FOREST AND CLIMATE CHANGE

By

Abdul Aleem Chaudhry[1]

Pakistan is blessed with great physiographic, climatic and edaphic contrasts. Topographically, Pakistan has a continuous massive mountainous tract in the north, the west and south-west and a large fertile plain, the Indus plain covering the Punjab and Sindh provinces, and the vast Cholistan, Thar, Thal and Makran deserts.

The northern mountain system, comprising the Karakoram, the great Himalayas, and the Hindu-Kush, has enormous mass of snow and glaciers and 100 peaks of over 5,400 m in elevation. K-2 (8,563 m) is the second highest peak in the world. The mountain system occupies one third of this part of the country. The western mountain ranges, not as high as in the north, comprise the Sufed Koh and the Suleman. The south-western ranges form a high, dry and cold Balochistan plateau. Characteristically, the mountain slopes are steep, even precipitous, making fragile watershed areas and associated forest vegetation extremely important from hydrological point of view. The valleys are narrow. The mountains continuously undergo natural process of erosion. The climatic variations with high intensity rainfall in summer, cold winters and of fragile soils in the northern regions render these mountains prone to landslides.

The country is drained by five rivers ; namely, Indus, Jhelum, Chenab, Ravi and Sutlej which have given rise to the alluvial plains commonly known as the Indus plains. Indus arising in snow covered northern mountain ranges flows towards south through the Punjab and Sindh plains into a wide delta before entering Arabian Sea. Other rivers join it on the way, together feeding one of the largest irrigation systems in the world. The great river system of Indus in Pakistan derives a part of their water supply from sources which lie in the highlands beyond the Himalayas and the western mountains, and part from countless valleys which lie hidden within the mountain folds. Much of the silt of the alluvial plain is from natural geological erosion of mountains in the north brought down by rivers.

Thal desert lies between the rivers Indus and Jhelum, while Cholistan and Thar deserts occur on the south eastern edge of the alluvial plains. These have been formed by the silt deposited by the pre-historic Ghagra river. Makran desert is the part of the great Balochistan plateau.

Forests play a significant role in land conservation, regulation of flow of water, reduction of sedimentation in water channels and reservoirs, supplementing the fuel needs, fulfilling the timber requirements and maintenance of the ecological balance. The following drawing (courtesy : Punjab Forest Department) depicts the various uses of trees both tangible and intangible, and so the forests :

1. Ph. D.

Forests of Pakistan

Forests cover about 30 per cent of global land area while Pakistan having total area of 87,980km^2, contains *4.8 per cent (4.2 million hectares* of total land area under natural and planted forests (PFI 2005). FAO (2011) estimates *however show only 2% of land area under forests (*796,095 km^2, *Land area of AJ&K and Gilgit-Baltistan not included, (*FAO (2011) however quotes 770,880 km^2 area that does not tally with the computations/area statement given in Table 1*) the estimates based on survey sheets 1:250,000, and the forest area based on 10% or more tree cover)*.Pakistan is a forest-deficit country ; 0.001 forest cover per capita (FAO 2011) against the world average of ONE ha per capita. Main reason for the low forest cover is that more than 70% land area of Pakistan is Arid and semi-Arid with annual rainfall of 250-500 mm : too low and erratic to sustain natural vegetation and to plan afforestation / regeneration programmes. The gap between supply and demand for forest goods and services is increasing with the rising population. Pakistan is the eighth most populous country in the world having a population of more than 170 million, which is expected to rise to 210 million by 2025 with an annual growth rate of 2.2%.

Only about 80% of the area defined as forest in Pakistan actually has tree cover, while the rest is largely denuded. Percent (%) land area under forest cover in different parts of the country also varies a great deal : KPK : 16.6%, Punjab : 2.9%, Sindh : 2.8%, Balochistan : 1.7%, Gilgit-Baltistan : 9.5%, and Azad Jammu and Kashmir : 20.7% (Forestry Statistics of Pakistan. Pakistan Forest Institute Peshawar 1996). FAO (2011)

report annual deforestation at the rate of 41,000 ha (-1.8%) 1990-2000, and 43,000 ha (-2.2%) during 2000-2010.

Land use data including forest area have been reported by Forestry Sector Master Plan (FSMP) Project in 1992, with the help of Landsat Satellite Thematic Mapper Images at a scale of 1 :250,000 covering the whole of Pakistan. Total Forest Area under the control of the Forest Departments (including Azad Kashmir and the Gilgit-Baltistan) is 4.26 million hectares. The distribution of forests and rangelands in Pakistan is given in Table 1 below :

Table 1.Forest and Rangelands areas (thousand hectares) *based on satellite imagery 1990*

Forest Type	Khyber Pakhtunkhwa	Punjab	Sindh	Balochistan	Gilgit Baltistan	Azad Kashmir	Total area	%
Geographic area	*10,174*	*206,26*	*14,091*	*34,719*	*7,040*	*1,330*	*87,980*	
Coniferous	940	30	-	42	660	241	1,913	2.17
Irrigated Plantations	-	79	23	1	-	-	103	0.11
Riverain Forests	13	27	112	20	-	1	173	0.19
Scrub Forests	539	132	-	504	-	16	1,191	1.35
Mangrove Forests	-	-	205	2	-	-	207	0.23
Linear Plantations	2	14	-	-	-	-	16	0.01
Farmland trees	70	306	54	23	6	7	466	0.52
Miscellaneous	120	20	5	-	-	10	155	0.17
TOTAL FOREST	1,684	608	399	592	666	275	4,224	4.75
Percent tree cover	16.6	2.9	2.8	1.7	9.5	20.7	4.75	
*Rangelands**	*150*	*2,694*	*393*	*795*	*2,104*	*151*	*6,287*	*7.15*
Under the control of Forest Departments	1,555	3,260	1,048	1,086	3,049	567	10,565	12.0

Source : *Forest Sector Master Plan (FSMP – 1992)* ** Forestry Statistics of Pakistan. PFI 2004.*

Pakistan Forest Institute Peshawar conducted a “National Forest and Range Resources Study” in 2004 (PFI - 2004) that highlighted the negative change in forest cover as follows (Table 2) :

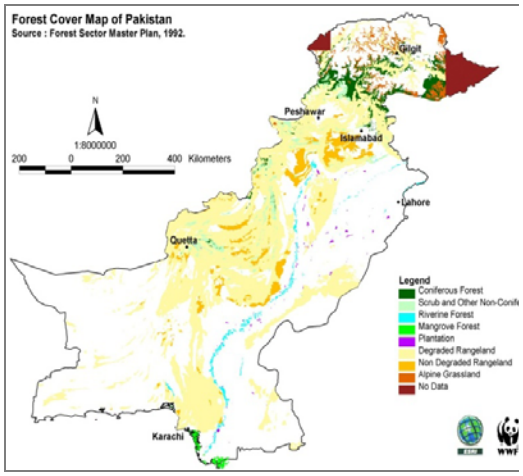
Table 2.Forest and Rangelands areas (thousand hectares) *based on satellite imagery 2001 compared with satellite imagery 1990*

