources, and subsequently affect food supply, health, industry, transportation and ecosystem sustainability. Problems are most likely to arise to southern parts of country where the resource is already under stress, because that stress would be exacerbated by changes in supply or demand associated with climate change. Previous record and projections by GCMs and RCMs depicts that extreme events (drought and flooding) would become more frequent and of greater magnitude in different parts of the country. These extreme events would place stress on existing infrastructure and institutions, with potentially major economic, social and environmental consequences. Therefore, particular emphasis needs to be placed on the impacts/mitigation of such extremes.

Introduction

The earth's climate has been evolving continuously over millennia but the last two centuries have witnessed the development of the greenhouse problem, which threatens to change climate in an unprecedented manner. Patterns of solar variability, the effects of the El Niño-Southern Oscillation (ENSO), changes in the atmosphere (as revealed by isotopic studies of ice cores), variability in the extent and volume of land and sea ice, and natural variability of the biosphere illustrate both the variety of internal and external sources of variation and the range of responses caused by different earth system components.

Over the last century, an average annual increase in surface air temperature of about 2.9°C has been observed in boreal Asia. Nations in Asiatic region are especially concerned about the build-up of greenhouse gases in the atmosphere because of the potential effect on the region from climate change related shifts in patterns of storms, floods and droughts as well as a rise in sea level. Asiatic region has been historically vulnerable to fluctuations in the monsoons, the El Nino Southern Oscillations and tropical cyclones.

The Country Profile

The country has a long latitudinal extent stretching from the Arabian Sea in the south to the Himalayan Mountains in the north. It is located in sub-tropics and partially in temperate region. It is the home of about 18 billion people and probably a larger portion of those is most vulnerable to climate change. Large numbers of residents live in low coastal areas or river deltas where sea level rise and flooding are the

[9] *Director, *Deputy Director, Pakistan Metrology Department, Islamabad- Pakistan*

likeliest devastating consequences of rises in global temperatures as the climate shifts. Climatologically, most parts of Pakistan are arid to semi-arid with significant spatial and temporal variability in climatic parameters. 59% of the annual rainfall is due to monsoon rains; a dominant hydro-meteorological resource for Pakistan

- Greater Himalayan region above 35°N receives winter precipitation mostly in the form of snow and ice. The snow melt contribution keeps the rivers perennial throughout the year.
- The coastal climate is confined to a narrow strip along the coast in the south and southeast,
- The north is dominated by the mountain climate ranging from humid to arid.
- In between, the climate is broadly of tropical continental nature

The objective of the study is to assess the past climate changes and compute the projected changes in different Agro-climatic regions of country for next half century using Regional and Global Climate models. In view of these changes, vulnerabilities of different regions may be accessed and suitable coping mechanisms/adaptation strategies be proposed.

Data and Methodology

Climatic data for the last 50 years (1951-2000) was analyzed for computing past climate changes. Graphs were drawn for the mean annual and seasonal rainfall, maximum, minimum and mean temperature values for 60 stations in different agro-climates of the country

- Temperature data (Mean & seasonal temperature both monsoon and winter periods) were analysed.
- Precipitation data (Annual and seasonal totals) were analysed
- Then trend lines were drawn and changes were worked out from the fitted curves. Contour lines were drawn on country maps and regions of positive and negative changes were marked.
- GCMs Climate Scenario generator MAGIC and Regional Climate Model RegCM2 were used for projected rainfall and temperature data based on 1961-1990 data.

Analysis of Results & Conclusions

Climate change is a primarily influenced by the total stock of GHGs in the atmosphere and not by annual GHG emissions. Historically, developed countries and economies in transition have been responsible for about 75% of the total global stock of GHGs. In terms of annual contributions too, the level of emissions across different countries shows considerable variations in terms of absolute amounts and per capita emissions.

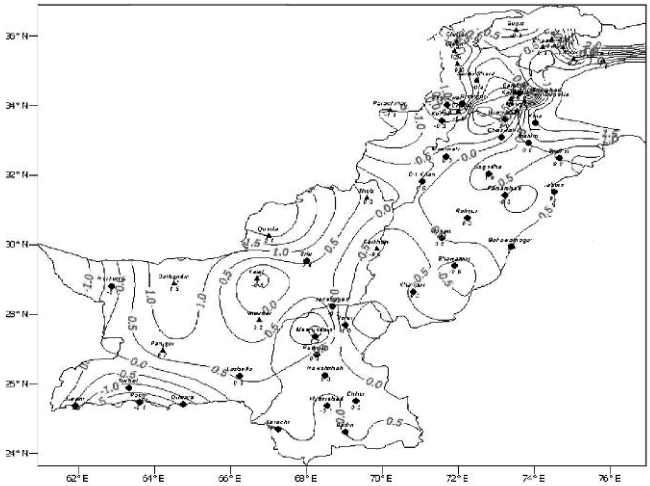


Figure 1: Annual Mean Temperature Trend Change

Pakistan is highly vulnerable to climate change as its economy is heavily reliant on climate-sensitive sectors like agriculture and forestry, and its low-lying densely populated deltas are threatened by a potential risk of flooding. In Pakistan, annual mean surface temperature has a consistent rising trend since the beginning of 20th century. Rise in mean temp. of 0.6-1.0°C in arid coastal areas, arid mountains and hyper arid plains, 10-15% decrease in both winter and summer rainfall in coastal belt and hyper arid plains, 18-32% increase in rainfall in monsoon zone especially the sub-humid and humid areas is observed. There is 5% decrease in relative humidity in Balochistan, 0.5 to 0.7% Increase in solar radiation over southern half of country.

ANNUAL TEMPERATURE CHANGES

a)	Over the Thermal Low Region	(Increased)	0.2 to 1.0°C
b)	Coastal Areas (Balochistan)	(Decreased)	- 0.5 to -1.5°C
c)	Monsoon belt	(Generally decreased)	- 2.0 to 0.0°C
d)	Northern Mountains (Greater Himalayas)	(Generally increased)	-1.5 to 1.5°C
e)	Thar region	(Increased)	0.3 to 1.0° C
f)	Sindh Coast	(Generally Increased)	0.0 to 0.5° C

There is 3-5% decrease in cloud cover in central Pakistan with increase in sunshine hours, 3-5% increase in ETO due to 0.9°C temperature increase. A 5% increase in net irrigation water requirement with no change in rainfall. Expanding aridity in Northern parts outside monsoon range and arid regions. In the last 100 years, 7 strong, 10 moderate and 7 weak El Nino events; and 17-64% departure of rainfall from normal variability during strong events.

PRECIPITATION CHANGES DURING 1951-2000

Region	On annual basis	Monsoon Season (Jun – Sep)	Winter Season (Dec – Mar)
Coastal areas	Negative	Negative	Positive
Quetta region & SE Sindh	Positive	Positive	Positive
Western Balochistan around Nokkundi	Negative	Negative	Negative
Monsoon belt	Positive	Positive	Mostly positive
Northern Mountains	Positive	Positive	Negative

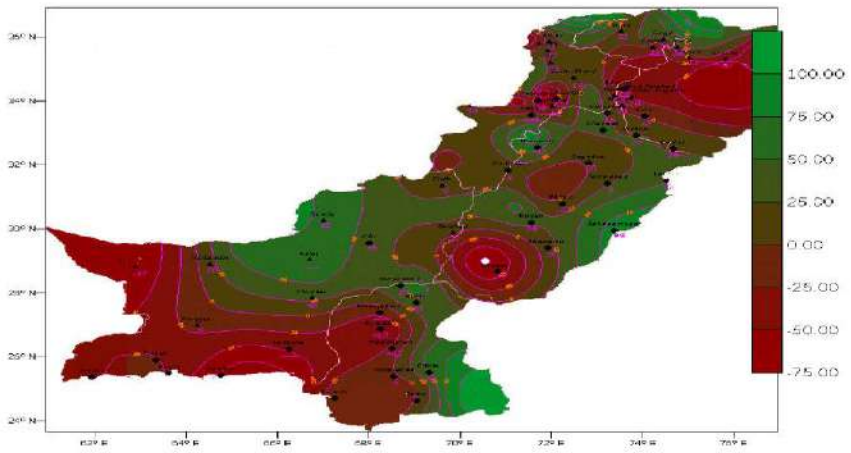


Figure 2: Annual Precipitation Changes during 1951-2000

Tropical cyclones also are an important feature of the weather and climate in parts of Tropical Asia. The core area of cyclogenesis exists in the northern Indian Ocean, which particularly affects Bangladesh, India, Pakistan and Sri Lanka. Frequency of depressions and Cyclones has increased over Bay of Bengal and the Arabian Sea during last 50 years. Moreover the intensity of systems also increased during last quarter of the 20th century.

Other extreme events include low-temperature winds, such as those that blow from the North West into the southern plains of country during January. In the mega-cities
and large urban areas, high temperatures and heat waves also occur. These phenomena are
exacerbated by the urban heat-island effect and air pollution. Geographically much more extensive is the El Niño-Southern Oscillation (ENSO) phenomenon, which has an especially important influence on the weather and inter-annual variability of climate.

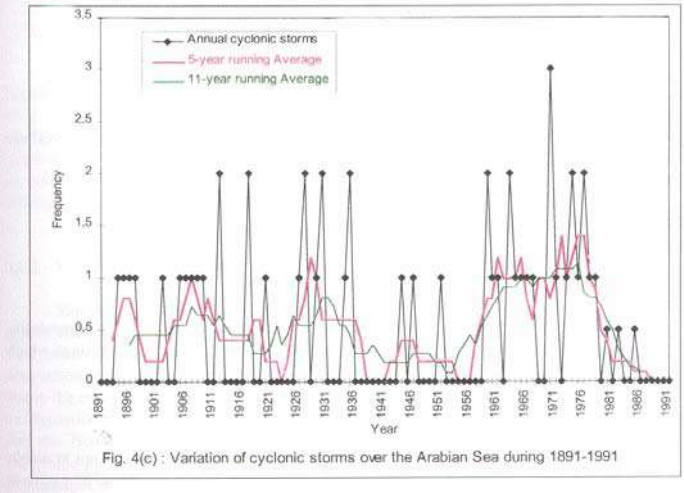


Figure 3: Variation of Cyclonic Storms over the Arabian Sea during 20th Century

The strength of such connections for Pakistan has been demonstrated in several studies. El Nino phenomena suppress monsoon rainfall activity over Pakistan (Chaudhry 1995). La Nina phenomena have a negative impact on winter precipitation over Pakistan (Azmat 2002). Recent history's worst drought (1998-2001) over Pakistan and most of South Asia is linked with La Nina phenomena
(Hoerling, M., and A. Kumar. 2003)

Projected Changes in Precipitation and Temperature

SCHENGEN model was used for generating climate change scenarios during next half of 21st century based on 1931-90 data. Results indicate a progressive change in temperature during the period. However changes in rainfall pattern may not be uniform and south-western coastline and western Balochistan may experience low rains.

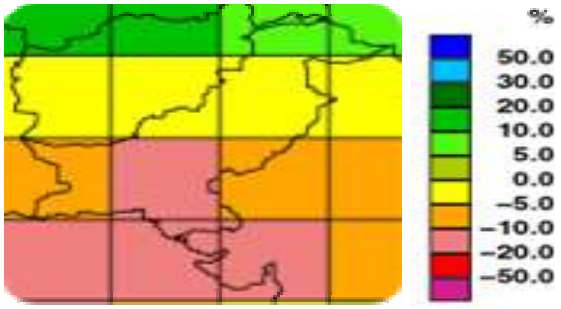


Figure 4: Projected Precipitation Changes on Annual Basis using GCMs Output

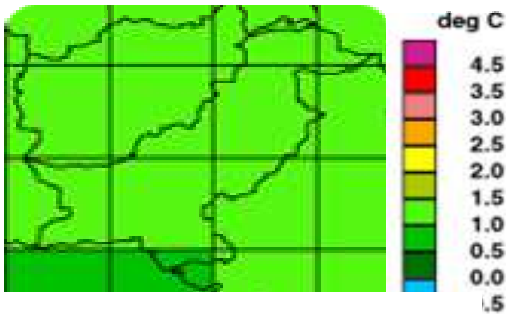


Figure 5: Projected Temperature Changes on Annual Basis using GCMs Output

RCMS Projections:

The RCMs analysis depicts a bit different results in relation to precipitation. Southeast Sindh and Cholistan depict a positive change during next half century. However temperature trend is nearly same.

Potential Impacts of Climate Change:

Climate change represents an additional stress over already resource stressed country. Projected climate changes in the region include strengthening of monsoon circulation, increase in surface temperature, and increases in the magnitude and frequency of extreme rainfall events. Climate-related effects also will include sea-level rise. These changes could result in major impacts on the country's ecosystems and biodiversity; hydrology and water resources; agriculture, forestry, and fisheries; mountains and coastal lands; and human settlements and human health.

Forestry & Marine life*:* The effects on mangrove forests are at start. Pakistan, least affected by sea level rise, would face the loss of the mangrove forests which are the source of fuel wood and food to local inhabitants and breeding ground for 90 percent of Pakistan shrimp, its main fisheries export.
Agriculture Climate-sensitive crops—such as rice, other grains and cereals, vegetables, and spices are particularly important. There is little doubt that agricultural systems in Asia have adapted to a range of environmental stresses over the region's long history of human settlement and land-use change. Whether such resilience can continue in the face of climate change and economic and population changes is uncertain, although it is expected that the processes of ongoing adaptation to changing environmental circumstances will continue.

Agricultural productivity: is likely to suffer severely due to high temperature, severe drought and flood conditions and soil degradation. As a result, the food security of many countries in the region would be under threat. Aquaculture productivity is al so likely to undergo dramatic changes as a result of temperature changes in water. The rise in the sea level would cause submergence of large tracts of the vast Asian coastline, leading to a recession of flat sandy beaches. The ecology of mangroves and c oral reefs around Asia too is likely to suffer severely. In a warmer climate, the El Nino-Southern Oscillation (ENSO) events become stronger and more frequent. Therefore, their impact on the Asian monsoon could lead to high inter-annual variation in rainfall characteristics.

Tropical cyclones could become more intense. When combined with the sea level rise, this would result in an enhanced risk of loss of life and property in the coastal low-lying areas in cyclone-prone like Southeast Sindh. Warmer and wetter conditions would increase the potential for a higher incidence of heat-related and infectious vector-borne diseases such as malaria and dengue. Climate change would also exacerbate the threat to biodiversity due to changes in land use and land cover and population pressure.

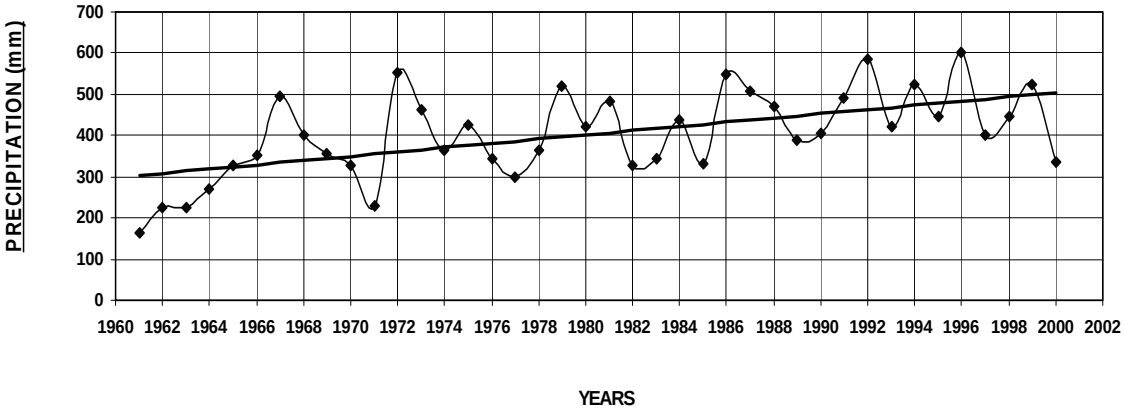
Water Sector*:* Water and agricultural sectors are likely to be the most sensitive to climate change. Fresh water availability is expected to be highly vulnerable to the anticipated climate change. While the frequency and severity of floods would eventually increase in river deltas. The arid and semi-arid regions could experience severe water stress.

