GC 11.SACEP/NFP
Agenda Item 5.15

Collaboration with National Botanical Research Institute (NBRI), Lucknow to Develop Programme on Climate change and it's Impact on the Flora of the South Asia

The 9th Governing Council of SACEP held in August 2005 at Thimphu, Bhutan identified the adaptations to Climate Change as one of the key areas concerned in the region and SACEP Secretariat was asked to incorporate it into its Work Programme. Subsequently, the 10th Governing Council of SACEP held in January, 2007 in Kathmandu, Nepal also recommended carrying forward the Work Programme recommended by the 9th GC.

In order to carry forward the above decision SACEP entered into a collaboration with NBRI, Lucknow, a premier CSIR Research Institute of India and a Centre of Excellence for the South Asian Region to develop a programme on adaptation issues related to Climate Change. As a first step a 'Regional Workshop on Climate Change and its impact on Flora of the South Asia Region', was conducted collaboratively with NBRI of India from 9 to 12 March 2008 at Lucknow, India. The Workshop was funded by the Ministry of Environment and Forests, the Ministry of Science and Technology, The Ministry of Earth Sciences of India and SACEP. There were 53 participants, mainly senior level government officials from 8 member countries of SACEP who participated at the workshop.

A proposal on adaptation to Climate Change developed by SACEP and NBRI, was discussed and finalized during the workshop (Annex I).

The participants of the workshop also prepared an adopted a Draft Declaration (Lucknow Declaration) on Climate Change and its Impact on Flora in the South Asian region (Annex II) to be endorsed at the 11th Meeting of the Governing Council of SACEP.

It is requested that the 11th Meeting of the Governing Council of SACEP endorses the Proposal and Adopts the Draft Declaration.

Impact of Climate Change on Flora: A South Asian Initiative

(Proposal for a coordinated action programme developed at the NBRI-SACEP International Workshop on "Climate Change and its Impact on Flora in the South Asia Region", NBRI, Lucknow, India, March, 09-12, 2008)

Impact of Climate Change on Flora:

A South Asian Initiative

Preamble:

The reports of Inter-governmental Panel on Climate Change (IPCC 2007) have highlighted the gravity of consequences that the life on earth, including mankind, is to face in coming times. IPCC report predicts that global warming is likely to increase mean temperature up to 5.8°C over the next 100 years, and that it could lead to melting of glaciers, polar ice caps and rise in sea levels. This may also affect species reproductive cycles, growing seasons, and species interaction to impact agricultural productivity, besides changing the natural course of many species, and drive many taxa to the verge of extinction. It is projected that 20-30% of the plants and animal species assessed by IPCC are at increased risk of extinction, if global average temperature exceeds 1.5 to 2.5°C. Impact of climate change on plants are manifested mostly by the upward migration / range shifts of species along temperature-altitudinal-latitudinal gradients, reduction in population size, structure and dynamics of species vulnerable to climate change, changes in phenology and reproductive cycle, range expansion of invasive species, etc. Thus, global climate change poses a serious threat to living organisms and support systems.

Climate change will give rise to environmental pollution and abnormal weather which may lead to decrease in overall growth and productivity of plants. There have been studies to understand plants behaviors to such environmental changes. Predicting the responses of ecosystems to climate change requires scaling up from key mechanisms, such as photosynthesis or growth that are best understood at the organism level. These mechanisms are fundamentally linked to genes, gene networks, and their interplay with the environment.

Despite the remedial measures taken such as cutting the emissions of greenhouse gases by the industrialized Nations, some recent emerging evidence suggests that the heat-trapping gases like carbon dioxide, produced mainly from the burning of fossil fuels, continue to raise temperatures, change the global climate, and affect ecosystems around the World.

South Asia (SA), the most populated continent, is the home for about 50% of the world's terrestrial plants and animal species, is also one of the rapidly growing economies of the world.