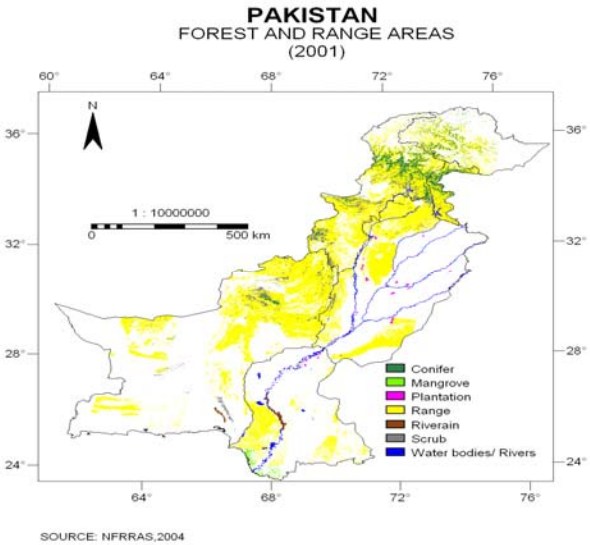
Province/ Administrative Unit	**Land area (m ha)**	**Forest Area (2001)**		**Forest Area (1990)**	
		Area (m ha)	**% of total**	**Area (m ha)**	**% of total**
Khyber Pukhtunkhwa	10.17	1.49	14.65	1.68	16.6
Punjab	20.63	0.44	2.13	0.61	2.9
Sindh	14.09	0.28	1.99	0.40	2.8
Balochistan	34.72	0.45	1.30	0.59	1.7
Gilgit Baltistan	7.04	0.32	4.55	0.67	9.5
Azad Jammu Kashmir	1.33	0.34	25.56	0.28	20.7

Total	**87.98**	**3.32**	**3.77**	**4.22**	**4.8**

Source : *National Forest & Range Resources Study (PFI- 2004)*

The distribution of forests and rangelands is compared in the following Maps 1 and 2.





Map 1 : Source : *Forest Sector Master Plan (FSMP – 1992), Visual interpretation of Landsat Images (1988-90)*

Map 2 : Source : *National Forest & Range Resources Study (PFI- 2004), based on Landsat Images 2001*

The distribution of forests in Pakistan by ***Tenure*** (in thousand hectares) is given below :

Table 3. Tenure system in Forest and Rangelands areas (thousand hectares)

Forest Type	Khyber Pakhtunkhwa	Punjab	Sindh	Balochistan	Gilgit Baltistan	Azad Kashmir	Total area
State	-	-	-	707	-	567	1,274
Reserved	98	337	292	-	-	-	727
Protected	629	2747	720	378	67	-	4,547
Unclassed	7	115	25	-	-	-	147
Resumed	33	9	5	-	-	-	47
Guzara	550	-	-	-	-	-	550
Communal	-	-	-	-	2,982	-	2,982
Section 38	26	9	-	1	-	-	36
Chos Act	-	1	-	-	-	-	1
Private Plantations	159	-	-	-	-	-	159
Miscellaneous	53	42	-	-	-	-	59
Total	**1,555**	**3,260**	**1,048**	**1,086**	**3,049**	**567**	**10,565**

** Forestry Statistics of Pakistan. Pakistan Forest Institute Peshawar. 1996*

The forest types found in Pakistan include :*Littoral and Swamp forests, Tropical dry deciduous forests, Tropical thorn forests, Sub-tropical broad-leaved evergreen forests, Sub-tropical pine forests, Himalayan moist temperate forests, Himalayan dry temperate forests, Sub-alpine forests, and Alpine scrub*. Besides the natural forests irrigated forest plantations, and farmlands plantations have also been raised. Avenue plantations include canal side, roadside, railway track side and shelterbelt plantations. The percent cover of these forest types in 1999-2000 was : moist and dry temperate coniferous 41%, scrub including tropical thorn 35.5%, manmade irrigated forest plantations 5%, riverain 7%, mangrove 10.5%, mazri land 0.5% and linear plantations 0.5% (*Forestry Statistics of Pakistan 2004*).

As is obvious from the land use (forest area) figures quoted above, the three sources viz., Forestry Sector Master Plan (1992), Pakistan Forest Institute Peshawar (2004) and FAO (2011) provide contrasting figures. No common ground is available to tally the data, and the need to have a strong data base is felt.

State of Forestry in Pakistan

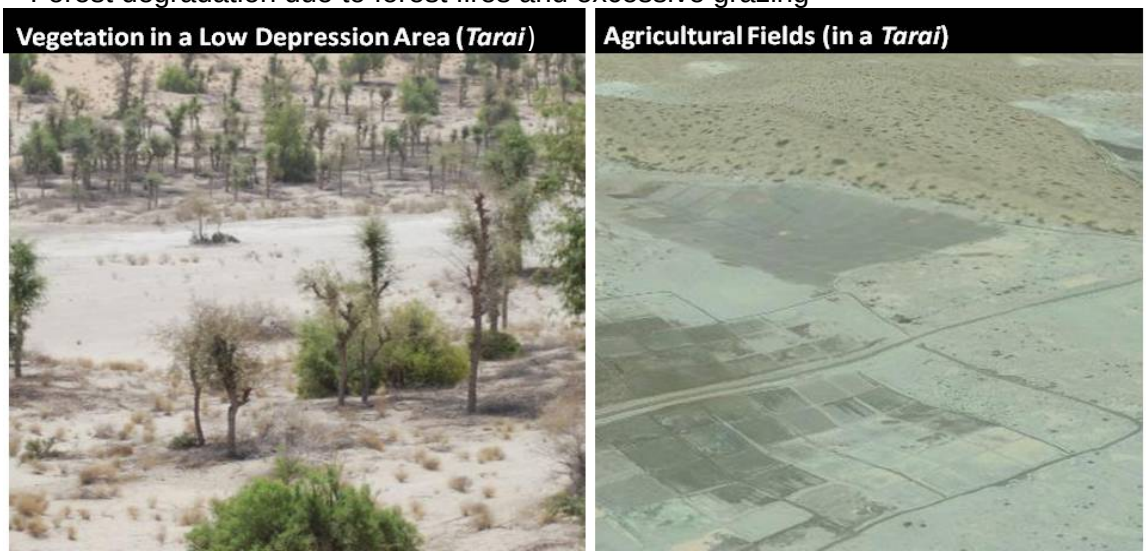
As recognition of the multiple values of forests has grown, so have concerns for their disappearance. In Pakistan, subtropical, temperate, riverine and mangrove forests are being lost because of questionable land use practices and the ever-increasing demand for timber and firewood that is met with through uncontrolled and unsustainable cutting inflicted by both legal and illegal means. Reasons for unsustainable commercial harvesting in state forests in general include : lack of political will and commitment, poor planning, unrealistic forest working plans, and weak implementation of forest protection laws. The primary causes of over-harvesting by domestic cutting in private and community forests are widespread poverty, population pressure, lack of fuel wood alternatives, and a lack of awareness about sustainable resource use methods.