Diminishing Flows in Indus Basin:

Glacial melt water is a key source of water for river system in Pakistan. However, along the eastern slopes of the Himalaya, glacier cover has decreased rapidly in recent years, and total cover is now approaching the lowest experienced in the past 10000 years. The Gangorti glacier is retreating 98 feet per year. At this rate scientists predict the loss of all central and eastern Himalayan glaciers by 2035.

As the glacial cover has decreased, so have the downstream flow volumes. Analysis of precipitation and inflow data shows a direct relationship indicating that, in dry years inflows are reduced despite the fact that temperatures were higher in upper watersheds.(Fig-3). This finding appears to contradict projections of

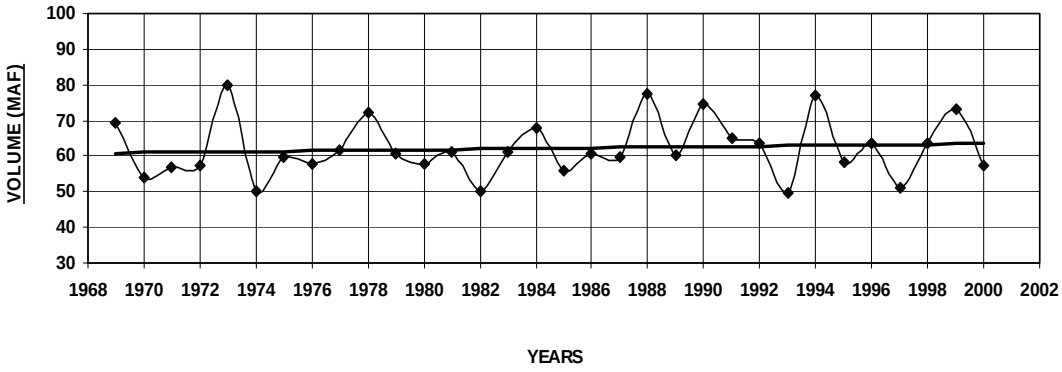
RAINFALL PATTERN IN NORTHERN AREAS DURING (1961-2000)



the Intergovernmental Panel on Climate Change that warmer temperatures will cause glacial contributions to downstream flow regimes to increase in the short term.

However, historical stream flow data indicates that this increased flow phase has already passed, and that the basins have entered a potentially long-term trend of declining flows. The continuation of this trend would exacerbate water shortages that were already apparent across the country during recent severe drought.

WATER FLOW AT QILA BESHAM



Increased temperature with or without any change in precipitation, over the last few decades is causing glacier melting leading to higher rates of sliding and sediment loads in the upper watershed.

Quality of Freshwater

Water quality would suffer from the projected impacts of climate change. Poor water quality effectively diminishes the availability of potable water, and increases the costs associated with rendering water suitable for use. Changes in water quantity and water quality are inextricably linked. Lower water levels tend to lead to higher pollutant concentrations, whereas high flow events and flooding increase turbidity and the flushing of contaminants into the water system.

Warmer air temperatures would result in increased surface-water temperatures, decreased duration of ice cover and, in some cases, lower water levels. These changes may contribute to decreased concentrations of dissolved oxygen, higher concentrations of nutrients such as phosphorus, and summer taste and odour problems. River flows are expected to become more variable in the future, with more flash floods and lower minimum flows. Both types of hydrological extreme have been shown to negatively affect water quality.

Ecological Impacts:

Water is also a critical, limiting factor in the existence and distribution of our natural ecosystems. Wetlands, important natural modifiers of water quality, are highly sensitive to climate change. As water flows through a wetland, contaminants such as metals, nutrients and sulphates are often filtered out. Lower water table levels, however, decrease the assimilative and purification abilities of wetlands. Drier conditions have also been associated with acid pulses (which can cause fish kills) and the formation of highly toxic methyl-mercury.

Water Demand:

The consequences of climate change for water resources depend not only on possible changes in the resource base (supply)…but also on changes in the demand, both human and environmental, for that resource.

Future water demand will be affected by many factors, including population growth, wealth and distribution. Globally, it is estimated that between half a billion and almost two billion people are already under high water stress, and this number is expected to increase significantly by 2025, due primarily to population growth and increasing to climate change and improved groundwater monitoring

Conclusion:

The developing countries of Asia like Pakistan, where impacts of climate change are likely to be felt most severely because of resource and infrastructure constraints, "need to develop and implement incremental adaptation strategies and policies to exploit no-regret measures and stressing the importance of considering climate change in planning, designing and implementing development activities.

The first is a macro strategy and involves rapid sustainable and equitable development that will increase income levels, education and technical skills, improve public food distribution, disaster preparedness and management and health care systems and reduce vulnerability. The second strategy is a micro strategy and involves the management of sectors most sensitive to the climate change. This means developing new institutions or modifying existing ones to promote adaptation to climate change. It would also involve modifying climate-sensitive infrastructures already planned or implemented or other long-term decisions that are sensitive to climate.

Continued monitoring and analysis of variability and trends in key climatic elements is the need of hour. Weather forecasting systems in the region must be improved and implement reforms on land-use planning. New techniques for confident projection of regional climate change and its variability, including extreme events must be applied. Coordination of climate change adaptation activities among countries in the region may be enhanced and non-governmental organization (NGO), community and the public must be kept aware of developments on risks of climate change and involve them in planning, adaptation, and mitigation strategies.

References:

IPCC, 2001: Summary for policymakers, A report of working group of the IPCC.
Nessa, J. & Karmakar, S 1997" Climate change & its impacts on natural disasters and SW monsoon in Bay of Bangal.
WMO 1991. "Proceedings of the 2nd World Climate Conference".
WMO 1995. " Climate Change 1995; Cambridge University Press
Hoerling, M., and A. Kumar. 2003. The perfect ocean for drought. Science, 299:691–694.
Azmat H.et.el 2003" Imapct of La Nina on Pakistan Winter Precipitation, WMO-ESCAP TSU quarterly Bulletin.
Q.Z.Chaudhry 1995. Summer Monsoon Rainfall Prediction- Ph.D dissertation

APPLICATION OF SIMULATION MODELS FOR ASSESSMENT OF CLIMATE CHANGE AND ITS IMPACTS ON WATER RESOURCES, FOOD AND AGRICULTURAL PRODUCTION

(APN/CAPABLE COMPREHENSIVE RESEARCH PROJECT)

Arshad M. Khan [10]

Introduction

This APN/CAPaBLE project is directed towards (1) enhancing the climate change-related research capacity of Bangladesh, Nepal & Pakistan in the areas of Regional Climate Modelling (RCM), Crop Simulation Modelling (CSM), and Watershed/Water Management Modelling, (WSM;WMM) by training 5-10 scientists in each discipline from each country in the operation, validation and use of selected models by holding intensive training workshops with the help of Abdus Salam International Centre for Theoretical Physics (ICTP), Trieste, Italy; University of Georgia, Griffin, (UGG), USA and Commonwealth Scientific and Industrial Research Organization, (CSIRO), Australia; and (2) making use of this enhanced capacity to conduct research in the three countries to formulate plausible climate change scenarios, assess the corresponding impacts on water resources and agricultural production, and identify appropriate adaptation measures. The results of this research will be disseminated to national planners and policy makers as well as the general public and may also provide useful inputs to the IPCC Fourth Assessment Report.

Activities conducted

1. Workshop on Regional Climate Modelling: A two week Workshop on Regional Climate Modelling was held at Islamabad from 16-27 February, 2004. It was organized around the latest version-3 of the Regional Climate Model, RegCM, developed by ICTP. The Workshop was attended by 26 participants: 6 from Bangladesh, 6 from Nepal and 14 from Pakistan, drawn from five different organizations in Bangladesh, two in Nepal and five in Pakistan. The programme basically covered: (i) formal lectures on the concepts of regional climate modelling and the structure and application of RegCM, (ii) hands-on training on the operation of RegCM3 and handling of its outputs, and (iii) conducting of various simulation projects using the model. In order to provide future assistance and guidance to the participants, an e-mail based Regional Network on RegCM users was set up; it has since been widely used. The Proceedings of the Workshop have been compiled, published and made available to the participants and APN.

2. Collection, Digitization and Analysis of Historical Climate Data; Pakistan: Monthly meteorological data for various parameters covering the period 1931 to 2000, as well as monthly Normal data for the 30 year periods 1931-60 and 1961-90, were collected and archived. Daily meteorological data of 18 selected stations covering the period 1931-2003 has also been obtained; 80% of it has been digitized. The available climate data were statistically analysed to study the changes in temperature and precipitation over various regions of Pakistan on annual and seasonal basis. Based on this analysis the following work was done: (i) climate classification of Pakistan using Thornthwaites Index and identification of different climatic zones, (ii) assessment of past climate changes over the period 1951-2000 in different climatic

[10] *Executive Director, Global Change Impact Studies Centre- Islamabad Pakistan*

zones, and (iii) three research papers presented in national and international conferences. A technical report covering the work completed so far has been drafted.

Bangladesh**:** Comprehensive data (1951-2000) on major climatic parameters have been procured from Bangladesh Meteorological Department (BMD), digitized and formatted in Excel. The data was analyzed to study the trends of major climate parameters. Effort has been made to analyze 'dry spells' and 'wet spells' for each of the years covered by the above data, and to express them in terms of decadal incidences of dry and wet spell events for at least 24 stations. A technical report has been drafted. Nepal: Although meteorological stations in Nepal have been established for various reasons since 1950s, the systematic arrangement for establishing such stations started only in 1968. The records of all the existing stations were examined and the monthly temperature (Maximum and Minimum) and precipitation data for all those having records of more than 20 years have been collected and digitized. In addition, the data of stations having less than 20 years of records have also been collected for inter-comparison purposes as well as to fill up the gaps in the spatial presentation of the meteorological parameters. The available data were subjected to statistical analysis after ascertaining the erroneous entries. Trends have been worked out for precipitation (67 stations), mean temperature, maximum temperature and minimum temperature (20 stations) for all the stations for which data is available. The year-wise frequency of extreme events in precipitation during the study period was also computed. A technical report describing the above work has been drafted.

3. Implementation, Validation and Use of Regional Climate Models; Pakistan: (i) Data sets ERA40, NNRP2, ECMWF and CRU were acquired from ICTP to run and validate RegCM3. Most of these have also been provided to Bangladesh and Nepal. A number of experiments were carried out for the calibration and validation of RegCM3 over the South Asia region, in particular Pakistan, using different sets of initial and boundary conditions and convective schemes. These included simulations of: winter temperature and precipitation in South Asia (1994-95); the heavy rainfall at Lahore, Pakistan during August, 1997; and the rainfall of 621mm in 10 hours at Islamabad on 23 July, 2001. Further validation work is in progress. (ii) An interface has been developed to use RegCM3 output data as initial and boundary conditions for the mesoscale model MM5 in order to carry out climate related studies at higher spatial resolution. Necessary tests to check its performance are in progress. (iii) A study is being conducted in collaboration with ICTP to look into the effect of remote forcings on winter precipitation of Central and South West Asia using the observed data from 1951 – 2000 and RegCM3 based simulations. (iv) Another Regional Climate Model, PRECIS (developed by Hadley Centre, Met Office, UK) has been acquired and two members of the team got trained in a training Workshop on PRECIS held in Bhutan in July 2004. The model has been implemented and its validation work started. (v) Based on the above work, two papers are planned for presentation at the RCM Mini Symposium on Climate Change in Europe, Prague, Czech Republic, Nov.29-Dec.3, 2004.

Bangladesh: Work is now in progress to validate RegCM3 for the South Asia region, particularly Bangladesh, using the ECMWF and CRU data sets. Simulations of monthly rainfall have been done for the period 1995-2000 and compared with TRMM observed precipitation data. The diurnal behaviour of monsoon rainfall over Bangladesh and neighbouring areas is now being studied using 60km grid mesh and different convective schemes. A paper based on this work is planned to be published in a special issue of the journal "Theoretical and Applied Climatology".

Nepal**:** The RegCM has been implemented and used for validation by comparison of monsoon rainfall outputs for the duration 1990-1094 over the central Himalayan region with different convective and ocean flux schemes.

4. Workshop on Crop Simulation Modelling: A two week Regional Training Workshop on Crop Simulation Modelling was held at Chiang Mai University, Thailand from 28 June – 09 July, 2004. Its

focused on DSSAT-4 (Decision Support System for Agro-technology Transfer, version-4) and the associated families of Crop Simulation Models (e.g., CERES, CROPGROW, CROPSIM etc.). Twenty one participants (6 from Bangladesh, 6 from Nepal and 9 from Pakistan,), drawn from 4 different organizations in Bangladesh, 2 in Nepal and 5 in Pakistan, attended the Workshop. The programme of the Workshop was a mix of formal lectures and hands-on computer sessions. The main topics covered included various scientific approaches used in crop simulation models, simulating seasonal analysis, and simulating the impact of climate change and climate variability on agriculture. The proceedings of the Workshop have been compiled, published and made available to the participants and APN.

5. Compilation and Digitization of Agricultural Data and Model Validation: (i) Effort has been initiated by the agricultural teams in each participating country towards compilation and digitization of data on agriculture, including site specific agronomic experimental data for major crops, soil data and climate related data, which are intended to serve as basic inputs for the operation, calibration and validation of DSSAT based crop simulation models for major crops. (ii) Work is also in progress in each participating country to identify and measure genetic and eco-type coefficients for the cultivars of major crops, as this information is of critical importance for the model validation under local conditions and for performing the model based simulation runs. (iii) The agricultural team in Pakistan has obtained from the University of Agriculture, Faisalabad, experimental data of 4 crop growth experiments on wheat in rain-fed and irrigated areas, which would be useful in the calibration and validation of CERES wheat model. The University has also committed to conduct similar agronomic experiments in various locations for rice and maize. (iv) In Bangladesh also the BSMR Agriculture University has committed to utilize the upcoming Kharif cropping season (for Aman) to run field experiments to firm up agronomic data, as required by the DSSAT model. The Bangladesh Agricultural Research Council (BARC) has also committed to collate and format crop physiological and phenological data for at least 3 cultivars (T. Aman, T. Boro and Wheat), which collectively constitute over 85% of the food grain produced in the country throughout the year. (v) Both in Bangladesh and Pakistan, work is in progress to collect data from various sources on major soil profiles of their respective countries and to format and digitize this data for use in DSSAT.

6. Selection of a Suitable Watershed Model: Effort is being made in consultation with CSIRO, Australia and Water & Power Development Authority (WAPDA), Pakistan to test and select a suitable watershed model for use in a 2-week training workshop on watershed modelling planned for early next year. In this connection, linkages have been established with various international organizations (e.g. Centre for Hydrology & Ecology, Wallingford, UK, University of British Columbia, Canada, University of Washington Seattle, USA) and the following watershed and water balance models acquired: (1) Brook90, developed by USDA -- a lumped model, applicable on uniform watersheds, (2) UBC Watershed Model developed by University of British Columbia, Canada – a semi-distributed model, applicable on medium scale watersheds, and (3) a Distributed Hydrologic Soil & Vegetation Model (DHSVM) developed by University of Washington, USA -- a GIS-based model, applicable on all scales, integrated with climate models. Preliminary evaluations of Brook90 and UBC Watershed Model have been successfully conducted for a medium-sized watershed of Pakistan. The DHSVM has been compiled in Linux as well as in WINDOWS environment for wider application by the users; its evaluation is in progress.