Climate change issues in SA region assume different dimensions in accordance with the changing patterns of ecology, environment, biodiversity, socio-economic settings and anthropogenic interventions. The flora and associated ecosystems/biomes in SA countries are likely to experience different impacts through retreat of glaciers in the Himalayan high ranges (e.g. India , Pakistan, Bhutan and Nepal) or sea level rise and associated floods and salinity intrusion in low lying region and islands (e.g., Bangladesh, peninsular India, Maldives, Sri Lanka). Furthermore, biodiversity in the SA region has already been experiencing unprecedented threats from increased human activities. This is evident from the fact that three out of thirty four global biodiversity hot spots are located in the SA region in the Indian subcontinent: i) Himalayas, ii) Indo-Burma, iii) Western Ghats and Sri Lanka.

Threats to the loss of floral and faunal species, especially endemics, and their habitats in these biodiversity hot spots are looming large and expected to increase at an unprecedented rate as the global temperature continues to rise. Urgent strategic initiatives are therefore required to respond to the challenges of climate change and its most disruptive impacts on floral diversity in SA region. Such initiative should include actions that are necessary to develop adaptive conservation management of plant diversity and associated resource systems through vulnerability assessment, integrated with adaptation and mitigation strategies against climate change.

Development of a realistic and regional specific data base and network on climate change-floral diversity in SA region, and creation of appropriate infrastructure and building enhanced institutional, technological and human resources for addressing climate change issues within and among each SA country are also important elements to be included in the action plan. Education, training and awareness building on climate – plant diversity changes and their impacts to flora and associated resources systems, including forestry, agriculture, health, etc. also assume great importance in the SA region-specific agenda on climate change. The priority ecosystems/biomes demanding immediate attention are the coastal lands, mountainous regions, and wetlands. These are the regions where species, particularly endemic species often have no alternative habitats to migrate to, and thus, the species of these ecosystems are under immediate threat due to climate change. The strategy, therefore, calls for appropriate action to address the issues across the diversity of resilient / sensitive ecosystems, encompassing plant species and populations vulnerable to climate change.

For addressing the modern technological and social issues concerning climate change, it is important that people are familiar with the subject. Scientific knowledge base generated by academicians and scientists should be disseminated for public awareness on the emerging issues. The programme will focus on imparting training, education and awareness to researchers, administrators, policy -decision makers, industry and other stakeholders on global warming and climate change.

With the availability of data sets for the analysis on climate change through the summary for policy makers of IPCC, climate change studies in SA countries have caught attention of researchers and voluntary organizations. Diverse issues such as greenhouse gas emissions, sea level changes along the coast, its relationship with forests and hydrology of river basins, and sustainable development are being addressed in the SA context.

Studies, targeting natural vegetation in diverse ecosystems/biomes within the SA countries over a considerable period of time are lacking and need urgent attention in terms of compiling relevant data sets from existing information sources as also establishing long-term monitoring mechanism for generating data sets for policy formulations in the region.

Therefore, it is proposed to develop a common programme entitled "**Impact of climate change on Flora: A South Asian Initiative**" for all the eight SA countries, with the following objectives and activities.

Objectives:

1. **Enhancing Capacity Building**
2. **Floral Vulnerability Assessment**
3. **Adaptation and Mitigation Strategies**

Objective 1: Enhancing Capacity Building

Activities:

1. To organize workshops and training program (short and long term) for researchers, administrators, policy / decision makers, industry and other stake holders.
2. To sponsor candidates from SA countries for post graduate diploma / degree courses on climate change in alliance with universities.
3. To organize public awareness programmes through various media.
4. To develop and exchange educational and public awareness materials on climate change.
5. To develop a South Asia Institute for implementation of education and training programmes.

Objective 2: Floral Vulnerability Assessment

Activities:

1. To develop baseline data on climate parameters and floral diversity from existing sources.
2. To assess the present status and distribution pattern of floral diversity at specific study sites.
3. To study the impact of climate change on phenology/reproductive traits.
4. To study vulnerability and adaptive responses of plants to climate change.
5. To prioritize threat -prone and indicator taxa and critical habitats for *in situ* conservation.