Tree cutting : *Photo credit : WWF Pakistan*

Fuel wood harvesting/collection. Photo credit : Punjab Forest Department

Deforestation, in Pakistan, is one of the most discussed subjects in the forestry sector. Various studies on the subject indicate various drivers of deforestation in the country (WWF 2009) ; major drivers of deforestation include :

- Agricultural expansion and subsistence farming
- Fuel wood collection for subsistence use by ever-growing population
- Commercial exploitation
- Forest degradation due to forest fires and excessive grazing



Removal of tree/vegetation cover and agricultural expansion : *Photo credit : WWF Pakistan*

The following could be the indirect drivers leading to deforestation :

- Market forces (e.g. prices of timber and timber products and the agricultural commodities)

- Population, town and village planning, etc.

- Forest Management practices

- Legislation (e.g. subsidies for agriculture, forest laws)

- Land tenure (no long-term interest, no sustainable management)

- Law enforcement / institutions / corruption

- Accessibility (e.g. road construction in previously inaccessible areas)

An important task in forest governance would, therefore, be “addressing the drivers of deforestation”. As a result, more responsible management approaches are being demanded that can accommodate complex economic and ecological needs. Designation

of selected forestlands as national parks, area for agro-forestry practices and the development of plantations and afforestation practices are needs of the hour.

The Forestry Sector Master Plan (1992) estimated that the country had been suffering an annual loss of 2.3 billion rupees as a result of flooding, erosion of fertile soil from upland watersheds and siltation of reservoirs and irrigation system (*and the estimates were made about 20 years back*). Yet, despite realising the pressing need to protect the existing forests and bring about significant increase in their size and despite considerable effort, it has not been possible to increase the forest cover over the last 35 years. Rather it has not been possible to maintain the status quo and check the downward slide as reported by FAO (2011).

Climate Change

Climate change is a global issue and its impacts are cross cutting in all sectors and walks of life. Carbon dioxide (CO_2) concentration in the atmosphere is on the rise since the Industrial Revolution (1789). CO_2 levels in the atmosphere before the Industrial Revolution was 280. The level increased to 390 ppm by 2009 and is expected to rise to 550 in 2050. As a consequence global average surface temperature rise in 20th century was 0.6 ^{o}C ; that is expected to rise by 2100 by another 1.4 °C to 5.8 °C.

Pakistan only contributes 0.04% to the total carbon emissions in the world (ADPC 2009). Yet Pakistan is one of the most vulnerable countries which will be severely impacted by climate change (ADPC 2009). As with other countries, Pakistan is dependent on livelihood areas that are climate-sensitive. Of these livelihood sectors ; agriculture, forestry, water resources among others, are the most sensitive to climate change (Inter-cooperation 2010).

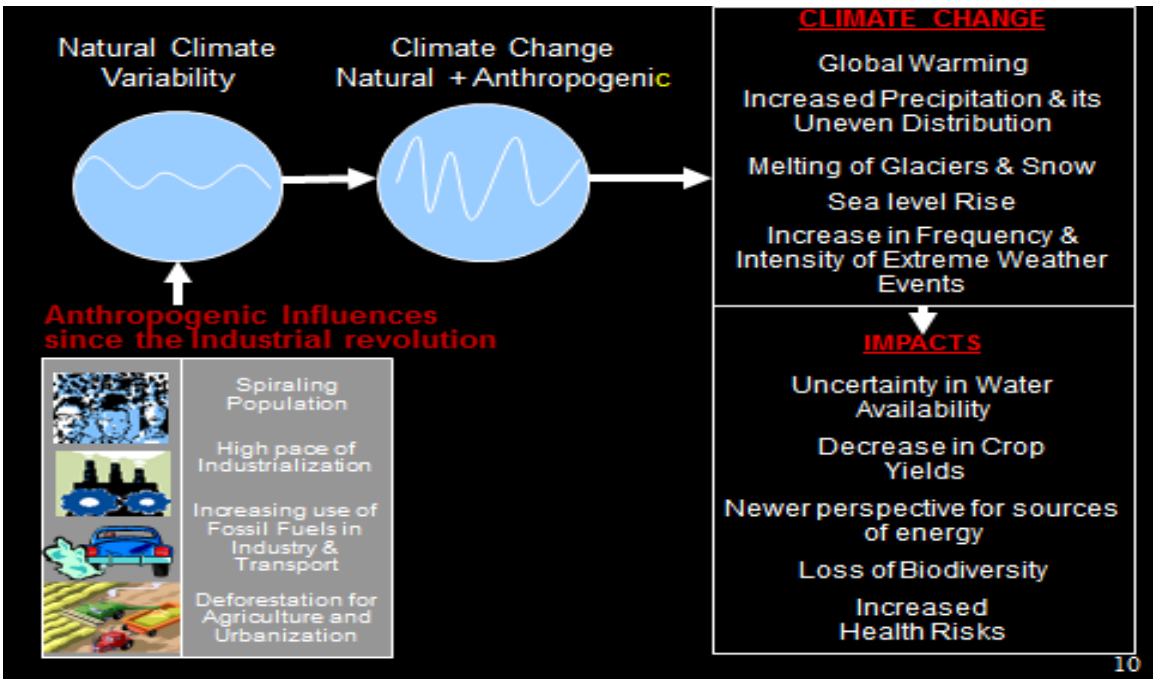
Climate sensitivity means an increase or decrease in temperature and precipitation in climatic trends, or more frequent incidences of climatic extremes will significantly impact such sectors. These changes and associated impacts all over the globe impose a need for measures that will make individuals and societies resilient in the face of a changing world.

The year 2010 was a year with unprecedented summer rains in all the regions in **Pakistan**. Even the regions which are not known for monsoons, received heavy and prolonged showers. On the other hand winter rains were delayed and temperatures were lower than previous years. Such particular events are part of the inter-annual variability and do not necessarily have to be a result of climate change. However, it is hard to isolate what climate change is from climate variability since these events are resulting from an unexpected increment in variability. What climate change might come up with is a higher frequency and magnitude of such events.

The IPCC (International Panel on Climate Change 2007) in its Fourth Assessment Report concluded that forest-related mitigation activities could considerably reduce emissions from sources and increase CO_2 removals by sinks at a low cost, and could be designed to create synergies with adaptation and sustainable development. Forest

mitigation options have to be considered as an immediate option to be applied over the next 20 to 30 years. The longer-term mitigation potential of such options remains, however, unclear (Inter-cooperation2010).

Climate change is attributed to greenhouse gases (GHGs). Greenhouse gases like Carbon dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O), Chloro-Fluoro-Carbons (CFCs) among others, naturally exist in the atmosphere to form a "blanket" that maintains the earth's temperature.



Impacts of Climate Change

Without the naturally existing GHGs, the earth's temperature would be very cold and life would not be possible. However, anthropogenic activities, mainly as a consequence of the industrialization and the increments in consumption patterns, have increased the concentration of GHGs in the atmosphere thereby thickening the "blanket" which prevents excess heat from escaping the earth thereby causing changes in the climatic system (e.g. changes in global average of temperature or changes in rain patterns).