Outcomes and Products

1. A large amount of historical climate data has been acquired, digitised, archived, checked for quality and subjected to statistical analysis in each participating country; technical reports have been drafted.
2. Two Workshops, each of 2 weeks duration, were held to train 26 and 21 scientists respectively in the fields of Regional Climate Modelling and Crop Simulation Modelling.
3. Based on the above training, useful research work was done in each participating country on the validation and use of the regional climate model RegCM3.

The following research papers and publications were produced:

a. Proceedings of the Workshop on Regional Climate Modelling (2004);
b. Proceedings of the Workshop Crop Simulation Modelling (2004);
c. "Past and Projected Climate Changes in Pakistan": Paper presented at the APN Meeting on Water Resources in South Asia, Kathmandu, Nepal, 16-17 Dec., 2003;
d. "Climate Change in the Mountain Regions of Pakistan": Paper presented at APN National Workshop, Islamabad, Pakistan, 7 August, 2004;
e. "Decadal Variability of Disastrous Climate and Weather Events in Pakistan": Paper presented at the International Symposium on Extreme Weather and Climate Events, Their Dynamics and Predictions, Beijing, China, Oct. 12-16, 2004.

4. Three more research papers are being prepared for submission by the end of 2004.

The project is making excellent progress in line with the envisioned objectives and targets. As per programme, two intensive Workshops were held to build and enhance the capacities of participating countries in the areas of regional climate modelling and crop simulation modelling. State-of-the-art models in the above areas have been acquired and are now in use in the three countries. Historical climate data have been acquired, digitized, archived and statistically analysed in each country and technical reports drafted. Three papers based on the project related work have been presented in national and international meetings and three more are in the pipeline. Thus the project objectives for the first year have been successfully achieved.

Future Objectives

1. Finalization of the analysis of historic climate data for identification of past climate change trends in the three participating countries and printing of reports.
2. Completion of the validation of regional climate model RegCM3 for the South Asia region.
3. Development of plausible climate change scenarios for the three countries, using RegCM3.
4. Validation of DSSAT-4 Crop Simulation Models for each country's local environment.
5. Research work on assessment of impact of climate change on major crops.
6. Two-weeks Workshop on Watershed Modeling (Feb./Mar., 2005, Pakistan) and printing of its proceedings.
7. One week Workshop on Review & Harmonization of Climate Change Scenarios and printing of its proceedings.
8. Development of GIS based Spatial data bases & Hydro-meteorological data series for the main river basins of each country.
9. Implementation and validation of Watershed Models.

Presentation

Climate Change

"the greatest challenge facing the world at the beginning of the century."

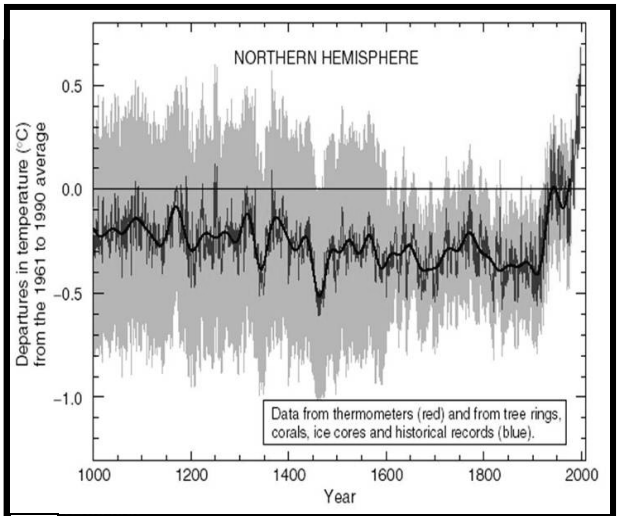
World Economic Forum
Davos, Switzerland 2000
(www.weforum.org/)

1

Why Global Climate Change (CC) is a Major Concern

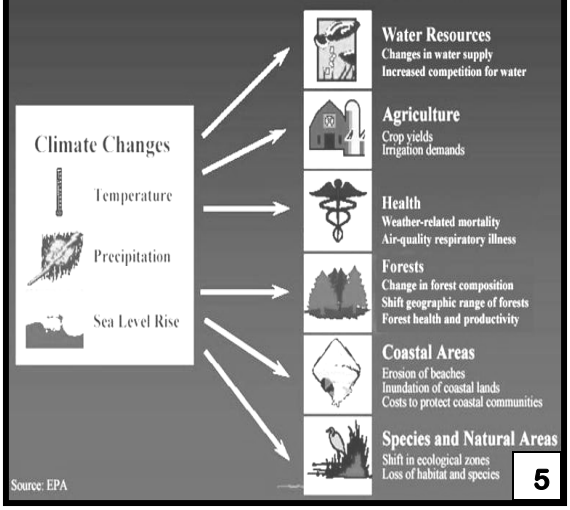
- Global Climate has a profound effect on a number of physical and biological systems;
- The very existence, survival and well-being of humans as well as all other living things depend upon the existence of favourable climatic conditions on our planet;
- In the past the temperature and other climate parameters of the earth had been changing with time due to natural causes but the time scale for these changes was typically several hundred to several thousand years;
- There is now a convincing evidence that the Earth's climate system has significantly changed on both global and regional scales since the pre-industrial era, with a large part of the changes being attributable to human activities;

2



4

Potential Climate Change Impacts



5

Some findings of IPCC Third Assessment Report (TAR)

- Average global temperature increased during the last century by 0.6 ^{0}C mainly due to increase in GHG levels;
- Future change in global average temperature is expected in the order of 1.4 ^{0}C – 5.8 ^{0}C over the 21st Century;
- The above changes will be accompanied by much larger changes (both, increases and decreases) of temperature and precipitation in different world regions;
- Frequency and intensity of extreme climatic events (storms, floods and droughts etc.) will increase considerably;
- These climatic changes will have considerable impact (both positive and negative) on various socio-economic sectors e.g., water, agriculture, health, forestry, biodiversity etc.

6

Global Response

Inter-governmental Panel on Climate Change, IPCC

- established by WMO and UNEP in 1988;
- produced Assessment Reports in 1990, 1995 and 2001

UN Framework Convention on Climate Change, UNFCCC

- Adopted in 1992;
- Ratified by 176 governments;
- KYOTO Protocol adopted in 1997; sets targets for GHG emissions reduction.

7

Global Response (contd.)

Climate Change is being addressed by a number of international research programs e.g.:

- The International Geosphere-Biosphere Program, IGBP
- The World Climate Research Program, WCRP
- The International Human Dimension Program on Global Environmental Change, IHDP
- DIVERSITAS, (An International Program on Biodiversity Science);
- Man and the Biosphere Program, MAB of UNESCO;
- Climate Change is also being addressed by several national research programs in all developed and several developing countries, e.g. India and China in S. Asia.

8

Global Change Science Studies in Pakistan

- Climate Change research has essentially remained neglected in Pakistan;
- Being cognizant of this fact, the establishment of a multi-disciplinary effort was proposed in 2001 by Dr. Ishfaq Ahmad, Special Advisor to the then Chief Executive of Pakistan;
- Accordingly, the Global Change Impact Studies Centre (GCISC) made a modest start in May 2002 with financial support from Ministry of Science & Technology.

9

Completed Major Activities of GCISC

- Book "Water and New Technologies" covering 5 key technologies: Satellite Remote Sensing; Nuclear; Biotechnology; Lasers; and Water Informatics; published in 2002;
- Workshop on "Mathematical Modelling and its Applications to Development Issues", Islamabad, 29 Oct. – 2 Nov., 2002; Proceedings published in 2003;
- International Symposium on Mountains of Pakistan – Protection, Potential and Prospects, Islamabad, 17 – 19 Dec., 2002; Proceedings published in 2003;
- South Asia Regional Workshop on Regional Climate Modelling, Islamabad, 16-27 February, 2004 with the help of ICTP and Asia Pacific Network for Climate Change Research (APN); Proceedings published in April 2004.

10

Major Activities in Progress

- Assessment of Past Climate Changes in Pakistan and Development of Future Climate Scenarios (jointly with PMD);
- Implementation and Validation of Regional Climate Models and Their Use for Climate Change Research (jointly with PMD);
- Implementation and Validation of Meso-scale Weather Prediction Models (jointly with PMD);
- Implementation and Validation of Crop Simulation Models in Pakistan (jointly with NARC, Univ. Agr. Faisalabad, Univ. Arid Agr., Rawalpindi);

11

Major Activities in Progress (contd.)

- Identification of Agro-climatic Indicators for Assessing Climate Change Impacts on Agriculture in Pakistan (Jointly with NARC, Univ. Agr., Faisalabad & Univ. Arid Agr., Rawalpindi;
- Study of the Implications of Virtual Water Trade for Pakistan in the Coming Decades;
- Preparation of a book "Persistent Organic Pollutants and Pakistan" (to be published later this year);
- Evaluation of various Watershed Models for use in our Climate Change Impact assessment work (Jointly with WAPDA, PCRWR).

12

Vulnerability of Developing Countries

Developing Countries like Pakistan are most vulnerable to Climate Change, because:

- A large part of their economy is based on agriculture which is climate sensitive;
- They have low technological and scientific base and have limited access to knowledge;
- They have low capacity to adapt to changes resulting from Climate Change;
- They lack financial and institutional capacity.

13

APN CAPaBLE Research Project:

2003-Theme I-Khan

Title: Enhancement of National Capacities in the Application of Simulation Models for Assessment of Climate Change and its Impacts on Water Resources and Food and Agricultural Production.

Duration: Three Years, beginning October, 2003

Lead Organizations:

1. Global Change Impact Studies Centre (GCISC)
2. Pakistan Meteorological Department (PMD)

Partner Developing Country Institutions:

- Bangladesh Unnayan Parishad (BUP)
  Department of Hydrology and Meteorology, Nepal (DHM)

Partner Developed Country Institutions:

International Centre for Theoretical Physics (ICTP), Italy; Commonwealth Scientific and Industrial Research Organization (CSIRO), (Australia); University of Georgia, Griffin, USA.

14

Major Objectives:

1. To enhance and build capability of scientists in each participating developing country by holding intensive training workshops with the help of participating developed country institutions, in the following areas:
   a) Regional Climate Modeling (RCM)
   b) Crop Simulation Modeling (CSM), and
   c) Watershed Modeling
2. To make use of this enhanced capacity to conduct research for formulating plausible climate change scenarios and assessing the corresponding impacts on water resources, and food and agricultural production;

15

Contd...

3. To identify appropriate adaptation measures to minimize adverse impacts of climate change;

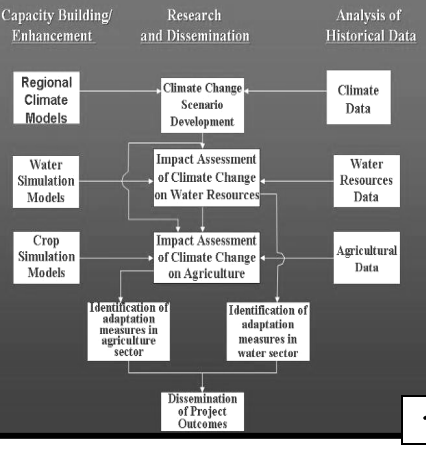
4a. To disseminate research results to policy makers and national planners;

4b. To provide useful inputs to IPCC Fourth Assessment Report;

4c. To assist in meeting the country's commitments under UNFCCC;

16

Project Approach & Activities at a Glance



17

Organizations Participating in the Project

Pakistan

1. Global Change Impact Studies Centre, **GCISC**
2. Pakistan Meteorological Department, **PMD**
3. Pakistan Agricultural Research Council, **PARC**
4. University of Agriculture, Faisalabad, **UAF**
5. University of Arid Agriculture Rawalpindi, **UAAR**
6. Pakistan Council in Research Water Resources, **PCRWR**
7. Water and Power Development Authority, **WAPDA**
8. Pakistan Inst. of Nuclear Science and Technology, **PINSTECH**
9. Pakistan Institute of Engineering and Applied Sciences, **PIEAS**

18

Organizations Participating in the Project

Bangladesh

1. Bangladesh Unnayan Parishad, **BUP**
2. Bangladesh Meteorological Department, **BMD**
3. SAARC Meteorological Research Centre, **SMRC**
4. Bangladesh Agriculture Research Council, **BARC**
5. Bangladesh Water Development Board, **BWDB**
6. Water Resources Planning Organization, **WARPO**
7. Institute of Water Management, **IWM**
8. Bangladesh University of Engineering and Technology, **BUET**

19

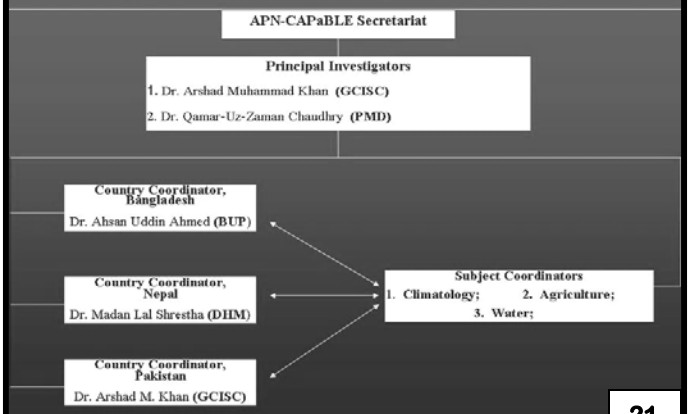
Organizations Participating in the Project

Nepal

1. Central Department of Hydrology and Meteorology, **CDHM**
2. Department of Hydrology and Meteorology, **DHM**
3. Nepal Agricultural Research Council, **NARC**
4. Institute for Development Innovative, **IDI**
5. Institute of Engineering, Lalitpur, **IEL**

20

Organizational Set-up of the Project

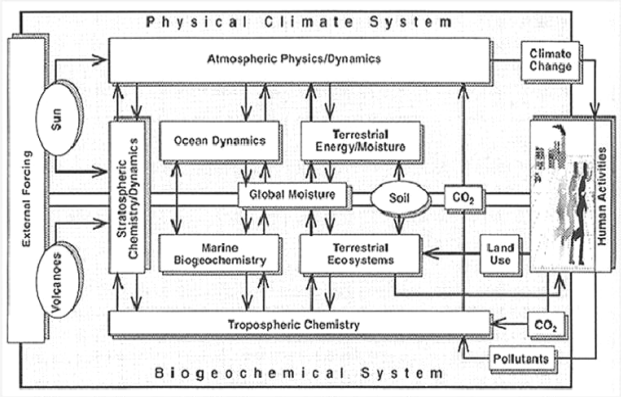


21

Need and Role of Simulation Models in the APN-CAPaBLE Project

- Regional Climate Models (RCM)
- Crop Simulation Models (CSM)
- Watershed Models (WSM)

22



Schematic diagram of the Earth system and its interactions, encompassing the physical climate system, biogeochemical cycles, external forcing, and the effects of human activities [Source:Earth System Science: Overview, NASA]. Projecting the future climate requires understanding and quantitatively predicting how the components and interactions will change as a result of natural and human activities.

23

Why do we need Regional Climate Models ?

1. Global Circulation Models (GCMs) provide information about average global temperature and average climatic conditions in various world regions, typically in grid sizes of 250km x 250km to 500km x 500km
2. Climate Change research at country level requires reliable predictions of future climatic conditions in various parts of the country corresponding to generally accepted scenarios of GHG concentrations in the atmosphere
3. GCMs also require weeks and months of operation on super computers and a very advanced level of expertise for their execution and result interpretation

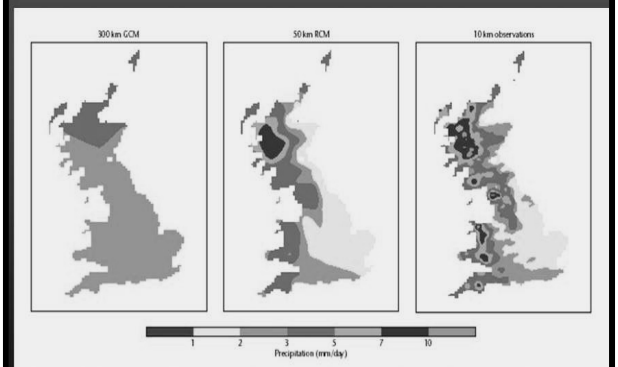
24

Why do we need Regional Climate Models (contd.)