Criteria for site selection:

- Unique biomes of different SA countries
- Availability of past floristic and climatic data
- No or minimum anthropogenic disturbance
- Topographic/Altitudinal gradients

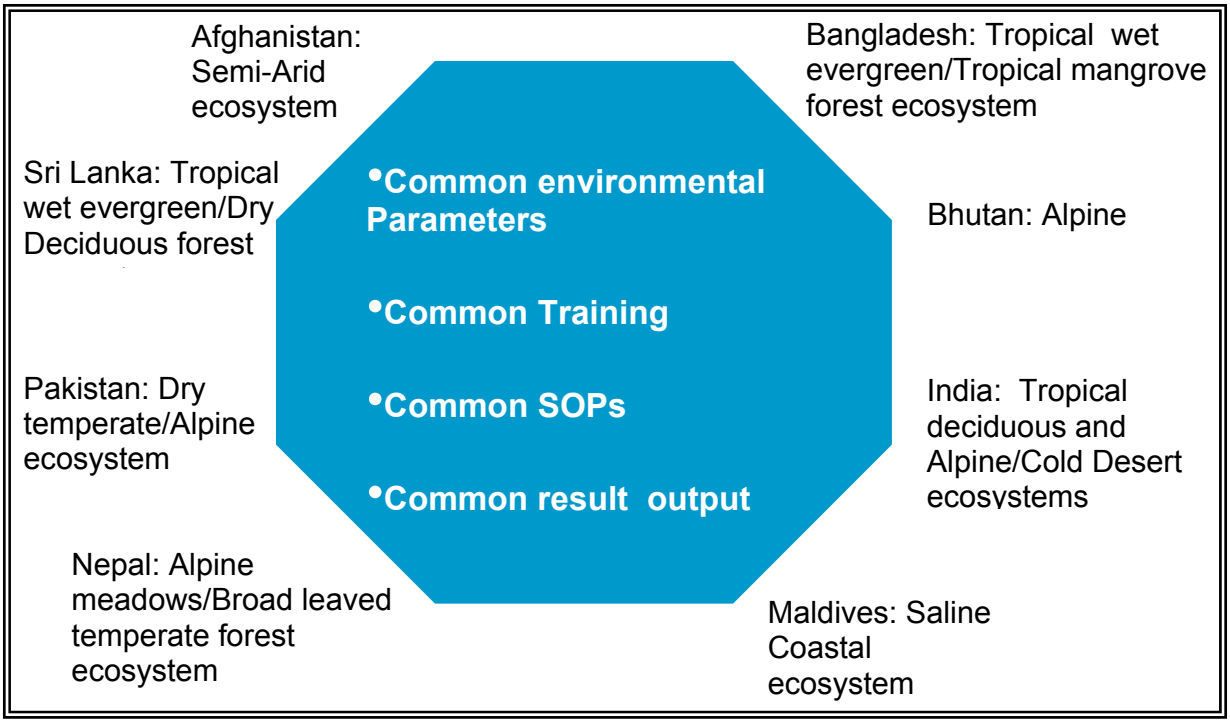

Fig. 1. Proposed Ecosystems/Biomes for identification of specific study sites

Objective 3. Adaptation and Mitigation Strategies

(A) Adaptation

Identification of economically important crop germplasm (rice) for adaptability to climatic change

Activities:

1. Screening of germplasm
2. Analysis of stress related enzymes/genes
3. Studying responses of targeted species under field conditions using appropriate technologies simulating climate change

(B) Mitigation

Identification of tree species having high carbon sequestration potential

Activities:

1. To study the carbon sequestration potentials of tree species in targeted ecosystems/biomes under different climatic conditions in SA countries
2. To estimate the net biome production / net ecosystem exchange (NEE) patterns in different ecosystems/biomes in SA countries with Eddy Covariance Flux Tower (carbon flux tower observations)
3. To develop strategies for CO_2 mitigation through afforestation / reforestation with selected species

Note: Study sites will be selected in Ecosystem/biome as proposed in Fig.1.