Major impacts of climate change are increments in average temperature and changes in rain patterns viz., increase in monsoon rainfall in sub-humid and humid areas and decrease in winter and summer rainfall in coastal belt and hyper arid plains ; increase in the mean global sea level (1-2 mm per year over the last century) ; worldwide retreat of glaciers ; whereas the observed impacts of global warming so far include : decrease in snow cover and thawing of permafrost ; shifts of plant and animal ranges ; earlier flowering of plants ; change in birds breeding seasons and emergence of insects ; and increased events of coral bleaching.

Glacier melt in the Himalayas is projected to increase flooding that will affect water resources within the next two to three decades and result into decreased river flows over time as glaciers recede. Decreased freshwater availability is also projected to lead to biodiversity loss ; coastal areas bordering the Arabian Sea in the south of Pakistan shall be at the greatest risk due to increased flooding from the sea and in some cases, from the rivers. Corollary, frozen ground anomalies have been recorded as increasing and glacial resources have also drastically declined from 1960 to 2000. The scientific proof is now established in the form of melting of ice cap in Greenland (Inter cooperation 2010).

Pakistan is predominantly an agriculture economy. Climate change is projected to decrease crop yields that would in turn affect livelihoods and food production mainly because of the combined impact of decreased yields with the current rapid population growth and urbanization. The risk of hunger and food security shall, therefore, be high. The climate change shall also increase the endemic morbidity and mortality due to diseases is projected to rise primarily associated with floods / droughts. Increases in coastal water temperatures would exacerbate the abundance of cholera. The existing social inequalities of resource use shall aggravate and intensify social factors leading to instability. The conflicts, displacement of people, changes in migration patterns may also be experienced.

Climate change is not a new influence on the biosphere then *why can't ecosystems just adapt without significant effects on their form or productivity?* This is mainly because of three main reasons viz., (i) *the rate of global climate change is projected to be* ***more rapid*** *than any to have occurred in the last 10,000 years,* (ii) because of anthropogenic impact (the forests cut down, soils plowed, rangelands used to graze the domesticated animals, non-native species introduced to many regions and lakes, rivers and oceans fished intensively) world's ecosystems are now *less resilient to automatically adapt to climate change,* (iii)pollution, as well as other indirect effects of the utilization of natural resources have increased since the beginning of the industrial revolution.

Developing countries are the least responsible for climate change as the world's least developed countries contribute only 10 percent of annual global carbon dioxide emissions, *Pakistan contributes only 0.04%*. However, the geographical location and socio-economic fragility makes the developing countries more vulnerable to the environmental, social and economic ramifications of climate change. The lack of resources and capabilities to adapt to the changes shall worsen the situation. The people who live in poverty around the world are the hardest hit by climate change as the poor are more dependent on natural resources and have less of an ability to adapt to a changing climate.

Pakistan amongst the developing countries affected by the change in climate shall be affected by increased intensity of floods and decrease in agricultural productivity, therefore, giving rise to the food insecurity (Inter-cooperation 2010). Impact on the forests in Pakistan is discussed in the following paragraphs.

Forests and Climate Change

Forests act as a sink of carbon dioxide, the major greenhouse gas responsible for global warming. They sequester carbon, i.e., absorb and convert atmospheric carbon dioxide into tree biomass via the process of photosynthesis in the young growing trees. During the process, oxygen is released which makes the environment refreshingly healthy. Forest reserves also exert a cooling effect on the climate besides being a source of livelihood for the dependent communities. Afforestation and reforestation activities could be a good choice for mitigating climate change as young forests can store as much as 15 tons of carbon per hectare per year in their biomass and wood.

Forests play a double role in climate regulation. Deforestation and forest degradation release the carbon that is stored in trees into the atmosphere as carbon dioxide and other gases. Deforestation and forest degradation account for around 12 to 20 per cent of annual greenhouse gas emissions. But, in addition, healthy forests absorb carbon dioxide from the atmosphere. Studies suggest that 5 billion of the 32 billion tons of carbon dioxide emitted annually by human activities i.e. over 15 percent of the total are absorbed by forests.

As such when forests are damaged and destroyed we lose not only the carbon storage provided by the trees, releasing carbon dioxide *to* the atmosphere, we also forego the forests' ability to absorb carbon dioxide *from* the atmosphere. It's a double loss.

Global change will impact carbon mitigation in the forests sector, but the magnitude and direction of this impact cannot be predicted with confidence over longer period. Global change may affect tree growth and decomposition rates, the area, type, and intensity of natural disturbances, land-use patterns, and other ecological processes.

Forestry can make a very significant contribution to a low-cost global mitigation portfolio that provides synergies with adaptation and sustainable development. However, this opportunity is not being taken fully into consideration in the current institutional context and has resulted in only a small portion of this potential being realized at present (mainly through the A / R CDM).

Forestry mitigation options include reducing emissions from deforestation and forest degradation, enhancing carbon sinks through enhancing the sequestration rate in existing and new forests, providing wood fuels as a substitute for fossil fuels, and providing wood products for more energy-intensive materials. Properly designed and implemented, forestry mitigation options can have substantial co-benefits in terms of employment and income generation opportunities, biodiversity and watershed conservation, provision of timber and fibre, as well as aesthetic, cultural and recreational services.

Table-4 presents a simple classification of the mitigation options in forestry (It is understood that these mitigation options consider all 5 carbon pools, including organic soil carbon). For each option, the corresponding forest management approach is specified. The combined effects of reduced deforestation and degradation, afforestation, forest management, agro-forestry and bio-energy have the potential to increase from the

present to 2030 and beyond. Thus, they all are important when discussing the implementation of the Bali Action Plan.

The carbon mitigation potential from reducing deforestation, promoting forest management, afforestation, and agro-forestry differ greatly by activity, regions, system boundaries and the time horizon over which the options are compared (IPCC 2007c IPCC Fourth Assessment Report (AR4), WG III).

Table 4 : Mitigation options in forestry

Mitigation options (general)	Mitigation options in the UNFCCC or its Kyoto Protocol (KP) (LULUCF)	Forest management options
Reduction of GHG Emissions	Reducing emissions from deforestation and forest degradation (REDD)	Sustainable management of (natural) forests
		Committing forests for REDD
Carbon sequestration	Afforestation Reforestation	Plantation, forestry, agroforestry, agro-sylvo-pastoral systems
	Enhancement of sinks through forest restoration (not yet clearlydefined)	In forested areas : enrichment, planting, guided natural regeneration
Carbon substitution	Substitution through harvested wood products : using forest products for electricity and fuel	Forest biofuel plantations, sustainable use of wood production

Source : *Inter-cooperation (2010)*

Realization of the mitigation potential requires institutional capacity, investment capital, research and development, and knowledge transfer, as well as appropriate policies, incentives and international cooperation. Under the mitigation options (*Other important elements in the overall context of mitigation options in forests are : How to treat reduced impact logging? How to treat "pioneer agroforestry"? How to treat synergies between REDD and adaptation? How to treat the substitution potential of wood products?*) of reducing emissions and increasing carbon sequestration, there are four forest management options to be considered, including :

- Reducing emissions from deforestation and forest degradation (REDD) ;
- Forest management (sustainable use of existing forests) ;
- Forest restoration (restoring degraded forest areas to a sustainably used forest) ;
- Afforestation and reforestation (In the newest reports of the IPCC and the Secretariat, "agroforestry" has been included in the agricultural sector. Nevertheless, it needs to be clarified that many A/R CDM projects that count under afforestation / reforestation are promoting agroforestry systems.) (restoring lost carbon stocks to a sustainably used forest).