4. Over the last decade, a new class of climate models, called Regional Climate Models (RCMs), has been developed, which can be operated even on PCs like Pentium 4. Operation time for a single simulation is typically several days to several weeks
5. The input of an RCM comprises partly the output of GCM and partly data on the topography, sea surface temperature and land-use pattern of a selected world region, typically a rectangle of sides 1500 to 3000km
6. Grid size of RCM output is typically 30km x 30km to 50km x 50km giving a 100 times better resolution than that of GCM

25

GCM Vs RCM Simulations of Winter Precipitation in UK



Patterns of present-day winter precipitation over Great Britain. Left, as simulated with the global model. Middle, as simulated with the ...al model. Right, as observed.

26

Overview of Regional Climate Models

	Country	Centre	Model
1	UK	United Kingdom Met Office (UKMO)	PRECIS
2	Italy	International Centre for Theoretical Physics (ICTP)	RegCM3
3	USA	National Centre for Atmospheric Research (NCAR) National Center for Environmental Predictions(NCEP) Colorado State University	MM5 RSM RAMS
4	Germany	Max Plank Institute for Meteorology (MPI)	HIRHAM4
5	Japan	Meteorological Research Institute (MRI)	MRI
6	Canada	Canadian Centre for Climate (CCCma)	CRCM
7	Sweden	Swedish Meteorological and Hydrological Institute	SweCLIM
8	China	Institute of Atmospheric Physics	RIEMS
9	Australia	Commonwealth Scientific and Industrial Research Organization (CSIRO)	DARL

27

Crop Simulation Models

Crop simulation models are computer based models that help to identify in quantitative terms, the impacts of changes in various bio-physical, management and climatic conditions on crop growth and productivity.

28

Some crop Simulation Models

- CERES family of models for Cereals:

  Wheat Rice Maize Sorghum Barley Millet

- CROPGROW series of models for Legumes:

  Peanut Dry bean Chickpea Soybean

- Other CROPGROW series of models:

  Sugarcane Tomato Sunflower

- CROPSIM model series for root crops:

  Potato Cassava

29

DSSAT

- A number of crop simulation models can be easily accessed and manipulated through DSSAT, a "Decision Support System for Agrotechnology Transfer" developed by 'International Benchmark Sites Network for Agrotechnology Transfer' project.
- DSSAT is a microcomputer software program combining crop soil and weather data to simulate multi-year outcomes of crop management strategies.
- It provides easy access to data bases and crop simulation models to test and monitor the performance of new cultivars or management practices under various agroclimatic conditions.

30

DSSAT (Contd.)

- **After sufficient calibration and validation, DSSAT based crop simulation models can be used:**
  - To determine potential impact of climate change on production of various crops; and
  - To provide management scenarios for adapting to climate variability.

31

Need for Watershed Simulation Modeling

- Changes in water flows in river systems owe to changes in global temperature and changing patterns of precipitation;
- A small change in average global temp. could result in large changes in river flows through changed rates of glacier melt and changed patterns of precipitation;
- National planners and decision makers need to know the magnitude of changes in river flows over the next several decades as a result of expected climate change;
- Reliable estimates for the above can best be provided with the help of Hydrological Simulation Models (HSM).

32

Hydrological Simulation Models

Hydrological simulation models use mathematical equations that establish relationships between inputs and outputs of water system, and calculate results like runoff volume or peak flow.

Types of Hydrological Models

- **Theoretical vs. Empirical Models**
- **Stochastic vs. Deterministic Models**
- **Event vs. Continuous models:**
- **Complete vs. Partial Models**
- **Calibrated Parameter vs. Measured Parameter Models**
- **Lumped vs. Distributed Models**
- **General Models vs. Special Purpose Models**

As data sources and computing powers are increasing, more sophisticated, distributed models, based on the principles of physics are finding increasingly large applications

33

Some Important Hydrological Models used in Pakistan

UBC Watershed Model

Being used by WAPDA (Pakistan Snow & Ice Hydrology Project)

- A semi-distributed model
- Being used for making forecasts of flow into Mangla Reservoir (since 1988)
- Was used to study the impacts of climate change in Indus Basin (1992)

IBMR (Indus Basin Model Revised, developed by the World Bank)

Was used by WAPDA, in collaboration with University of Colorado

- A semi-distributed, water management model
- Calculates inflows into main networks and water balance
- Was used to evaluates large-scale water resource investment alternatives, under a set of climate change scenarios (1992).

SOBEK Model (Delft Hydraulics, The Netherlands)

Was used by Flood Commission of Pakistan

- Lumped, rainfall-runoff model
- signed to forecasts floods
- es options for flood reduction and diversion of flood water at barrages

34

Selection Criteria for a Watershed Model for our Project

1. The Model should
   - be particularly sensitive to climate change issues;
   - be able to cover glacier regimes and the snow deposition and melting;
   - be amenable to calibration and validation based on the available data;
   - be suitable for applications in different situations to cover the main rivers in Bangladesh, Nepal and Pakistan;
2. Its Complexity should be manageable within the available human and computing resources in the three countries;
3. Software codes should be accessible and amenable to necessary modifications to suit actual conditions existing in South Asia region.

35

APN-CAPaBLE
South Asia Workshop on Regional Climate Modelling
Islamabad, Pakistan
February 16-27, 2004

- Focus:
  RegCM3 Model developed at ICTP, Trieste Italy
- Resource Persons:
  - Four Scientists from ICTP led by Dr. Filippo Giorgi, Head, Physics of Weather and Climate Section, ICTP
  - One Scientist from GCISC / PMD
- Participants: 26
  Bangladesh: 6, Nepal: 6, Pakistan: 14

36

Main Features of the RCM Workshop

- Provided a comprehensive coverage of all the operational aspects of the Model RegCM3
- Hands-on Working Sessions facilitated acquainting the participants with the operation and use of the model
- Participants were provided opportunity to work in groups and carry out simulation projects using RegCM3
- The results of the above simulation projects were thoroughly discussed at the end of the Workshop
- Participants and Resource Persons agreed to set up a South Asia Network of RegCM3 Users

37

Additional Workshops Planned under the Project

- APN-CAPaBLE South Asia Regional Training Workshop on Crop Simulation Modeling: Chiang Mai University, Chiang Mai, Thailand, 28 June to 09 July, 2004
- APN-CAPaBLE South Asia Training Workshop on Watershed Modeling; Islamabad, Pakistan, 4-15 October, 2004
- APN-CAPaBLE South Asia Workshop on Review and Harmonization of Climate Change Scenarios; Kathmandu, Nepal, 13-17 Dec, 2004
- APN-CAPaBLE South Asia Workshop on Comprehensive Research Results; 7-11 November, 2005

38

Concluding Remarks

- In view of the increasing importance of Global Change science worldwide, Bangladesh, Nepal and Pakistan must join in the International effort in this field;
- Climate Change will affect all sectors of the economy of these countries. They should therefore develop and implement appropriate adaptation measures well in time so as to avoid calamities;
- For this, Climate Change research in Bangladesh, Nepal and Pakistan requires strong support from, both, the Government and the relevant International Organizations;
- The Climate Change Scientists in Bangladesh, Nepal and Pakistan are grateful to APN for help in enhancing their research capacity through the award of the CAPaBLE Project.

39

EDUCATION AND RESEARCH IN ENVIRONMENT AND CLIMATE CHANGE IN PAKISTAN

Murtaza Malik[11]

Abstract

Environmental education is offered at all levels of formal education in Pakistan. At the school level, students receive environmental education through teaching of subjects that incorporate environmental concepts; and participation in Global Learning and Observation to Benefit Environment (GLOBE) Program, and co- and extra-curricular activities such as environmental clubs and nature walks. At the university level, environment related subjects have been integrated into more than twenty programs while seventeen institutions are also offering separate diploma, bachelor-, master- and doctoral-level programs on environment. Climate change is not offered as an independent course though it is taught as a component of many university level courses. A number of university institutions as well as research organizations are involved in research activities on environment and climate change. The research base, however, is narrow with most of research activities directed towards monitoring and situation assessment instead of technology development and innovation.

Keywords

Environmental Education, Pakistan, Climate Change, GLOBE, Research

Introduction

Pakistan is faced with a number of environmental issues which, inter-alia, include water scarcity and pollution, air pollution, deforestation, land degradation, loss of biodiversity and unplanned urban and industrial development. These issues are resulting in rapid depletion and degradation of natural resources and environment thus having adverse impacts on the livelihoods of people by causing declining yields, reducing employment opportunities and incomes. Degradation of environment is also affecting the health of the people by increasing the burden of disease. According to 1995 estimates, air and water pollution and land degradation cost US$ 2.2 billion or about 4 percent of GDP to Pakistan's economy [1]. The current total cost of environmental degradation may be manifolds.

Rapid degradation of environment in Pakistan can be attributed to a number of key factors including the lack of environmental awareness and education. Recognizing this fact and considering that environmental education is vital tool for furthering the cause of sustainable development, Pakistan has taken significant measures to promote environmental education at all levels of formal education. This paper presents an overview of these measures as well as current situation of research on environment and climate change in Pakistan.

Environmental Education Related Policies

Pakistan's National Conservation Strategy (NCS), which was approved by the Federal Cabinet in March 1992 and is serving as the de facto environmental policy of Pakistan till to date, emphasizes the need for making efforts both to strengthen and reinforce the educational curricula at all levels so as to develop educated believers and practitioners of sustainable development. The strategy also outlines policies and measures for incorporating environmental education both in the formal and non-informal sectors [2}. Other policy documents which include provisions relating to environmental education include

[11] ***Program Manager, Policy Coordination and Environmental Governance, National Environmental Action Plan–Support Program (Neap-Sp),Ministry Of Environment, Islamabad, Pakistan***

Biodiversity Action Plan, Mid-Term Review Report of NCS and the National Environmental Action Plan [3-5].

Environmental Education in Schools and Colleges

One of the premier initiatives in environmental education in Pakistan was the Coordinated Environmental Education Project (CEEP) which was jointly implemented by the Ministry of Education and the Environment and Urban Affairs Division (now Ministry of Environment), from 1989-1992. Under this project a number of pilot-activities aimed at training of teachers and development of environmental education teaching aids were carried out [6].

Since the commencement of implementation of NCS in 1992, government-, non-governmental- and private sector organizations have taken a number of initiatives aimed at greening of the formal education system. These include development and dissemination of teacher guides and teachers training manuals, training of teachers, integration of environmental concepts in the curriculum of science subject for class four to ten, introduction of environmental concepts into selected textbooks at primary level in Northern Areas of Pakistan, inclusion of chapter on environment in the textbook of "General Science" at the secondary level, and initiation of diploma programs on environment. Efforts are also being made to offer an optional "Environmental Studies" course to the secondary level students. The Ministry of Education has already developed curriculum in this regard while Punjab and Sindh have prepared textbooks as well [6,7].

In line with the recommendations of NCS, the Ministry of Environment has included promotion of environmental education at schools, college and university levels as a key component of National Environmental Action Plan Support Programme (NEAP-SP) which is being implemented since 2002 with the assistance of the United Nations Development Program and donor agencies. Keeping the objectives of this component in view, the Ministry of Environment and Curriculum Wing of the Ministry of Education have recently started implementation of a project titled "Promotion of Environmental Education at School and College Level (EEPP)". The project, which is being supported by the Swiss Agency for Development and Corporation, will result in integration of age-appropriate environmental concepts into relevant textbooks from grade one to twelve throughout Pakistan. It will be implemented over a period of four years and will target more than 200,000 educational institutions and 26 million students across the country [7]. Keeping in view the fact that implementation of the EEPP and consequent integration of environmental concepts in textbooks would require teachers to be better equipped with adequate knowledge and skills in environment; the Ministry of Environment is also working on integration of environment in teacher training programs. The first project in this has been developed under auspices of NEAP-SP with a view to integrate environment into relevant textbooks of certificate, diploma and bachelor level teacher training programs offered at the Allama Iqbal Open University. The project is currently being processed for approval and, on implementation, is expected to target more than 200,000 teachers annually.

The Ministry of Environment is also implementing the "Global Learning and Observation to Benefit Environment (GLOBE) Program in Pakistan which aims to enhance environmental awareness; contribute to scientific understanding of earth; and improve student achievement in science and mathematics. The Program, which is based in the USA and is being implemented in more than 100 countries, involves school students in grade one to twelve that conduct a set of experiments in the area of Atmosphere, Land Cover, Biology, Hydrology, and Soils, according to their skill level, and report the data via the Internet. To date, Pakistan has 12 GLOBE schools and 18 GLOBE teachers and has reported over 8,800 scientific measurements to the data archive of GLOBE program. The Ministry of Environment has also developed a project proposal with a view to expand the GLOBE program in Pakistan through creation of a pool of

GLOBE teachers and trainers, provision of GLOBE laboratory instruments to schools, and through outreach activities such as web-chats and conferences.

Other environmental education initiatives in Pakistan include regular organization of essay, painting, poster and declamation contests on special occasions such as Earth Day and the World Environment Day. Students from across the country participate in these contests. Several hundred environmental clubs have also been established in schools and further work on expansion of these clubs is underway.

Environmental Education in Universities

In parallel to efforts for promotion of environmental education at school and college level, Pakistan has also been activity pursuing introduction and promotion of environmental education at the university level. Consequently, environment related courses have been infused in more than 20 programs including Botany, Chemistry, Physics, Zoology, Geology, Biochemistry, Microbiology, Geography, Genetics, Physiology, Freshwater Biology, Economics, Sociology, Pakistan Studies, Social Work, Law, Archeology, Women Studies, Public Administration, Education and Psychology [8]. Furthermore, contents of the programs such as agriculture, forestry and engineering programs, which already had a significant environmental component, have been further reinforced.

Specialized diploma, bachelor-, master- and PhD-level programs on environment are also being offered in more than fifteen public and private sector institutions across the country [9,10]. These institutions include:

- Center for Environmental Management, Balochistan University of Information Technology and Management Sciences, Quetta
- COMSATS Institute of Information Technology, Abbott bad
- Department of Environmental Engineering, NED University of Engineering And Technology, Karachi
- Department of Environmental Science, Allama Iqbal, Open University, Islamabad
- Department of Environmental Sciences, University of Peshawar
- Department of Home and Health Sciences, Allama Iqbal Open University, Islamabad.
- Dr. Pervaz Hassan Center for Environmental Law, Punjab, University, Lahore
- Environmental Engineering Division, Department of Civil Engineering, NWFP University of Engineering and Technology, Peshawar
- Environmental Science Department, Lahore College for Women University, Lahore
- Fatima Jinnah Women University, Rawalpindi
- Institute of Environmental Engineering and Management, Mehran University of Engineering and Technology, Jamshoro
- Institute of Environmental Engineering and Research, University of Engineering and Technology, Lahore
- Institute of Environmental Science and Engineering, National University of Sciences and Technology, Rawalpindi
- Institute of Environmental Sciences, Punjab University, Lahore
- Institute of Environmental Studies, University of Karachi
- Kinnaird College for Women, Lahore
- Postgraduate Center for Earth Sciences, University of Punjab, Lahore

In addition to the above listed institutions, many universities have established separate departments which offer environment related courses to their bachelor and master degree programs of these universities. Examples are Department of Energy and Environment, Faculty of Agricultural Engineering, Sindh Agricultural University, Tandojam; Center for Energy and Environment Studies, Ghulam Ishaq Institute of Technology, Topi; and NWFP and Department of Environmental and Soil Sciences, Agriculture University, Peshawar. A number of universities including University of Engineering and Technology,

Taxila and Bahria University, Islamabad are also planning to launch master level programs on environment.