Approaches

1. Identification of unique ecosystem/biome for each of the SACEP countries. Ecosystem will be identified depending upon the importance of the ecosystem services and/or vulnerability of the ecosystem towards climate change
2. Development of long -term study plots.
3. Development of capacity among different SACEP countries by
    a. Constituting key faculty team for imparting training,
    b. Imparting common training to all the involved partners,
    c. Developing common SOPs,
    d. Generating all the results to common output platform for simulation modelling.
4. Development of infrastructure for SACEP partners
5. Implementation of the proposal
6. Prioritization of the activities
7. Activity phasing
8. Imparting awareness and education among masses and educating policy makers.
9. Setting up a Forum for Climate Change Challenge to Flora in South Asia

    FC3F-SA web portal for member countries for data base development, project implementation and information exchange.

Strategy

For implementing such an interknit programme, it is proposed to develop an appropriate implementation structure as shown in Fig. 2.

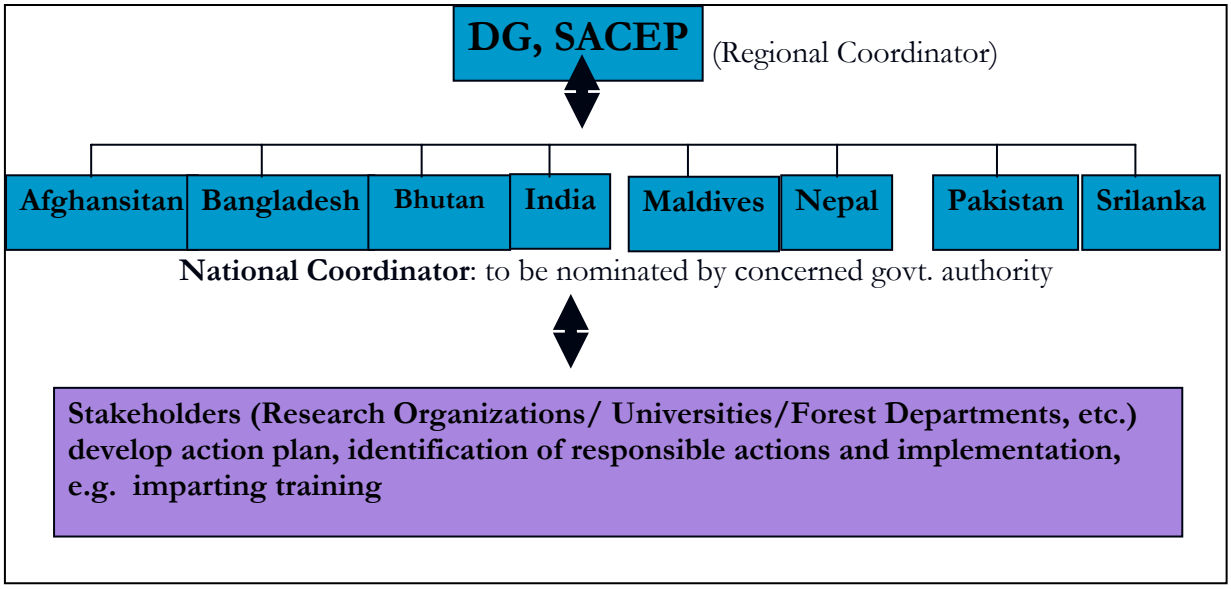

Fig.2. Proposed implementation structure for the proposed programme

In order to develop a common system for collection of relevant environmental parameter relevant to climate change, it is proposed to install Eddy Covariance Flux Stations to monitor climate variables viz. fluxes of PAR, heat, water, CO2, evapotranspiration and other trace gases. One Eddy Covariance Flux Tower is proposed to be established in each representative ecosystem in each SA country.

Partners will be trained by competent regional and international experts to collect common ecological and physiological parameters, which include:

- ✓ community structure,
- ✓ population abundance,
- ✓ plant phenology,
- ✓ mortality and natality,
- ✓ species recruitment and replacement,
- ✓ invasion pattern,
- ✓ root/shoot partitioning,
- ✓ carbon/nitrogen analysis in both plant and soil,
- ✓ estimation of carbon sequestration (SLA, LAI, gas exchange)
- ✓ water relation parameters.