Deforestation and forest degradation contribute substantial amounts of greenhouse gases to the atmosphere each year (12 to 20 per cent), *measures to protect*, *restore*, and *sustainably manage forests,* therefore, offer significant climate change mitigation potential. Conserving existing forests will keep emissions from deforestation and

degradation of forests out of the atmosphere. Restoring forests through *planting trees* or *facilitating the natural regeneration of trees* will increase the amount of carbon that forests can remove from the atmosphere and store in their biomass. Finally, sustainably managing forests through measures such as *reduced impact of logging* and more *strategic planning of road construction* can help avoid emissions from forest degradation. All of these measures can make a substantial contribution to the mitigation of climate change. Forestry activities are, therefore, very important tools for mitigating climate change (Inter-cooperation 2010).

Conservation refers to the conservation of forests that have not historically, and are not currently, under threat. Since these forests are not facing deforestation or degradation, there is no way to reduce emissions from deforestation and degradation. Sustainable management of forests means that forest areas designated for the production of timber are managed in such a way as to effectively balance social, economic and ecological objectives ; improving the management of such forests offers a significant opportunity to reduce emissions.

Climate Change Impacts on Forests in Pakistan

Climate change is likely to have an adverse effect on the forestry sector in Pakistan as the rate of change in the values of climate parameters may be too fast to allow gradual migration of various tree species to neighbouring areas with relatively more favourable climatic conditions. High temperature and increased precipitation would also increase forest insects, pests and weeds, which may result in greater damage to forest vegetation. As a result, the most likely impacts of climate change will be decreased productivity, changes in species composition, increase in forest insects, pests and weeds, reduction of forest area, biodiversity loss and change in the distribution patterns of both plants and animals and reduction of forest area, increased degradation of mangroves resulting from increased intrusion of sea water into the Indus delta due to sea level rise, greater risks of glacial melt and landslides in mountainous regions ; further degradation of rangelands and degraded areas affected by waterlogging, salinity etc., due to utter lack of adaptation capacity in these impoverished regions.

Measures proposed to be taken to cope with climate change

The measures proposed to be taken to cope with climate change shall include the increasing access to high quality information about the impacts of climate change ; improving technological responses by setting in place early warning systems and information systems to enhance disaster preparedness ; practicing energy efficiency through changes in individual lifestyles and businesses ; reducing the vulnerability to livelihoods to climate change through infra-structural changes ; and promoting good governance and responsible policy by integrating risk management and adaptation.

In production sectors it is important to develop new and innovative farm production practices, including new crop varieties and irrigation techniques ; improve forest management and biodiversity conservation, empower communities and local stakeholders so that they would participate actively in vulnerability assessment and

implementation of adaptation ; mainstream climate change into development planning at all scales, levels and sectors.

Mitigation and Adaptation in Forest Ecosystems
General

Forests act as a sink of carbon dioxide, the major greenhouse gas responsible for global warming. Forests sequester carbon, i.e. absorb and convert atmospheric carbon dioxide into tree biomass via the process of photosynthesis in the young growing trees. During the process, oxygen is released which makes the environment refreshingly healthy. Forest reserves also exert a cooling effect on the climate besides being a source of livelihood for the dependent communities. Afforestation and reforestation activities could be a good choice for mitigating climate change as young forests can store as much as 15 tons of carbon per hectare per year in their biomass and wood.

Following actions are proposed in general to mitigate and adapt to conserve the forest ecosystems :

- Minimize the damages and decrease vulnerability of forest ecosystems caused by external agents by taking appropriate measures to adapt to the projected adverse impacts (e.g. erratic precipitation and change in surface temperature) of climate change and increase ecological resilience of forest ecosystem.

- Improve governance and management of forests in Pakistan to acclimatize to the impacts of the changing climate by promoting best practices of Sustainable Forest Management (SFM) via setting appropriate Criteria and Indicators (C&I) to ensure the social and environmental values and services from forests.

- Improve the understanding of forests and climate relationship through enhanced scientific research by addressing the essential knowledge gap about climate change impact on Pakistan's forests through research on forest adaptation.

- Intensify public mass awareness and build capacities of professionals on the issue. Promote awareness raising among general public, forest communities and enhance capacities of forest managers regarding the contribution of forests in combating climate change.

- Address deforestation to safeguard environment and protect carbon sinks ; provide alternate means of fuel and livelihood to the local populations.

- Enhance afforestation and regeneration programmes to increase forest cover in the country. Encourage social / agroforestry.

- Encourage biological control of forest pests and restrict the use of chemical insecticides to maintain ecological / biological balance.

- Determine the extent of change in distribution of species and adopt relevant mitigation measures.

- Emphasise upon ex-situ conservation to conserve the genetic resources of species especially those that are endangered.
- Build institutional and professional capacities for development and implementation of **REDD+** mechanisms. Build capacities of national institutions and provincial forest departments for effective development and implementation of innovative mechanisms aiming at avoiding deforestation and enhancing forest carbon stocks.

- Restore, conserve and enhance the forest carbon sinks ; and minimize the carbon loss from existing forests. Develop and implement mechanisms to avoid deforestation and enhance forests' capability to sequester more emissions from the atmosphere.

- Monitor and evaluate the progress. Develop effective mechanisms to gauge the progress from the onset and during implementation of the proposed actions.

The future outlook

- The forest cover (including State and private forests/farmlands) is planned to be increased from 4.9% in 2004-05 to 5.2% of the total land by 2009-10 and, as the Millennium Development Goal, to increase it to 6.0% by 2015.

- Annual tree-planting campaigns are run during spring and monsoon seasons. Afforestation rates have increased from 70 thousand saplings per annum in the 1970s to even up to one million in recent years.

- On July 15, 2009, 541,176 saplings were planted on a single day, which is a world record.

- The government is planning to undertake additional major programmes for increasing the forested area.

- The government plans to carry out intensive institutional and legal reforms in forestry both at the federal and provincial levels ; revise and prescribe forest working plans on the basis of integrated ecosystem management approach ; prepare projects and programmes for the protection of existing forests and restoration of depleted state, community, and privately owned forests ; promote social forestry and integrated watershed management ; and intensify efforts on large-scale afforestation to increase forest cover.

- It is envisaged to identify environmentally sound, socially acceptable and cheap alternatives to substitute for wood as fuel and timber to minimize dependence on forest trees.

- It is planned to promote LPG use and enhance the use of fuel saving stoves in Northern / Hilly areas to cut down on fuel wood consumption.

- Rangelands improvement is planned to include : enactment of legislation to provide legal instruments and support to rangeland management ; extending ground cover for retaining maximum rainwater on the grazing lands to protect against wind and water erosion ; improvement of rangeland conditions through scientific management and restoration of native grasses and other forage species ; prescribing grazing regimes on the basis of local ecology and practices of managing rangelands ; and persuading farmers to practice controlled and rotational grazing.