As regards education on climate change, no separate course or program is offered at the university level. Basic concepts of climate change, however, are integrated in a number of courses offered in specialized programs in environmental sciences and engineering e.g. environmental chemistry, environmental policy, air pollution. These concepts are also taught as part of courses offered under non-specialized programs mentioned above.

Research in Environment and Climate Change

Research activities focusing on environment are carried out under almost all the university programs mentioned in Section 3 as well as by public sector research organizations such as Pakistan Council of Research in Water Resources (PCRWR), Space and Upper Atmosphere Research Commission (SUPARCO), Pakistan Forest Institute (PFI), Pakistan Atomic Energy Commission (PAEC), and Pakistan Council for Scientific and Industrial Research (PCSIR). Research in climate change, however, is being mainly undertaken by public sector research organizations such as Global Change Impact Studies Center, Pakistan Agricultural Research Center, PCRWR, SUPARCO, PAEC, National Energy Conservation Center (ENERCON), National Institute of Oceanography and PFI.

Although a few universities and research organizations, which are well equipped in terms of equipment and manpower, produce high quality research output, the research base in environment and climate change, in general, remains narrow with most of the research activities directed towards monitoring and situation assessment instead of technology development and innovation. The contributing factors to this situation include lack qualified researchers, absence of well-equipped laboratories and limited availability of financial support for research in environment and climate change.

Conclusions and Recommendations

Pakistan has made considerable efforts for promotion of environmental education at various levels of the formal education system. The ongoing and planned initiatives of various government and non-governmental organizations will result in further strengthening of environmental education at the school and college levels. Substantive efforts, however, still need to be made for introduction of environmental education in the informal education system.

At the university level, the number of institutions offering programs in environment has increased sharply over the last decade. Majority of the institutions, being in the public sector, do not have enough funds to enable them employ adequate number of full time qualified and experienced faculty members, undertake research and procure laboratory equipment and books and journals. The result is shortage of staff, poor or non-functional laboratories, poorly stocked libraries and limited research output. Another issue of concern is the lack of employment opportunities for environmental graduates from these institutions.

In order to assure the quality of specialized program on environment offered by various institutions (Section 4), it is recommended that a mechanism should be evolved for accreditation of these programs based on well-defined criteria. A strategy also needs to be developed to address the issue of unemployment of environmental graduates. Establishment of a professional organization e.g. “Environmental Society of Pakistan” or “Pakistan Environmental Engineers and Scientists Association” and launching of a local peer reviewed journal on environment is also recommended with to view to promote research culture on environment.

Disclaimer

The views expressed in this paper are those of the author and do not reflect the views of the Government of Pakistan or the Ministry of Environment.

References

[1]. Brandon, C (1995). Valuing the Environmental Costs in Pakistan: The Economy Wide Impact of Environmental Degradation, The World Bank, New York.

[2]. Ministry of Environment (2003). A Handbook on Pakistan National Conservation Strategy, Ministry of Environment, Government of Pakistan, Islamabad.

[3]. Government of Pakistan, IUCN and WWF (2000), Biodiversity Action Plan of Pakistan, Ministry of Environment, Islamabad.

[4]. Government of Pakistan and IUCN (2000). Mid-Term Review Report of NCS, Ministry of Environment, Islamabad

[5]. Ministry of Environment and UNDP (2001). Program Document, National Environmental Action Plan Support Program, Ministry of Environment, Islamabad.

[6]. Rehman, Aurangzeb (2004), Personal Communications, Curriculum Wing, Ministry of Education, Islamabad.

[7]. Malik, Murtaza (2003); Project Document, Environmental Education at School and College Level Project, NEAP-Support Program, Ministry of Environment, Islamabad.

[8]. Higher Education Commission (2003). Official Communications between the Ministry of Environment and Higher Education Commission, Islamabad.

[9]. Malik, Murtaza [2004]. National Directory of Institutions Offering Specialized Programs on Environment in Pakistan. Ministry of Environment, Islamabad (available at www.environment.gov.pk).

[10]. Malik, Murtaza (2000). University Level Environmental Education in Pakistan- a review of postgraduate programs. Unpublished Report, LEAD-Pakistan, Islamabad.

IMPLEMENTATION OF UN FRAMEWORK CONVENTION ON CLIMATE CHANGE IN PAKISTAN

*Jawed Ali Khan[12], *Murtaza Malik and *Irfan Anjum*

Abstract

This paper describes the key initiatives taken by the Government of Pakistan in connection with the implementation of United Nations Framework Convention on Climate Change (UNFCCC). These, inter-alia, include conduct of various studies, implementation of projects such as Fuel Efficiency in Road Transport Sector Project and Commercialization of Wind Power Potential, and preparation of the National Initial Communication on climate change. The paper also presents an overview of Pakistan's first Initial National Communication to UNFCCC as well as planned initiatives in the area of climate change.

KEYWORDS
Climate Change, Pakistan, Fuel Efficiency, National Communication, ALGAS, GHG

Introduction

Pakistan became one of the first signatories to the United Nations Framework Convention on Climate Change (UNFCCC), and thereafter ratified it on June 1, 1994. It was also the first country to sign a "Letter of Intent" with the US Government for initiation of projects under the Activities Implemented Jointly pilot phase started in 1995. Pakistan has been a regular participant of the various Conference of Parties (CoP) meetings and related UNFCCC committees and is currently a member of the "Consultative Group of Experts on National Communications". At CoP-7, Pakistan was nominated for the Expert Group on Technology Transfer (EGTT) while during the 9th meeting of CoP, held in December 2003, it was elected as the Vice-President of the CoP-9 Bureau. Since the early 1990s, Pakistan, in addition to taking important policy, legislative and institutional measures [1], has also completed a number of major studies and projects focusing on climate change and Greenhouse Gas (GHG) reduction. This paper presents an overview these initiatives as well as a summary of Pakistan's first National Initial Communication to UNFCCC.

Climate Change Related Studies

A brief description of the major climate change related studies undertaken in Pakistan is as follows:

a. Climate Change in Asia: Regional Study on Global Environmental Issues (1992-4)

This study was undertaken during 1992-94 with the assistance of the Asian Development Bank (ADB). It resulted in development of detailed analyses of the country's vulnerability to climate or weather- related events and the potential impacts of climate change in 2010 and 2070. The study report also presents an evaluation of the technical and economic feasibility of options, both, to adapt to climate change and to limit GHG emissions or enhance their sinks. The report also recommended an appropriate national response strategy for implementing the recommended options.

b. Asia Least-cost GHG Abatement Strategy (ALGAS) (1994-1998)

This four-year study was carried out as part of the technical assistance project covering 12 Asian nations, including Pakistan, with the specific aim of identifying and quantifying the least-cost options for GHG mitigation. The Pakistan study was completed in 1998. The study resulted in (i) the first comprehensive inventory of GHG sources and sinks in Pakistan based on Intergovernmental Panel on Climate Change

[12] *Director General (Environment); *Program Manager (Policy Coordination and Environmental Governance) & *Section Officer, Ministry of Environment, Islamabad, Pakistan*

(IPCC) recommended methodology; (ii) analysis and prioritization of mitigation options, and (iii) drafting of a long-term GHG abatement strategy. It also specified mitigation projects in different sectors of economy, some of which have subsequently received GEF funding [2].

c. *Prompt Start Measures for the Implementation of the UNFCCC– Support for the Country Study of Pakistan: Inventory Study*

This study was carried out during 1994-95 with the support of the German Agency for Technical Cooperation (GTZ). It aimed at: (a) collecting and adapting basic data on natural resources; (b) elaborating, verifying, and testing data about sources and sinks of GHGs; (c) processing data for use of IPCC model; (d) elaborating emission scenarios, and (e) elaborating a first assessment of technical and political options to mitigate GHG emissions.

d. *Country Case Study on Climate Change Impacts and Adaptation Assessment*

The study was funded by the Global Environment Facility (GEF) through a project of the United Nations Environment Program (UNEP) during 1996-98. It provided a basic understanding of the potential impacts of climate change and the adaptation measures necessary to address it in Pakistan [3].

A description of some of the on-going studies on climate change in Pakistan is presented elsewhere [4, 5].

National Communication to UNFCCC

Pakistan's Initial National Communication (PINC) to the UNFCCC, a requirement of non-Annex I countries under Article 4 and 12 of the Convention, was prepared with GEF financing through a consultative process. The PINC report was submitted to UNFCCC Secretariat, Bonn, Germany, on 15 November 2003.

The PINC report [1] provides a detailed description of the national circumstances, GHG inventory; climate change impacts in key sectors, adaptation measures and financial and technological needs and constraints, proposals of research and general description of steps taken. The GHG inventory, which covers the period July 1993 to June 1994 following the Pakistani fiscal year, includes five significant source categories, i.e. the energy, industrial processes, livestock and agriculture, forestry and land use change and waste sectors. Solvents and other product use, the sixth GHG source category identified by IPCC has been excluded from this inventory due to absence of activity and emission data on solvents used in dry cleaning printing, metal degreasing, painting and industrial uses.

According to GHG inventory, the total national emissions and removals for the period 1993-4 amounted to 94,571.0 gigagrams (Gg) of carbon dioxide (CO_2). The energy sector was by far the highest contributor to CO_2 emissions, contributing 81% of total CO_2 emissions when measured according to the source category approach. The forestry and land use change sector accounted for 7% of CO_2 emissions, while industrial processes accounted for 12%. The agriculture sector was the primary source of methane (CH_4) emissions in the country, accounting for 87% of all CH_4 emissions. Fugitive emissions and emissions from waste management accounted for the remainder of CH_4 emissions. The bulk of nitrous oxide (N_2O) emissions (81%) also came from the agriculture sector, with the remaining emissions coming from human sewage and the energy sector. NOx emissions can be attributed almost entirely to the energy sector with the transport sector being the major source. The primary source of carbon monoxide (CO) emissions was from the transport sector, accounting for 81% of all CO emissions. Industrial processes and field burning of agricultural residues all contributed to CO emissions in the country. Emissions of methane volatile organic compounds (NMVOCs) rose primarily from industrial processes.

On the basis of the GHG inventory, the PINC explores the main emitting sectors for viable mitigation opportunities. These options are further analyzed and evaluated to assess their emissions reduction

potential and the economic and financial implications of their implementation in energy, forestry and agriculture sectors. A total of twenty-one abatement options were developed for the energy sector while six options were analyzed for forestry and land use and two options were analyzed for agriculture and livestock. As part of the research undertaken for the Pakistan National Communication, vulnerability and impact assessment studies were conducted for key sectors including water, agriculture, forests, coastal zones, cyclones, livestock and biodiversity. These studies were undertaken to evaluate the effects of climate change and understand the long run impacts that changes in climate variables such as temperature and precipitation can have on key sectors of the economy. The National Study Team, in consultation with experts from the IPCC, formulated a set of synthetic scenarios consistent with scenarios generated using the Model for Assessment of Greenhouse gas Induced Climate Change (MAGICC) software used extensively by the United Nations Environment Program (UNEP) and other UN agencies. A temperature change of +0.3°C per decade and a ±1.0 percent change per decade in precipitation were recommended. The forecasts were done for the years 2020 and 2050.

The main findings of the vulnerability and assessment studies are summarized below:

- *Impact on Water Resources:* The effect of climate change on water resources is expected to be significant. In general, increase in temperature would not only increase water demand because of higher evaporation rates, but may also increase rainfall due to additional moisture supplied to the clouds because of higher evaporation from the sea surface. Similarly, increased rainfall may cause increase in magnitude of floods.
- *Impact on Agriculture:* Climate change is expected to have significant impacts on agriculture. Potential impacts which were explored in the sector study, were potential vulnerability of crops to heat stress, possible shifts in spatial boundaries of crops, changes in productivity potential, changes in water availability and use, and changes in land use systems.
- *Changes in Land Use:* The projected increase in temperature by 2050 would reduce the growing season length and productivity of all the three cropping systems, but might provide more time for preparation of land for the next crop and have implications for land use in agriculture.
- *Impact on Forests:* In general, a shift in the location of different biomes is likely under the change in precipitation scenarios. Cold and temperate conifers will show a northward shift, pushing against the cold conifer/mixed woodland, which in turn will encroach upon the southern and lower edges of the alpine tundra. Similarly, the northern boundaries of warm conifer/mixed forest will also move north, pushing against the southern boundaries of the temperate conifer/mixed forest.
- *Coastal Areas:* The primary impacts of sea level rise are the direct physical effects on the coastal zone due to changes in coastal dynamical processes because of sea level rise. Such impacts may include the risk of erosion, flooding, inundation and displacement of wetlands and lowlands and salinization of ground and surface water. Another serious impact of changes in atmospheric and sea temperatures is the increased risk of occurrence of severe cyclones and storm surges.

The PINC report also presents general adaptation options for water resources, through conservation practices, improved watershed management, water harvesting, water quality protection, establishment of weather forecasting and information network for farmers, improved maintenance and building new canals and small dams etc. Recommended adaptation options for agriculture include changes in cropping patterns, adjusting cropping pattern with water availability, changes in land use, improved productivity management, adaptation in range land ecosystem, restoration of degraded areas and use of feed management techniques and fodder banks. In the forestry sector, the report recommends pest control, changes in species and varieties, preservation of watersheds, and control of wood wastage as adaptation measures. The report also identifies key areas of further research and public awareness activities for the key sectors of the economy.

Projects and Programs

One of the major projects being implemented in Pakistan with the broader objective of mitigating GHGs by improving fuel efficiency in the road transport sector is the "Fuel Efficiency in Road Transport Sector (FERTS)", funded under GEF Operational Program on climate change. The project is being managed by the Ministry of Environment through National Energy Conservation Center (ENERCON). The specific objectives of the project include development of a market for instrumented tune-up centers through establishment of tune-up demonstration centers, provision of training to mechanic and workshop owners; launching of mass awareness campaigns; establishment of a revolving loan fund for financing the purchase of tune-up equipment; and conducting policy/project feasibility studies for further improvement of fuel efficiency in the road transport sector. Thus far 21 tune-up centers have been established in major cities against a target of 30. Moreover, 1567 mechanics and 778 workshop owners have been trained while seven policy studies have been also been completed. Intensive mass awareness campaigns are also underway.

Another ongoing climate change related project is the "Commercialization of Wind Power Potential in Pakistan". This project aims at stabilizing GHG emissions through promoting the commercialization of wind power in Pakistan by establishing commercial feasibility for wind energy in the country, identifying and overcoming barriers to future investments in renewable energy, and scaling up the practical demonstration of the technology to attract potential entrepreneurs. A feasibility study is being carried out through monitoring and analysis of wind data for assessing wind power potential in the coastal areas of Pakistan. It would set in place a complete package of resource assessment, evaluation of economic viability and marketability, and effective implementation arrangements for future applications. A GEF full Project Brief for large-scale demonstration of wind power project in the coastal areas of Pakistan, including cost sharing from potential investors will also be developed on the basis of the feasibility study. The work envisaged under the project has almost been completed and a project brief is under preparation for submission to GEF

Pakistan is also implementing the ADB-funded Promotion of Renewable Energy, Energy Efficiency and GHG Abatement (PREAGA) Project. This is a regional technical assistance project of the ADB, which is being implemented by Pakistan Council for Appropriate Energy Technologies, and aims to promote the use of renewable energy, energy efficiency and GHG abatement technologies in selected developing member countries to help realize sustainable development, including poverty alleviation, gender and development and environmental protection.