The following presents a larger scope to be adopted by the partners:

- Collection of previous data from protected areas (National parks/BR/sanctuary) on species composition, population dynamics and the environmental variables to develop time series models.
- Past satellite vegetation maps, if available, can be used in simulation modeling.
- Past meteorological data sets need to be collected.
- Climate simulation studies using appropriate technologies, like FACE and FATI

The Lucknow Declaration 2008

This consensus document was prepared under the auspices of the National Botanical Research Institute, Lucknow and South Asia Co-operative Environment Programme (SACEP) International Workshop on Climate Change and it's Impact on Flora in the South Asian Region held in the background of increasing global concerns related to climate change at National Botanical Research Institute, Lucknow from March 9 to 12, 2008

Aware that the countries in the South Asia region are very rich in terrestrial and marine Flora which are storehouse of global Carbon as well as source the rapidly growing regional demand of food.

Acknowledging that climate change poses a major threat to the conservation and long term survival of biodiversity in South Asia. Recalling that all the countries in the region are presently engaged in research and studies on the impact of climate change on flora particularly food and forestry crops in the region.

Recognizing that cultivation and the legal harvesting and trade in wild species is an important and sustainable source of livelihood and income to many rural communities and that adequate protection, sustainable harvest and wise use of wild plants can play vital role in conservation of species and their habitats as well as in lifting people out of poverty and securing their future and that it is clear now as per the recent IPCC report that Climate Change is having an adverse effect on the productivity of plants.

Recognizing that all the countries in the region have committed themselves to the UNFCC Convention and are actively associated in various actoivities related to both mitigation and adaptation to climate change.

Recalling the decision taken in the Tenth Governing Council meeting of SACEP on 25th January 2007 make to Climate Change a priority issue in the work programme (2007-2008). Stressing the importance of mutual networking and technical support as well as financial and technical support from the international community for building expertise, resources, and capacity to address the needs of studying the impact of Climate Change in the SA Region.
Realising the need for collaborative research on the effect of global climate change on South Asian flora and the need for urgent action for enhancing regional preparedness for sustainability.

Acknowledging that the Lucknow meet recommended and to take immediate steps to create a South Asian forum for enhancing the preparedness to face the challenges posed by the global climate change to regional flora and ecosystems.

Believing that regional cooperation can provide the best solution for regional problems, we the delegates at the NBRI – SACEP International Workshop on Climate Change and its Impact on Flora in the South Asian Region, hereby support the Lucknow Statement on the effect of global climate change on South Asian flora and regional action plan, and urge for;

i. Establish of a South Asia Forum for Climate Change Challenges to Flora in South Asia (FC3F-SA)to support and guide the development of regional and local strategic plans by working closely with global, regional and local governmental and non-governmental partners. This Strategic Plan will be developed for promoting education, research and extension, for knowledge-based assessment, monitoring, preparedness and mitigation of climate change effects on flora in South Asian countries.
ii. Setting up a FC3F-SA web portal of member countries for communication, creation of database on regional floral diversity, ecosystems, climate change indicators and projects in progress.
iii. Generate multidisciplinary climate change information to supplement existing educational materials, textbooks and publications in member countries.
iv. Coordinate with Donor agencies to generate Fund for regional projects to evolve standard operative procedures to collect data, monitor, quantify and analyse climate change impact on agriculture, forestry and wild flora.
v. Enhance focus on strategies for responding to climate change vulnerability of flora through adaptation and mitigation research on trees, higher and lower plants.
vi. Evolve strategies to minimize climate change impacts on agriculture and minimize agricultural impacts on climate change. Promote the development of stress tolerant varieties and management practices to cope with climate stress on agriculture and forestry systems.
vii. Integrate biofuel policy in a comprehensive energy, agriculture, climate, population, social and ecosystem sustainability model.

Research on models for scale up of carbon balance from experiments to ecosystems, life cycle green house gas analysis of biofuel and crop production systems, climate stress response of plant growth and development, ecosystem dynamics and climate impact modeling in hot spots to prioritize adaptation opportunities to meet the challenges of climate change.