- It is planned to develop through biotechnology, drought-tolerant, salt tolerant and water-use efficient crop varieties with high yields and lower water consumption. This will help in reclamation of nearly 6 million hectare of salt affected waste land and large areas of sandy desert through an integrated approach, whereby salt tolerant, fast growing grasses, shrubs and trees could be used as animal fodder as well as economic conversion to Methane or ethanol.

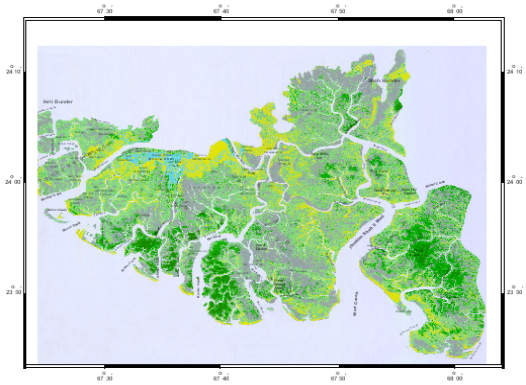
- A national Sustainable Land Management Project is in operation with the objectives of combatting desertification and reclaiming degraded lands. The project envisages adoption of soil conservation measures ; promoting rainwater harvesting techniques ; discouraging ground water harvesting for irrigation in water stress areas ; reclaiming waterlogged and saline lands with the involvement of local communities/private sector ; and rehabilitation of degraded rangelands.

Climate change in the context of Forest Ecosystems

Different forest ecosystems are affected by climate change in a variety of ways. Such impacts have been highlighted for the mountain forest ecosystems, rangelands, degraded lands, wetlands, mangroves and other vulnerable ecosystems and biodiversity ; these impacts need to be mitigated to maintain the productivity of the forests and help enhance the mitigating role that the forests can play. Following is an account of the climate impacts on the forest ecosystems and the measures suggested for mitigation :

Mangrove Forests

Coastal mangrove forests extend over 132,000 hectares, representing about 3% of the forest area of Pakistan. About 97% of these forests are located in the Indus deltaic region and the remaining 3% along the Balochistan coast. Mangrove forests are a rich source of nutrients for a variety of marine species, are breeding grounds for many varieties of coastal fish, meet the timber, fuel wood and grazing requirements of the local population, regulate ground water extraction in the deltaic and coastal areas, reduce ground subsidence rate ; provide a natural defence system along the coast ; and are the mainstay of local population as they provide the livelihood for them.



Distribution of mangrove forests in Indus delta
Photo credit : Pakistan Flood Commission 2005

Mangrove forests, Keti Bunder Thatta district
Photo credit : WWF Pakistan

The mangrove ecosystems in Pakistan have been seriously degraded over the last 50 years as a result of inadequate flows of freshwater down stream Kotri, industrial, urban water pollution, over-fishing, over-grazing, over-cutting for fuel wood and timber, and in some cases urbanization. They will be under greater threat of destruction due to increased intrusion of sea water into the Indus delta as a result of sea level rise caused by climate change.

In order to address the issue of minimum required water escapages below Kotri Barrage to check seawater intrusion and address other environmental concern, the government of Pakistan in 2005 commissioned a group of studies and got their findings reviewed by an International Panel of Experts (IPOE). The IPOE (2005) has recommended, inter alia (Pakistan Flood Commission 2005) :

- An escapage at Kotri Barrage of 5,000 cfs or 0.3 maf per month throughout the year is required to check seawater intrusion, accommodate the needs for fisheries and environmental sustainability, and to maintain the river channel, and

- in order to supply sediment to the delta, sustain mangrove vegetation and preserve river morphology, an additional total volume of 25 maf in any 5 years period (an annual equivalent amount of 5 maf) needs to be released in a concentrated way as flood flow (in Kharif period i.e. during April- September), to be adjusted according to the ruling storage in the reservoirs and the volume discharged in the four previous years.

- IPOE however was of the view that this will require additional storage capacity to prevent a reduction of water availability for irrigated agriculture.

- However, the recommendations still remain to be implemented, on the one hand, due to insufficient storage capacity and, on the other hand, pending a consensus agreement among the four provinces.

Mangrove specific recommendations include :

- Improve the management of mangroves in the deltaic region to check degradation.
- Protect mangrove forests to conserve the rich source of nutrients for a variety of marine species and breeding grounds for many varieties of coastal fish.
- Build natural plantation barriers along coastal areas to control sand and soil erosion and to minimize the disastrous impacts of cyclones and tsunamis.
- Improve the natural defence system along the coast, regulate ground water extraction in the deltaic and coastal areas to reduce ground subsidence rate by enhancing mangrove forest cover.
- Address sea water intrusion into Indus deltaic region by allocating enough water to ensure minimum environmental river flows down Kotri ;
- Maintain optimal river water flow for continuation of sediment and nutrient transfer to the marine ecosystem.
- Identify the minimum amount of water inflows required downstream Kotri to maintain marine ecosystem.
- Reduce and control solid and liquid waste disposal in the bay areas.
- Identify coastal habitats that are most vulnerable to sand and soil erosion.
- Involve agricultural research institutions to identify the vegetation, shrub and trees most suited for the coastal areas.
- Designate plantation areas for vegetation recovery and regeneration in the coastal areas.
- Initiate campaigns to plant mangroves, coastal palm and other trees suitable for coastal areas to control sand and soil erosion.
- Get local community organizations involved in building and maintaining vegetative barriers in the coastal areas.

- Provide required fresh water inflows downstream *Kotri* to maintain coastal marine ecosystems in good health.

- Design special coastal areas biodiversity and habitat preservation programme**.**

Rangelands

Rangelands cover almost a third of Pakistan's total area and form an important component of its natural resources. Besides supporting two-thirds of the entire population of sheep and goats and over half of the cattle population of the country, they provide livelihood to millions of herders and pastoralists. Rangelands support two-thirds of the entire population of sheep and goats, and over half of the cattle population of the country.

There is however no proper rangeland management system in Pakistan. Heavy grazing pressure and utilization beyond their carrying capacity level has been reducing their productivity. The rangelands in Pakistan are particularly vulnerable to the impacts of climate change because the capacity for adaptation in these impoverished regions is very low.

Rangelands improvement is planned to include : enactment of legislation to provide legal instruments and support to range land management ; extending ground cover for retaining maximum rainwater on the grazing lands to protect against wind and water erosion ; improvement of rangeland conditions through scientific management and restoration of native

Desert rangelands. Cholistan : *Photo credit : author*

Alpine pastures : Photo credit : *WWF Pakistan*

grasses and other forage species ; prescribing grazing regimes on the basis of local ecology and practices of managing rangelands ; and persuading farmers to practice controlled and rotational grazing (GoP-PC 2005).

- Develop climate change adaptation strategy for rangelands and pastures.

- Improve the quality of rangelands by increasing native rangeland vegetation and planting adapted species, and by proper rangeland management

- Plant multipurpose fast growing local tree species on farmlands in order to meet the needs of timber, fuelwood and fodder for livestock.

Alpine pastures : Photo credit : *WWF Pakistan*

Punjab urial in Potowar rangelands : Photo credit : A*uthor*

- Rehabilitate rangelands, employ grazing systems, and reduce low quality livestock.