Pakistan has also initiated the "Compressed Natural Gas (CNG) Research, Development and Demonstration Program" for introducing natural gas, which is the cleanest of fossil fuels, as an alternate transport fuel in the country. Under this program, which is being implemented by the Hydrocarbon Development Institute of Pakistan, the government has provided incentives to the private sector including totally deregulated consumer price. As a result, CNG industry started developing during late 1990s and now Pakistan is the largest CNG user country in Asia and the third largest in the world. Currently, 500 CNG stations are providing CNG to about 500,000 vehicles all over the country [6].
A number of projects aimed at mitigation of climate change and adaptation to climate change in Pakistan have also been, or being, carried out under the United Nations Convention on Biological Diversity (UNCBD) and United Nations Convention to Combat Desertification (UNCCD).

The Way Forward

Despite technical and financial constraints, Pakistan has made diligent progress over the past decade in assessing and evaluating issues relating to greenhouse gas emissions and climate change. Concrete measures, especially in the area of policy formulation, capacity building, technology transfer, raising

public awareness and establishment of a clearing house for information sharing and networking, however, need to be taken to respond to the challenges posed by climate change in an effective manner.

The Ministry of Environment plans to establish a Climate Change Cell for coordinating all climate change related activities and ensure that climate change issues are addressed in various policies of the Government. In order to strengthen capacity in the context of preparation of national communications, the Ministry, with the support of GEF, intends to shortly launch a follow-up project to PINC. Another related GEF funded project namely "Pakistan National Capacity Self Assessment Project" has also been approved and is likely to commence soon. This project will result in identification of national level priorities and needs for capacity building to address global environmental challenges to meet the obligations under UNFCCC, UNCBD and UNCCD and preparation of action plan and projects in this regard. The Government is also considering Pakistan's accession to Kyoto Protocol and a decision in this regard is likely to be taken shortly. This initiative will enable Pakistan to tap further international funding for climate change related interventions.

Disclaimer

The views expressed in this paper are those of the authors and do not reflect the views of the Government of Pakistan or the Ministry of Environment.

References

[1] Government of Pakistan (2003). Pakistan's Initial National Communication on Climate Change, Ministry of Environment, Islamabad (also available at http://unfccc.int/)

[2] ADB/GEF/UNDP (1998). Asia Least-Cost Greenhouse Gas Abatement Strategy (ALGAS) - Pakistan. Manila, Philippines. Asian Development Bank, Global Environment Facility, United Nations Development Program. October 1998.

[3] GOP/UNEP (1998). Study on Climatic Change Impact Assessment and Adaptation Strategies Study for Pakistan. Islamabad. Government of Pakistan and United Nations Environment Program.

[4] Khan, A.M. (2004). Application of Simulation Models for Assessment of Climate Change and its Impacts on Water Resources and Food and Agriculture Production, Proc. Workshop on Networking and Capacity Building in Global Change Research, 08-10 June 2004, Islamabad.

[5] Akhter, N (2004), Priorities for Human Dimensions Research in Pakistan, Proc. Workshop on Networking and Capacity Building in Global Change Research, 08-10 June 2004, Islamabad.

[6] Pervez, M (2004), Personal Communications, Hydrocarbon Development Institute of Pakistan, Islamabad.

APN PROPOSALS PROCESS

APN ANNUAL CALL FOR PROPOSALS 2004

Linda A. Stevenson

The Mission of APN

An understanding of the complex mechanisms and impacts of global change on human health, welfare and ecosystems is becoming increasingly important for humanity. The Asia-Pacific Network for Global Change Research (APN) is an inter-governmental network whose mission is to foster global change research in the Asia-Pacific region, increase developing country participation in that research, and strengthen interactions between the science community and policy-makers. We believe that international cooperation among governments and scientists will help increase the understanding of the complex mechanisms and impacts of global change on ecosystems and human society in the Asia-Pacific region. This is necessary to identify and address the problems that may arise from that change.

The Annual APN Call for Proposals

As part of its programme of activities the APN issues an annual Call for Proposals. This guide explains the types of proposals which are of interest to the APN, the method and format for writing and submitting proposals, and the decision making process by which they will be judged. Further information about the activities of the APN is available on the APN Website <http://www.apn.gr.jp> or from the Secretariat.

The APN Call for Proposals involves an *optional* pre-proposal stage, and the APN recommends particularly those researchers who have never previously submitted a proposal to APN.

Procedure for Proposals Submission:

1. Eligibility

To be eligible for consideration under the APN Call for Proposals 2004 a proposal *must* meet the following basic criteria:

- Relate to an area of scientific interest within the APN Research Framework
- Be an approved activity of interest to the APN
- The proponent must be based in an APN Approved Country
- Involve action or contributions from at least three APN Approved Countries, **at least two of which must be developing countries**;
- Follow the format specified in the guide for proponents (full version available on website)
- Include the two-page cover sheet. *Note that the two-page cover sheet is of essential importance in the Rapid Assessment Stage. During this stage the proposals are evaluated on the basis of this cover sheet;* and
- Arrive at the APN Secretariat no later than **midnight (24:00) - Japanese time - on Wednesday, 22 September 2004**.

Any proposal that fails to meet the above basic criteria will not be considered for funding by the APN under this Call for Proposals.

2. Funding Limit and Multi-Year Funding

The APN is able to provide a limited amount of financial support for research and workshop activities that fall within its areas of interest. For example, the *average grant awarded for 2003 projects was approximately US$ 40,000*. Proponents may, however, request partial support for a larger project. The total budget the APN sets aside for its annual Call for Proposals is approximately US$ 750,000. Proponents should be aware that, although APN will consider multi-year projects (maximum of 3 years), due to budgetary restrictions only a limited number of multi-year projects may be funded. Proposals submitted for multi-year funding will be considered provided that a

clear breakdown of the year-by-year funding requirements is given, together with the expected outcomes at each stage of the project. If a multi-year proposal is approved, continued funding will not be guaranteed and the project undertaken will be subject to rigorous review after year one.

3. Evaluation

Eligible proposals will be evaluated against the *11 criteria* outlined below (and which are detailed in full on pp 6-8):

1. Extent and quality of regional collaboration;
2. Technical soundness;
3. Building regional and national capacity for global change research;
4. Developing and strengthening links with government policy and programmes;
5. Administrative support;
6. Consideration of funding options;
7. Increasing synthesis and analysis work at national and regional levels;
8. Developing and strengthening relations with regional and international global change programmes and inter-governmental bodies and mechanisms;
9. Raising awareness of global change issues with the general public;
10. Meeting standardised data collection and user needs, and open access to research sites; and
11. Improving communications.

4. Timetable

There are nine (9) stages in the APN Call for Proposals process, as outlined in the table below.

	Action	Date
Stage 1 *(optional)*	Submission of pre-proposals to the APN Secretariat.	Deadline: Friday, 18 June 2004
Stage 2	Submission of full proposals to the APN Secretariat.	Deadline: Wednesday, 22 September 2004
Stage 3	Rapid Assessment Stage (only the two-page proposal coversheet is assessed at this stage).	October 2004
Stage 4	Proponents whose proposals are rejected are informed that they have been unsuccessful in their application. All successful proposals are sent to the APN reviewers for their initial rating.	November 2004
Stage 5	APN's internal reviewers (SPG Members) submit their initial rating of proposals.	January 2005
Stage 6	Proponents whose proposals pass the initial rating are sent questions/comments from the reviewers. All other proponents are informed that they have been unsuccessful in their application.	January 2005
Stage 7	Proponents respond in writing to reviewers' questions/comments.	January 2005
Stage 8	1) APN's internal reviewers (i.e. SPG members) submit revised ratings on the basis of proponent responses in Stage 7. 2) External mail reviewers (with relevant expertise) submit comments on the proposals and the proponent responses.	February 2005
Stage 9	After the IGM decides which proposals to fund, the APN Secretariat communicates final decisions to proponents.	End April 2005

5. APN Support

Where APN funding is to be provided for a proposal, the Secretariat and the Principle Investigator will sign a contract outlining payments, activities, timeframes and reporting requirements, etc. Reports will cover a common set of issues, including financial accountability and outcomes of the funded activity.

6. FUNDING FROM OTHER SOURCES

Where additional funding from other sources is stated in the proposal, the proponent may be required to show evidence that this funding has been secured.

7. ENQUIRIES

Enquiries and correspondence should be directed to **Dr. Linda Stevenson** at the **APN Secretariat**.

Dr. Linda A. Stevenson
APN Secretariat, IHD Centre Building, 5F
1-5-1 Wakinohama Kaigan Dori
Chuo-ku
Kobe 673-0073
JAPAN
Tel: +81-78-230-8017
Fax: +81-78-230-8018
Email: lstevenson@apn.gr.jp
Website: http://www.apn.gr.jp

FUNDAMENTAL CRITERIA FOR PROPOSAL SUBMISSION TO APN

Linda Stevenson

I. Criteria

Proposals must fall within the APN Research Framework (outlined below), which sets out the broad research interests of the APN. The primary concern of the APN is to provide an input to policy through the integration of the natural and social sciences with a view to developing a better understanding of the relationship between the causes and impacts of global change and human society and ecosystems. The **Human Dimensions of Global Change** is, therefore, also central to the APN Research Framework.

In the Call for Proposals 2004, the APN will consider all proposals that:

a) Fall within the APN Research Framework outlined below; and

Therefore, proposals must directly address one or more of the following areas of interest to the APN:

(1) Climate Change & Variability;
(2) Changes in Coastal Zones & Inland Waters;
(3) Changes in Atmospheric Composition;
(4) Changes in Terrestrial Ecosystems & Biodiversity; and
(5) Human Dimensions of Global Change

b) Concern activities of interest to the APN as listed below:

The APN is prepared to support activities in the field of global change research relating to:

(1) Synthesis and analysis of existing research and new research which addresses knowledge gaps in key areas.

Note: The proponent must clearly address the existing gaps while explaining fully why the research is needed, and provide all relevant supporting background literature.

(2) Capacity building and networking

Note: It is important that the proponent clearly addresses why the said capacity building and/or networking is needed in the area specified, and the kind of follow-up activities expected to ensure the outputs are sustainable and that the activity is not a one-off event.

(3) Planning and scoping workshops

Note: The proponent must clearly address why the proposed workshop is needed, how it will benefit APN member countries, and provide full details on the selection process of participants.

(4) The development of policy products such as integrated assessments, impact assessments, climate models, etc.

Note: The proponent must clearly address why the project proposed is needed, show that the work is not being (or has not been) duplicated, and explain how the project outcomes will benefit policy- and decision-making in the region.

c) Proponents who have previously received APN support MUST also provide the following information:

1. Relevant APN project(s) title(s) and reference number(s);
2. An electronic copy of the APN final project report(s)[13];
3. A list of all outputs following completion of the APN project, including proceedings, reports, peer-reviewed papers, etc; and

[13] ***If the proponent cannot provide a full project report of his/her previously supported APN project, a detailed explanation must be given.***

4. A summary of how the activity(s) has evolved since receiving APN funding.

d) In cases that a proposed project will generate new data or datasets and/or collect existing data or datasets, the proponent must make the said data available to APN within 12-24 months of project completion in order that APN can freely disseminate the data on the APN website.

The APN **will not** support:

1. The running costs of institutions;
2. The salaries of administration staff or existing researchers who receive **full-time salary support**; and
3. The establishment or maintenance of long-term observation and monitoring systems.

Eligible proposals will then be considered against the 11 criteria detailed below:

Criterion #1. Extent and quality of regional collaboration

Proposals **must** involve action or contributions by **three or more APN Approved Countries, at least two of which are developing countries**, or promote the basis for initiating such collaboration, for example, through a workshop or similar activity. Due regard should be given to proposals from or involving less developed countries. The overall goal should be the generation of long-term sustained regional collaboration, not just a one-time event or project. In addition, the scientific contribution of **each** participating country should be explained in detail (for example this may include the extent of participation in the writing of the proposal, the scientific contribution and activities to be undertaken, data-collection, report writing, etc.).

The APN Approved Countries are:

1. APN Member Countries

Australia	Indonesia	New Zealand	Thailand
Bangladesh	Japan	Pakistan	USA
Cambodia	Lao PDR	Philippines	Viet Nam
China	Malaysia	Republic of Korea	
Fiji	Mongolia	Russian Federation	
India	Nepal	Sri Lanka	

2. Countries currently engaged in membership discussions

Pacific Island Countries

Criterion #2. Technical soundness and degree of consistency and sustainability

Proposals should generate confidence about research excellence, data quality, capacity for programme management, and willingness and ability to pursue activities from a multidisciplinary perspective, as appropriate.

It should be made clear in the proposal the extent to which it is based on, or part of, a planning and scoping activity in or about the region, as activities based on adequate planning and scoping processes are more likely to lead to successful long-term outcomes.

Criterion #3. Building regional and national capacity for global change research and problem solving

It is expected that proposals will contribute to the fundamental APN goal of building regional and national capacity (technical expertise) for researching global change issues. The result should be a

long-term gain, for example, by increasing local skills and knowledge, improving decision making processes or increasing or improving national involvement in international processes.
Proposals should also show how existing resources (buildings, laboratories, research sites, equipment, libraries, data sets, communication facilities, travel budgets, etc.) can be used more efficiently or how their potential value can be better realized as a result of the proposed activity.

Criterion #4. Developing and strengthening links with government policy and programmes

The APN is committed to improving science-policy links and fostering harmony between its activities and policy issues which concern most governments in the region. Proposals should include an indication of how the activity might assist with national government and business decision-making processes, or support national, regional or global scale programmes aimed at dealing with global change problems. Harmonisation with the work of other bodies active in the region (for example, APEC, ASEAN, UNEP, ESCAP, SPREP) is desirable.
The APN emphasizes the need to contribute to solving ecological, social and economic problems associated with global change impacts, such as those identified in IPCC processes.

Criterion #5. Adequate administrative support

Proponents should indicate how necessary administrative support will be provided for the proposed activity. Ideally, administrative support would be provided by one of the parties involved in the project, freeing any APN funding for the proposed core activity. *APN funding is not available for administrative staff payments, or to supplement the pay of existing researchers who receive full-time salary support (see Appendix 4, p13)***.**

Criterion #6. Adequate consideration of funding options

The APN strongly encourages co-financing arrangements. In addition, it is the APN's concern that funding from other sources should be secured. The APN also encourages in-kind contributions from proponents. Where additional funding is secured from sources other than APN, evidence of the funding may be required.

Criterion #7. Increasing synthesis and analysis work at national and regional levels

The APN believes that more attention needs to be paid to synthesis and analysis work derived from the many research outcomes already available. This will require the development and use of appropriate integrative techniques, and will often involve research teams drawn from several disciplines and from policy- and decision-making interests.

Criterion #8. Developing and strengthening relations with regional and international global change programmes and inter-governmental bodies and mechanisms

A key goal of the APN is to strengthen cooperative relations amongst the global change research community. Accordingly, proposals should specify how the activity will incorporate cooperation with the global change programmes of DIVERSITAS, IGBP, IHDP, WCRP, and other environmental research networks, such as START, with global change components.
The existing or proposed extent of the project's involvement with START and the global change research programmes, if any, should be clearly stated. Other proposals related to regional networks such as IAI can be considered within APN procedures provided that they comply with the APN requirements. The APN encourages regional initiatives to be seen as part of a global effort.

Criterion #9. Raising awareness of global change issues with the civil society

APN members consistently stress the importance of good public knowledge of global change issues, to help ensure the successful development and implementation of response strategies to these issues. Proposals should indicate how the proposed activity could lead to better public knowledge. Any proposed consultation processes should be indicated, and information provided about how results will be disseminated.

Criterion #10. Meeting standardised data collection and user needs, and open access to research sites

In the interests of the greatest benefit in the shortest time for the greatest number of countries in the region, the best proposals will promote **better data collection, analysis and dissemination, open access (to existing and new datasets) and access to research material and sites**.

Criterion #11. Improved communications

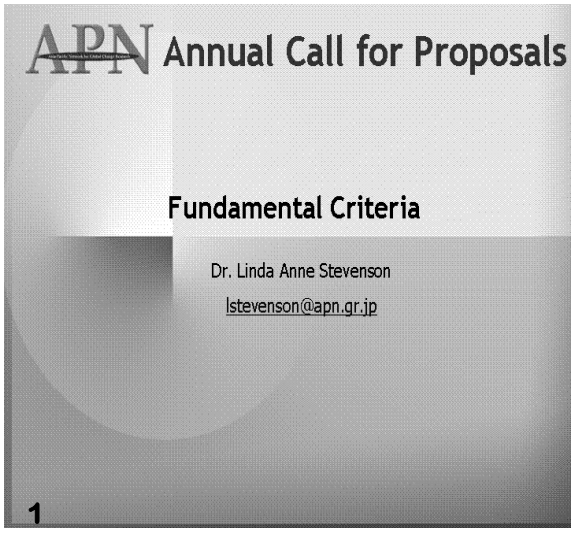
The best proposals will contribute to lasting improvement in communications among APN members, including both the enhancement and use of communications networks.

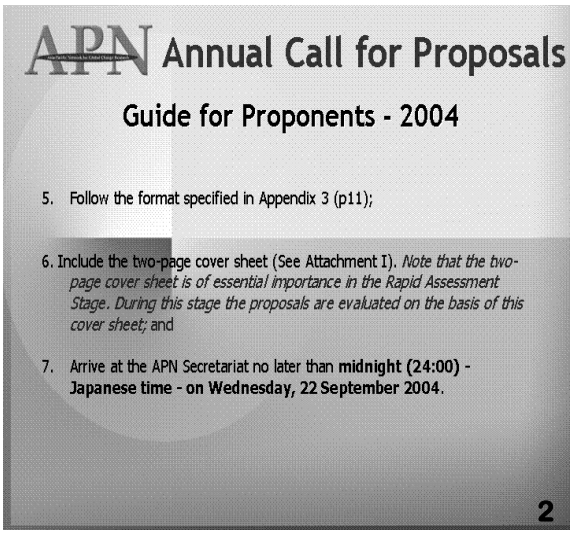
II. Weighting of Criteria

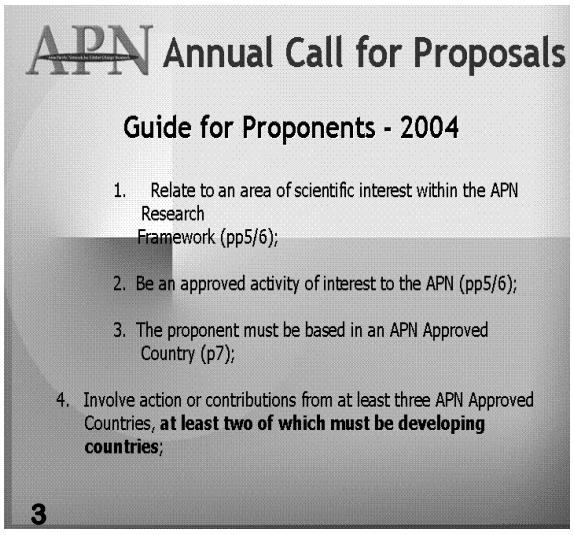
Proposals will be judged primarily against criteria #1 to #4 reflecting the highest priorities of the APN. Criteria #5 and #6 will be used to assess the proper administrative and financial arrangements required for conducting the project. The remaining criteria will be used to judge how thoroughly a proposal meets the wider aims of the APN.

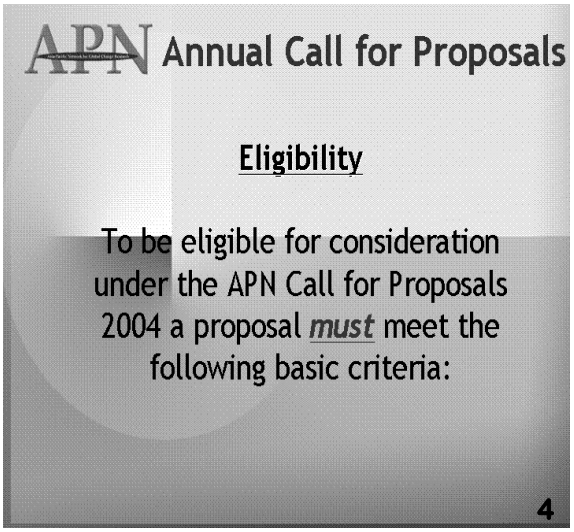
Format for Full Proposals	
Section	Information Required
1. Project Title	Full title of the proposed project.
2. Detailed Proposal	Description of the entire project, APN funded portion, work plan, timeline, etc. expanding where necessary on information included in the two-page cover sheet. Ensure that all information addressed on pp5-6 is included where necessary.
3. Relationship to Priority Topics in the APN Research Framework	Full description of the relationship of this proposal to the APN Research Framework as well as linkages to the Human Dimensions of Global Change.
4. Regional Collaboration	A detailed explanation of how the project will develop regional collaboration.
5. Capacity Building	An explanation of how the project will build national/regional capacity to conduct global change research.
6. Scientific Contribution of each Participating Country	An explanation of the scientific contribution of each participating country, for example, in writing the proposal, in the activities to be conducted, report writing and other relevant information.
7. Links to Policy	A full explanation of how the project will link to the policy-making process.
8. Relationship between Global Change Research Programmes and Networks	Details on any relationship between the project and the work of DIVERSITAS, IGBP, IHDP, START and WCRP; and other global change research programmes and networks. This should include previous relationships and specific collaboration, if any, in the proposed project.
9. Related Research Work	Details of existing research work on the proposed topic. This should include a full background literature review, where necessary.
10. Appendix 1 Major Collaborators	Details of the major collaborators (*names, organisations, contact details*).
11. Appendix 2 CV of Proponent	Short CV of Principal Investigator (proponent) and major collaborators (***maximum of two pages each***).
12. Appendix 3 Budget Estimate	Detailed budget estimate for the project in US Dollars, clearly indicating the APN portion and in-kind or other financial contributions. Proponents should refer to the APN's 'Financial Guidelines' (Appendix 4, p13).
13. Appendix 4 Details of funds from sources other than APN	Where funds are received (in-kind and other contributions) from sources other than APN for your project please provide details on the amount, source and specific purpose/use of both the APN funds and the funds from other sources in the project. Note that written evidence of other funding sources may be required.

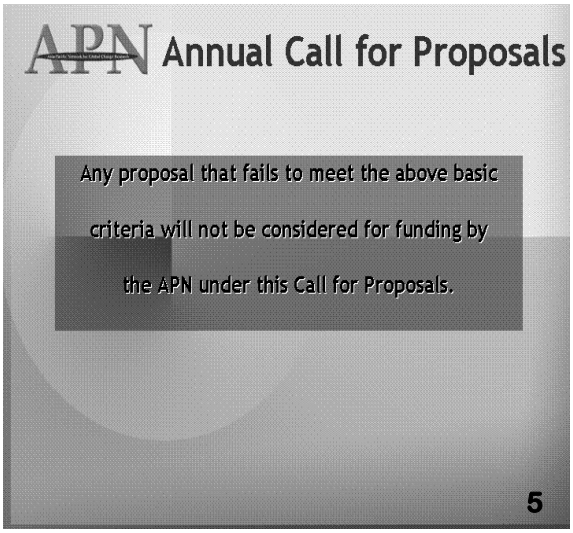
PRESENTATION











PROGRAM

TUESDAY JUNE 08, 2004		
0830	Registration of Participants	
Session 1:	Inauguration Chief Guest: Eng. Dr. Akram Sheikh, Deputy Chairman, Planning Commission	
09:00-09:15	Welcoming Remarks	Dr. Amir Muhammed Chairman, Pakistan Global Change Research Committee
09:15-09:45	Asia-Pacific Network for Global Change and its Activities	Dr. Linda Stevenson, Program Manager, APN
09:45-10:30	Global Change and the Earth System; Implications for Pakistan	Dr. Will Steffen, Executive Director IGBP
10:30-10:45	Inaugural Address	Engr. Dr. Akram Sheikh Deputy Chairman, Planning Commission
10:45-11:10	Tea Break	
Session 2:	International Programs	
11:10-12:10	Earth System Science Partnership and its Activities	Dr. Will Steffen, Executive Director, IGBP
12:10-12:50	International Human Dimension Program and Research Projects	Dr. Aminur Rahman, Associate Professor, Independent University of Bangladesh
12:50-14:00	Lunch	
14:00-14:45	Priorities for Human Dimensions Research in Pakistan	Dr. Nasim Akhter, Chairman, IHDP National Committee for Pakistan
14:45-15:30	Climate Change Perspective in Pakistan	Mr. Anjum Bari, Director, Pakistan Meteorological Department
15:30-16:00	APN Annual Research Proposals process	Dr. Linda Stevenson, Program Manager, APN
16:00-16:30	Tea Break	
19:30	Dinner hosted by GCISC	
WEDNESDAY JUNE 09, 2004		
Session 3:	Regional and National Programs	
09:00-09:45	Application of Simulation Models for Assessment of Climate Change and its Impacts on Water Resources and Food and Agricultural Production (APN/CAPaBLE Project)	Dr. Arshad M. Khan, GCISC
09:45-10:30	Education and Research in Environment and Global Change in Pakistan	Dr. Murtaza Malik, Ministry of Environment
10:30-11:00	Tea Break	
11.00-11:45	Implementation of UNFCCC in Pakistan	Mr. Jawaid Ali Khan, DG , Ministry of Environment
11:45-12.30	General discussion on present status and future prospects for Global Change Research in Pakistan	Plenary discussions
12:30-13:45	Lunch	
13:45-14:00	Fundamental criteria for proposal submission to APN	Dr. Linda Stevenson (APN)
14:00-14:30	Identification of suitable topics under the APN Research Framework	Dr. Amir Muhammed & Dr. Linda Stevenson (APN)
14:30-17:00 (Including tea break)	Break out Session: Writing Proposals (4 groups of 10 participants will write proposal on a specific topic under the APN Research Framework relevant to the Region.)	Dr. Linda Stevenson (APN) Dr. Amir Muhammed (APN SPG Co-Chair) Dr. Arshad Khan (APN Project Leader) Dr. Will Steffen (IGBP Resource person)
Thursday June 10,2004		
Session 4:	Concluding Session	
09:00-11:00	Recommendations on priorities for Global Change Research in Pakistan and institutional mechanism to stimulate and fund GC research	
11:00-11::30	Tea Break	
11:30-12:30	Closing Session	
Afternoon	Departures	

LIST OF PARTICIPANTS

RESOURCE PERSONS

1. Dr. Amir Muhammed
PAKISTAN
President
Asianics Agro Dev Int'l
House No. 13, Street 49, F-6/4, Islamabad, Pakistan
+92-51-2276424
asianics@comsats.net.pk

2. Dr. Linda Anne Stevenson,
JAPAN
Programme Manager for Scientific Affairs
APN Secretariat
Asia-Pacific Network for Global Change Research
IHD Centre Bldg. 5F, 1-5-1 Wakinohama Kaigan Dori,Chuo-Ku, Kobe, 651-0073,
Tel: +81-78-230-8017
Fax: +81-78-230-8018
Email: lstevenson@apn.gr.jp

3. Dr Will Steffen
SWEDEN
Executive Director,
International Geosphere Biosphere Program,
Royal Swedish Academy of Sciences
Box 50005
S-104 05 Stockholm
Ph: 46-8-16-64-48
Fax: +46 (-8) -166405
will@igbp.kva.se

4. Dr. Aminur Rahman,
BANGLADESH
Associate Professor, School of Business,
Independent University of Bangladesh, 90 Park Road,
Baridhara, Dhaka,
Ph: +2 988 1917 / +2 989 4879,
E-mail: aminur@iub.edu.bd

5. Dr. Nasim Akhtar,
PAKISTAN
Deputy Director General, Animal Sciences Institute,
National Agricultural Research Centre, Park Road, Islamabad,
Phone: +92 51 9255040,
Fax: +92 51 9255221
E-Mail: nasimaktar_2000@yahoo.com

6. Dr. Arshad Muhammad Khan
PAKISTAN
Executive Director
Global Change Impact Studies Center
62-A, 1st floor
Saudi Pak Tower, Blue Area
Islamabad
Ph: 051-9219785
Fax: 051- 9219787
E-mail: *ak_gcisc@mail.comsats.net.pk*
gcisc@comsats.net.pk

7. Mr. Anjum Bari
PAKISTAN
Director
Pakistan Metrological Department
Sector H-8/2
Islamabad-
Ph: 9257313
Fax: 4432588
pmisba@isb.pakknet.com.pk

8. Dr. Murtaza Mailk
PAKISTAN
Program Manager, Policy Coordination Neap-Sp
Ministry of Environment
Ground Floor, ENERCON Building, G-5/2
Islamabad
Ph: 9202858
Fax: 9292858
neapspl@comsats.net.pk

9. Mr. Jawed Ali Khan
PAKISTAN
Director General Environment
Ministry of Environment
CDA Block 4, G-6
Islamabad
Ph: 9202574
Fax: 9223760
E-mail: jawedalikhan@hotmail.com

PARTICIPANTS LIST

1. **Ms. Bilquees Gul**
Assistant Professor
University of Karachi
P.O. Box # 8452, University of Karachi, 75270-
Karachi
Ph: 021-4820922, (R) 9243976
Fax: 021-9243976
E- mail: bgal@super.net.pk

2. **Dr. Mohammad Abid Khan**
Professor
NU-FAST- Peshawar Campus
160- Industrial Estate, Jamrud Road
Peshawar
Ph: 091-822321, (R) 814418
Fax: 091-822320
E-mail: m_abid6@hotmail.com

3. **Dr. S. Shoaib Raza**
Principal Engineer
PINSTECH
NED/PINSTECH, P.O. Nilore
Islamabad
Ph: 9290231-7/3354
Fax: 9290275
Res: 4442184
E-mail: ssraza@msn.com;
ssraza@pinstech.org.pk

4. **Muhammad Akhtar**
PhD. Scholar
University of the Punjab
Postgraduate Center for Earth Sciences
Punjab University, Lahore
Ph: 042-9231251
Fax: 042-9231251
Res: 041-788842
E-mail: akhtarme@yahoo.com

5. **M. Mohsin Javed**
Lecturer
Govt. College University
Department of Botany, Govt. College
University,
Lahore
Ph: 042-9211634
Fax: 042-
Res: -
E-mail: mmj_bot@yahoo.com

6. **Muhammad Asim**
Scientific Officer
National Agricultural Research Council
(NARC)
Wheat Program, NARC
Islamabad
Ph: 9255073
Fax: 9255034
Mobile: 0300-8569487
E-mail: asim75m@hotmail.com

7. **Muhammad Mudasser**
Research Fellow
Global Change Impact Studies Center
(GCISC)
Saudi Pak Tower, 61-A
Blue Area, Islamabad
Ph: 9219785
Fax: 9219787
Res: 4413712
Mobile: 0300-9606793
E-mail: mood1999@hotmail.com

8. **Dr. Imtiaz Hussain**
Sr. Scientific Officer
National Agricultural Research Center
(NARC)
Wheat Program, NARC
Islamabad
Ph: 9255073
Fax: -
Res: -
Mobile: 0333-5171232
E-mail: izhussain@yahoo.com

9. **Irfan Saeed Alrai**
Programme Manager
UNDP (Neap- Support Programme)
Pak-EPA, 44-E, 3rd Floor Aaly Plaza
Blue Area
Islamabad
Ph: 9224838
Fax: 9224837
Res: 4415371
Mobile: 0333-5127512
E-mail: neappc@isb.paknet.com.pk

10. **Armghan Shahzad**
Scientific Officer
National Agricultural Research Center
Land Resources Research Program
INRES, NARC, Islamabad
Ph: 9255060
Fax: 9255034
Res: -
Mobile: 0320-5463958
E-mail: armghan_shehzad@yahoo.com