- Build vegetative barriers to safeguard against the erosion of pastures and rangelands' topsoil.

- Maintain optimal livestock densities.

- Develop close coordination among forest and livestock departments for efficient management of rangelands.

- Safeguard rangelands from turning into deserts ; maintain soil nutrient and sub-soil moisture through appropriate vegetative cover.

- Promote rotational livestock grazing methods in pastures and rangeland, to facilitate regeneration of grasses and other vegetation.

- Use mixed herd of low maintenance, high production livestock for increased efficiency and low ecosystem impacts.

Degraded Lands

In Pakistan more than a quarter of agriculture land is vulnerable to wind and water erosion, salinity, and water logging. Unsustainable land management practices cause significant environmental problems, including soil erosion, loss of soil fertility and associated crop productivity, flash floods, sedimentation of water courses, and

deforestation and the associated loss of carbon and biodiversity. The main causes of degradation and deforestation are : faulty land use practices, uncontrolled livestock grazing, illegal removal of vegetation, water logging, salinity, sodicity and over-exploitation of ground water resources in arid areas especially the western dry mountains of Balochistan causing severe water scarcity. It is estimated that some 43 million hectares of land area has already been affected by desertification in Pakistan (SLMP 2007).

Like rangelands, it is the lack of adaptation capacity in the degraded land areas which makes them very vulnerable to the adverse impacts of climate change.

Land degradation. Climatic impacts. Potwar
Photo credit : WWF Pakistan

Land degradation. Anthropogenic impacts. Potwar
Photo credit : WWF Pakistan

Mitigation measures

- Combat land degradation and desertification in Pakistan in order to protect and restore ecosystems and essential ecosystem services that are key to reducing poverty.

- Address key barriers to Sustainable Land Management by strengthening institutional capacity, creating an enabling environment and demonstrating good practices.

- Address policy, institutional and knowledge barriers through targeted capacity building.

- Introduce innovations in sustainable agriculture practices, water and soil conservation techniques, integrated management of natural resources, sustainable pastoral activities, and agro-forestry for promoting Sustainable Land Management practices.

- Develop appropriate economic and social incentives and micro-credit schemes to help adopt Sustainable Land Management practices.

- Plan to exploit the saline and waterlogged areas by planting suitable tree, shrub and grass species.

- Monitor and evaluate implementation.

Wetlands

Pakistan, despite having an arid climate, supports over 780,000 ha of wetlands covering 9.7% of the total land area, with 225 nationally significant wetlands, of which 19 have been recognised as Ramsar sites of global significance. Wetland types represent the passage of the Indus River from the glaciers and high alpine lakes, through riverine and freshwater lakes to the coastal wetlands of the Indus Delta. These wetlands provide often unrecognised benefits and services, such as provisioning - food and fibre production - regulating services such as water balance, groundwater recharge, flood mitigation and storm protection ; cultural and social functions such as sacred and religious importance ; providing recreation and tourism opportunities ; and supporting functions such as soil formation and sediment retention. Main threats to wetlands include shortages of water to maintain the wetlands, poor water quality from increasing pollution, change in land use, encroachment and over-exploitation of natural resources, such as fish and wildlife.

Climate change is one of the biggest threats to water availability for wetlands, since increasing temperatures will increase the rate of glacier shrinkage. In the short term there could be an increase in flows available in the Indus system as the glaciers melt, even to the extent of increased risk of flooding. In the longer term, because of reduced glaciers there could be less water available for alpine lakes and the Indus River and its wetlands. Climate change is likely to increase climate variability – high rainfall and storm events will become more frequent. Climate change threatens to decrease water availability in Pakistan as a whole.

Wetland. Taunsa Barrage Wildlife Sanctuary Wetland
Photo credit : Punjab Wildlife & Parks Department

Jahlar Lake,Ucchali Wetland Complex, Salt Range
Photo credit : Punjab Wildlife & Parks Department

Ucchali lake : Ucchali Wetland Complex, Salt Range
Photo credit :Pakistan Wetlands Programme, WWF Pakistan

Astola Island, Gwader, Balochistan
Photo credit :Pakistan Wetlands Programme, WWF Pakistan

Mitigation measures include :

- Research the causes of depletion of wetlands' ecosystem ;
- Provide the necessary inputs to ensure sustainability of wetlands ecosystem ;
- Take remedial measures to reduce siltation of the wetlands ;
- Protect the habitat of birds and fish in Wetlands Ecosystem ;

- Impart efficient management to the wetlands ; and
- Devise legal procedures concurrent with scientific findings to control organic and inorganic pollution of wetlands.

Mountain Regions

Mountain areas are the important watersheds of the country that support the main forest and vegetation mass regulating the water flows to the down country. Major forest/ranges types occurring in the mountainous areas are : alpine meadows, sub alpine scrub, moist temperate and dry temperate coniferous forests, sub-tropical chir pine (*Pinusroxburghi*) forests, dry deciduous scrub forest in the northern mountains ; Juniper (*Juniperus excels*) forests, dry sub-tropical scrub forests and rangelands in western mountains in Balochistan ; Chilghoza (*Pinusgerardiana*) forests in Suleman Range. These are commercially important forests and rangelands that provide main livelihood to the mountain dwellers.

Mountain Regions are particularly vulnerable to climate change. There is a chance of more frequent formation of glacier lakes and their outbursts causing local floods, loosening of the frozen soil and stones, making landslides and avalanches more common, rampant Geological Erosion in higher reaches, depletion of forest resources, accelerated erosion resulting in land degradation, and the loss of an important source of livelihood for the people living in mountain areas.

Moist temperate coniferous forests. Murree hills
Photo credit : Punjab Wildlife Department

Moist Temperate coniferous forests. Ayubia National Park, KPK
Photo credit : WWF Pakistan

Sub tropical chir pine forests. Murree hills
Photo credit : Punjab Wildlife & Parks Department

Juniper forests. Ziarat Balochistan.
Photo credit : IUCN

Mitigation measures

The mitigation measures to counter the impact of climate change include :

- Initiate focused research on plant *phenology* ; trends in precipitation and temperature ; changes in the soil carbon and biomass of mountainous ecology.
- Investigate the effects of climate change on mountain biodiversity and the role of science integrated with indigenous knowledge for its preservations.
- Promote ecotourism and devise mechanisms to avoid accumulation of solid waste, trash and other unwanted material in hill stations and popular tourist destinations.
- Sensitize and take on board the local communities for promoting ecotourism.
- Actions to remove and further avoid accumulation of unwanted biomass in areas of higher altitudes so as to prevent clogging of mountain water channels.
- Develop special engineering projects to build check dams and other barriers to control solid waste, trash, biomass, and soil erosion from reaching plain areas.
- Promote growing natural shrubby barriers on slopes to avoid soil erosion, windstorm, hailstorm and snowstorm related damages.

- To map out vulnerability of ecosystems to climate change in mountainous areas of Pakistan. Conducting detailed scientific research in mountain areas to identify the most fragile and resilient ecosystems to the adverse impacts of climate change.

- Establish a coordination mechanism and plan of operation for the entities carrying out scientific studies to map out the ecological resilience of mountainous areas.