11. **Dr. Syed Sajidin Hussian**
Director
Global Change Impact Studies Center
(GCISC)
Saudi Pak Tower, 61-A Jinnah Avenue,
Islamabad
Ph: 9219785
Fax: 9219287
Res: 2240324
Mobile: 0330-5320558
E-mail: sajidin.hussain@gcisc.org.pk

12. **Dr. Kausar Suhail**
Professor
Govt. College University Lahore
Chairperson Department of psychology
GC University, Lahore
Ph: 042- 1110000-010 ext 256
Fax: 042-7243175
Res: 042-5725118
Mobile: 0300-9439228
E-mail: kausarsuhail@hotmail.com

13. **Ghazala Nasim**
Associate Professor
University of Punjab
Department of Mycology and Plant Pathology
University of Punjab, Qauid-e-Azam Campus,
Lahore
Ph: 042-9231187
Fax: 042- 9231089
Res: 042-5887154
Mobile: 0300-4447223
E-mail: ghazalansim@hotmail.com

14. **Dr. Muhammad Ashraf**
Director
Pakistan Council of Research in Water
Resources (PCRWR)
House # 3, St# 17, F-6/2
Islamabad
Ph: 9218985
Fax: 9218939
Res: 9257336
Mobile: -
E-mail: pcrwr@isb.comsats.net.pk

15. **Bushra Rashid**
Farmer Participatory Research and
Dissemination Officer
CAB International Regional Bio-Science
Center, Pak
Opp. 1-A, Data Gunj Bakhish Road
P.O.Box08, Satellite Town , Rawalpindi
Ph: 9290332
Fax: 9290131
Res: 0995-620438
E-mail: bushrarashid@yahoo.com

16. **Dr. Imtaiz Ahmad Qamar**
Senior Scientific Officer
Pakistan Agricultural Research Council (PARC)
Fodder Programme, IFHC National Agricultural
Research Centre Park Road, Islamabad
Ph: 9255038
Fax: 9255034
Res: 2279734
Mobile:
E-mail: iaqamar@yahoo.com

17. **Dr. Hafeez U.Khan**
Senior Research Officer
Pakistan Science Foundation
Constitution Avenue, G-5/2
Islamabad
Ph: 9202294
Fax: 9202468
Res: -
Mobile: 0320-4914440
E-mail: hafeez480@yahoo.com

18. **Mamoona Wali Muhammad**
Lecturer in Forestry
Pakistan Forest Institute
Peshawar
Ph: 091-9216127, 9216123
Fax: 091-9216203
Res: 091-841563
Mobile: 0300-5934844
E-mail: mamoonawali@hotmail.com

19. **Dr. Muhammad Ali**
Associate Professor
Bhauddin Zakariya University
Multan
Ph: 061-9210053
Fax: 061-9210068
Res: 061-224849
Mobile: 0300-6306745
E-mail: -

20. **Ata Hussain**
Meteorologist
Pakistan Meteorological Department
Sector H-8/2, P.O. Box 1214
Islamabad
Ph: 9257314-16
Fax: 4432588
Res: -
Mobile: 0300-5541670
E-Mail: atahussaingill@yahoo.com

21. **Ahsan Abdullaha**
Associate Professor
National University of Computer &
Emerging Sciences
FAST House, Rohtas Road, G-9/4
Islamabad
Ph: 111-128-128 Extn, 102
Fax: 2262885
Res: 5590175
Mobile: 0333-5119524
E-mail: ahsan.abdullah@nu.edu.pk

22. **Ihsan Ullah Khan**
Scientific Officer
Pakistan Agricultural Research Council (PARC)
Oilseed Programme, NARC
Park Road, Islamabad
Ph: 9255198
Fax: 9255059
Res: -
Mobile: 0333-5196684
E-Mail: ihsanuallah07@yahoo.com

23. **Dr. Zaheer Ahmad**
Scientific Officer
National Agricultural Research Council (NARC)
ASI, NARC- Park Road,
Islamabad
Ph: 9255029
Fax: -
Res: 2822055
Mobile: 0333-5121620
E-mail: drzaheer@comsats.net.pk

24. **Dr. Uzaira Rafique**
Assistant Professor
Fatima Jinnah Women University
The Mall –Rawalpindi
Ph: 9271170
Fax: 9271168
Res: 4428397
Mobile: 0300-5195982
E-Mail: uzairaiqbal@yahoo.com

25. **Muhammad Afzaal**
Meteorologist
Pakistan Meteorological Department
I.M.G, University Road, 75270
Karachi
Ph: 021-8112884
Fax: 021-8112885
Res: 021-8112879
Mobile: 0303-6213496
E-mail: afzaalkarori@yahoo.com

26. **Dr. Muhammad Ibrar Shinwari**
Research Associate-BSD/ Industrial
Pakistan Museum of Natural Sciences,
Botanical Sciences Division, Pakistan
Museum of Natural History,
Garden Avenue,
Shakarparian, Islamabad.
Ph: 051-9219937
Fax: 051-9221864
Res/Mobile: 0320-5142833
Email: mishinwari@yahoo.com

27. **Dr. Niaz Ahmad**
Principal Geologist
PINSTECH /PAEC
P.O. Nilore
Islamabad
Ph: 2207228
Fax: 9290275
Res: 2260250
Mobile: 0300-5383436
E-Mail: chandoor@isb.comsats.net.pk

28. **Shehzad Asad/Mr.**
Senior Scientific Officer
Crop Diseases Research Program, IPEP
National Agricultural Research Center
Park Road 45500
Ph: 9255177, 9255012-14
Fax: 9255034
Res: 2282357
Mobile: -
E-mail: asadtaimoor@yahoo.com

29. **Sajjad Saeed/ Mr.**
Meteorologist /Research Fellow
Pakistan Meteorological Department
/Global Change Impact Studies Center
61-A, Saudi Pak Towers, Jinnah Avenue
Blue Area, Islamabad
Ph: 9219785
Fax: 9219787
Mobile: -
E-Mail: sajjad_met@hotmail.com

30. **Adnan Safdar/ Mr.**
Scientific Officer
RIAD/PINSTECH. P.O. Nilore
Islamabad
Ph: 2207228
Fax: 9290275
Res: -
Mobile: 0300-5309340
E-Mail: adan_kayani1977@yahoo.com

31. **Dr. Azra Yasmin**
Fatima Jinnah Women University, The Mall, Rawalpindi
Environmental Programme, Fatima Jinnah Women University, The Mall, Rawalpindi
phone: 051 9270050-57 ext: 142
Fax: 0092 51 9271168
Mobile: 0303 7559089
Res: 0092 51 9271644
E-mail: r_n_malik@hotmail.com

32. **Dr. Riffat Naseem Malik**
Fatima Jinnah Women University, The Mall, Rawalpindi
Environmental Programme, Fatima Jinnah Women University,
The Mall, Rawalpindi
Phone: 051 9270050-57 ext: 153
Fax: 0092 51 9271168
Mobile: 03005289905
Res: 0092 51 9271644
E-Mail: r_n_malik@hotmail.com

33. **Mr. Mansoor Ahmad Malik**
Forest Officer NHA
Balkasar Distt.
Chakwal
Ph: 0573-569193
Fax: 0573-569487
Res: 0459-30795
Mobile: 0300-4529840

34. **Dr. Mansoor Ellahi**
Associate Professor
University of Veterinary and Animal Sciences, Lahore
Ph: 042-9122449-Ext 166
Fax: 042-9211461
Res: 042-5756563
Mobile: 0300-6624416
E-mail: masoorbabar@hotmail.com

35. **Syed Pervaiz Hussain**
Post Graduate Center for Earth Sciences, Punjab University
Post Graduate Center for Earth Sciences,
Punjab University, New Campus, Lahore.
Ph: 042-9231251
Fax: 042-9231252
Res: 042-5836531
Mobile: 0303-6403822
E-Mail: loin786@yahoo.com

36. **Dr. Shahzad Jehangir**
GCISC
Ph: 9219785
E-mail: jehangir2000@hotmail.com

37. **Imran Rafique Bajwa**
SO
Animal Sciences Int.
NARC
Islamabad
Ph: 9255072
Mobile: 03036540410
E-mail:

38. **Dr. Sadar Uddin Siddiqui**
Senior Scientidc Officer (PGRP)
Inst. Of Agri. Biotechnology
& Genetic Resources
National Agril Research Center
Islamabad 45500
Ph: 9255012 Ext 3095,3165,3171
Fax: 9255201
E-mail: ssadar@hotmail.com

39. **Dr. Aurangzeb Khan**
Env. Assessment Specialist
Envr. Section Planning commission
Room no 312 , P-NBlock
Pak Sectt. Islamabad
Ph: 92085090
Fax: 9210227
Res: 2841840
Mobile: 0320-4916061
E-mail: aurangzeb_nrm@yahoo.com

WORKSHOP PICTUERS

"Closing Ceremony"

Left to right: Will Steffen, Amir Muhammed, Linda A. Stevenson

"Workshop Participants"

Workshop Speakers & Chief Guest

Left to Right: Akram Sheikh, Will Steffen, Amin-ur-Rehman, Amir Muhammed, Mohammed Arshad Khan, Nasim Akhter

"Workshop Speakers"

Left to right: Nasim Akhter, Amin-ur-Rehman, Linda A. Stevenson, Will Steffen, Amir Muhammed, Mohammed Arshad Khan

INTERNATIONAL
THE NEWS
Wednesday, June 9, 2004

Networking and capacity building in global change research

Need for awareness in developing countries stressed

Our correspondent

ISLAMABAD: A three-day workshop on networking and capacity building in global change research organised by the Pakistan Academy of Sciences (PAS) began here on Tuesday.

Deputy Chairman Planning Commission Dr. Akram Sheikh was the chief guest at the inaugural session.

Dr. Linda Stevenson, programme manager of the Asia-Pacific Network for Global Change Research (APN), gave a presentation on the activities of APN, while Dr. Will Steffen, executive director of IGBP, discussed the implications of global changes and earth system on Pakistan.

In his address as the chief guest, Dr. Akram Sheikh said that besides improving the country's economic condition, the government is also trying to monitor the global change, trends and their impact. He said all necessary assistance would be provided to the concerned institutions and departments of the country to promote research mechanism for evaluating the global change situation.

Dr. Akram Sheikh asked the international organisations to encourage young scientists in this area and start comprehensive campaign, particularly in the developing countries to create awareness among masses regarding the issue. He said the government is also trying to create awareness about the issue through various ways, and said all the technologies being used for the betterment of human being would be utilised in this regard. He said that efforts would be made to strengthen such expertise.

Dr. Linda Stevenson in her presentation on 'APN Capable Programme and National Level Capacity Building' said that APN is working to foster global change research in the Asia Pacific region. She said the climate change could impact the water resources, agriculture, fisheries, human settlements, etc. She said that APN is striving to increase developing countries' participation in research on global change and strengthening interactions between the science community and policymakers.

Dr. Linda said the international cooperation among governments and scientists is essential to help increase the understanding and impacts of global change on ecosystems and human society, particularly in the Asia-Pacific region. She said that APN is also working to improve scientific and technical capabilities of nations of the region.

Dr. Will Steffen while speaking on 'IGBP and the Global Change Research Perspective' said the earth is currently operating in an analogue state. He said the impacts of abrupt climate change are the greatest, particularly in the least resilient developing countries.

Chairman Pakistan Global Change Research Committee Dr. Amir Muhammad said that the rapidly increasing industrial and agricultural development causing disturbance in the global climate. He said that decrease in the Himalayan glaciers and rise in the sea level are some of the well-known results of global climate change. He expressed the hope that the workshop would stimulate interest in the Pakistani scientific community and the country would be able to participate more effectively in the future research efforts of the global community with regard to the global change.

The speakers and participants at the workshop highlighted the fact that the long-term global environmental changes taking places on the earth are affecting the quality of human life. They said the global changes are mainly influenced by human activities, and asked member countries to conduct the research to ascertain causes and impacts of global change. They said that global environmental change research is essential to understand the cause, extent and impact of worldwide environmental changes including deforestation and urbanisation.

The workshop would continue at the same venue till June 10.

Pakistan
OBSERVER
9 June, 2004

Global environmental changes affect quality of human life

ISLAMABAD—Long-term global environmental changes taking places on the earth, do affect the quality of human life.

These views were expressed by the speakers at the inaugural session of three-day National Workshop on 'Capacity Building in Global Change Research' here Tuesday.

They said global changes are mainly influenced by human activities and asked member countries to conduct the research to ascertain causes and impacts of global change.

Participants said global environmental change research is essential to understand the cause, extent and impact of worldwide environmental changes including deforestation and urbanisation.

"Besides improving country's economic condition, the government was trying to monitor the global change trends and their impact", said Deputy Chairman, Planning Commission, Engg Dr Akram Sheikh, while speaking as chief guest.

He said all necessary assistance will be provided to the concerned institutions and departments of the country to promote research mechanism for evaluating the global change situation.

He asked international organisations to encourage young scientists in this area and start comprehensive campaign particularly in the developing countries to create awareness among masses regarding issue.

He said government is also trying to create awareness about the issue through various ways and said all those technologies will be utilised in this regard, being used for the betterment of human being.

He said efforts will be made to strengthen such expertise.

Program Manager, Asia Pacific Network (APN), Dr. Linda Stevenson in her presentation on 'APN capable program and National level capacity Building' said APN is working to foster global change research in the Asia Pacific Region.

She said climate change can impact water resources, agriculture, fisheries, human settlements etc.

She said APN is striving to increase developing countries' participation in research on global change and strengthening interactions between the science community and policy makers.

Dr. Linda said international cooperation among governments and scientists is essential to help increase the understanding and impacts of global change on ecosystems and human society particularly in the Asia-Pacific region.

She said APN is also working to improve scientific and technical capabilities of nations of the region.—APP

BUSINESS RECORDER WEDNESDAY 9 JUNE 2004

'Research vital to detect causes of global warming'

MEHMUD AHMED

ISLAMABAD: Scientists engaged in research on the changes being brought by human activities and spreading pollution, warming of geosphere and biosphere as well as the recession of Himalayan glaciers and break-up of the polar ice cap have been urged to expedite their efforts to establish measures to reverse the cycle.

In his keynote address to a workshop of researchers from Pakistan, Dr Will Steffen, who heads the International Geosphere and Biosphere Programme, also asked them to focus their work on preservation and development of freshwater systems, check desertification and deforestation that are causing frequent natural disasters.

Dr Akram Sheikh, Deputy Chairman of the National Planning Commission, opened the three-day workshop at the Pakistan Science Academy on Tuesday. It will close on Thursday with an address by Dr Ashfaq Ahmed, Special Adviser to the Prime Minister on Science and Technology.

The Asia Pacific Network (APN) for Global Change Research, an inter-governmental forum responsible for global change research and strengthening of interaction between the scientists and policy makers, is the main organiser of the workshop.

The perceptions of Dr Steffen and also by

Dr Linda Stevenson, Programme Manager of Japan-based APN research organisation, were supported by Dr Amir Muhammad, who co-chairs the APN and also presides over Asianics Agro Dev International Global Chance impact studies centre in Pakistan.

Basing his studies on the research of Dr James Lovelock, he echoed the warnings that unless the humans stopped now, they will really doom the lives of 'our descendents' by the middle of this century hurling them back into the Stone Age.

Dr Amir Muhammad regretted that the contribution of Pakistani scientists in the field of research did not compete effectively with the work done in China and India. He attributed this shortcoming to lack of financial resources and grants.

In his off-the-cuff remarks, Dr Akram Sheikh conceded that he was not aware of most of the things the scientists had predicted about and assured the assembly as part of the national planners he would do his best to get more allocations for the research work.

He also called for widespread education of masses of the dangers of reckless living and its consequences that the future generations will face.

Scientists attending the second session here on Wednesday will listen to a comprehensive report on the climate change perspective in Pakistan from Anjum Bari, Director of Pakistan Meteorological services and officials of the environmental ministry.