- Establish a research centre exclusively coordinating and disseminating scientific information on mountain areas ecosystems.

- Publish reports of the scientific findings and recommendations for preserving mountain ecology to adapt to the adverse impacts of climate change.

- Sustain and protect mountain ecology and plain areas from degradation and pollution. Discourage activities that contribute to depletion of mountain ecology while encouraging those that help in rejuvenating feasible climate at higher altitudes.

Other Forest Ecosystems

Irrigated forestry

Irrigation water has been used to raise irrigated forest plantations, farmland, tree planting, urban ornamental tree plantations and avenue plantations including roadside, railroad side and canal side plantations. They are the main source of fuelwood (about 90%) and timber (about 50%).

The future of irrigated plantations is however in jeopardy because of irregular and decreasing water supplies as a result of climate change. The decreasing production levels in agriculture and food crops may also force the planners to divert more irrigation water for the agricultural crops and neglect the tree plantations. In such a situation the biomass energy provision shall also be reduced impacting the energy sector further.

In the light of growing importance of natural forests in the mountain regions / watersheds for water flow regulation it is imperative to conserve the natural forests with almost zero exploitation and focus on irrigated forestry to meet the needs of timber and firewood requirements.

Mitigation measures

Mitigation measures include :

- Develop proper irrigation water utilization practices.

- Reduce the conveyance losses in the canals, and the irrigation network

- Reduce the water losses in the field due to uneven surfaces.
- Control waterlogging by properly managing the water use for agriculture and industrial uses.
- Control pollution entering into irrigation channels through industrial effluents, sewage and agriculture runoff.
- Adopt measures to improve the aquifer by justified use of ground water and improving the water/ runoff absorbing qualities of soils both in towns and rural areas.
- Emphasise on urban forestry to improve the local climate and water holding capacity of soils.
- Increase the timber and firewood production potential of irrigated forestry.
- Improve the management of irrigated forestry to obtain sustainable yiels.

Changa Manga irrigated forest plantation Kasur
Photo credit : Punjab Forest Department

Avenue plantation. Lahore Branch Canal Lahore
Photo credit : Author

Avenue plantation. Roadside. Motorway M2
Photo credit : Author

Avenue plantation. Roadside. Daphar irrigated forest plantation. Gujrat
Photo credit : Punjab Forest Department

Farmland plantation Okara
Photo credit : Punjab Forest Department

Urban forestry.
Photo credit : Punjab Forest Department

Wood harvesting in Changa Manga irrigated forest plantation Kasur
Photo credit : Punjab Forest Department

Wood transport in Changa Manga irrigated forest plantation Kasur
Photo credit : Punjab Forest Department

Biodiversity

Pakistan is home to a variety of biodiversity that is likely to be adversely affected by climate change. The flora and fauna as well as their habitats are already directly or indirectly being negatively influenced by human activities which lead to their degradation, displacement and, in most severe cases, even extinction ; climate change is projected to exacerbate this process.

Straight horned markhor. Balochistan.
Photo credit : WWF Pakistan

Sindh Wild goat. Hingol National Park
Photo credit : Waseem Ahmad Khan

Chinkara gazelle. Hingol National Park
Photo credit : Waseem Ahmad Khan

Migratory water birds on a wetland. Rangpur Thal
Photo credit : Punjab Wildlife & Parks Department

In Pakistan 31 species of mammals, 20 of birds and 5 of reptiles are already endangered and many more are on the list of Convention on International Trade in Endangered Species of Wildlife and Fauna (CITES) and their international trade is strictly controlled.

In general, climate change shall affect the competitiveness of different species by differentially altering their growth and mortality rates as well as their regeneration / reproduction success rates. Synchronous functioning of the life cycles of plants, animals and soil organisms will be potentially affected. Under the present unprecedented rate of climate change, a wide range of species is unlikely to adapt or migrate fast enough to ward off the impacts of climate change. Climate change in the past would have certainly caused alterations in biomes and ecosystems. However the non-availability of the required data on different aspects of biodiversity and ecosystems remains a major constraint in the quantitative analysis of the impact of climate change on biodiversity.

Carbon Stock Assessment

The world's forest management regime has been shifting strongly from commercial forest management towards the sustainable/carbon forest management. The sustainable/carbon forest management can accrue additional benefits which could come through sale of carbon credits apart from sustained flow of livelihoods for forest dwelling communities – another indispensable factor. This is attributed to forests important role recognized by international scientific fraternity towards the climate change and its future consequences.

Forests are responsible for 17.4% of greenhouse gas (GHG) emissions which is mainly because of the deforestation of huge patches of forestry lands (IPCC, 2007). Although, forests might not be the biggest emitters at this point of time but mankind's persistent unsustainable practices make forests potentially one of the biggest threat for the coming future. Forests apart from being emitters are also reckoned as one of the vital sinks of carbon which increases their importance manifold. The other associated forest benefits are ; providing habitats for biodiversity ; watershed improvement and provision of livelihood for millions of people are also highly positive attributes of forests.

The carbon management however requires measurement of carbon stocks in different levels of ecosystems. Usually, the carbon pools which are measured include ; Above Ground Biomass, Below Ground Biomass, Soil, Litter and Deadwood. The inclusion of each carbon pool for measuring totally depends on project activities and ground situations. Necessarily it is not required that all the carbon pools have to be measured. The measurement of pools is generally conducted on the basis of significance of each pool in the subjected area and few other things mentioned above.

Kyoto Protocol

Pakistan singed the **Kyoto** Protocol on 11th January, 2005, and subsequently adopted the Kyoto Protocol, which outlined the greenhouse gas emissions reduction obligation for Annex I countries, along with what came to be known as *Kyoto mechanisms* such as emissions trading, clean development mechanism and joint implementation but did not include REDD as an eligible offset project type. Most industrialized countries and some central European economies in transition (all defined as Annex B countries) agreed to legally binding reductions in greenhouse gas emissions of an average of 6 to 8% below 1990 levels between the years 2008–2012, defined as the first emissions budget period.

The United States was required to reduce its total emissions an average of 7% below 1990 levels ; however Congress did not ratify the treaty after Clinton signed it. The Bush administration explicitly rejected the protocol in 2001.

The Kyoto Protocol aims to reduce GHG emissions by 2012 and distinguished two types of countries :

- Annex-I countries : With binding emission targets (industrialised countries) : Western and Eastern Europe, Canada, Japan, New Zealand, Russia, Ukraine etc.

- Non-Annex I countries : With voluntary participation (developing countries) :

Climate Change Mitigation through REDD+

REDD+ is a mechanism that uses financial incentives to reduce the emission of greenhouse gases from deforestation and forest degradation and/or increases Green House Gases (*GHG*) removals in a measurable and verifiable way by providing incentives offering the opportunity, putting a value on forests with the ultimate goal to make standing forests more valuable ; referring to policies and measures and to pilot projects or demonstration activities.

Various strategies employed to reduce the rate of emissions from deforestation and degradation include the 'implementation of strategies to reduce deforestation and through an international REDD+ mechanism, these quantified emissions reductions will have a value and countries and/or sub-national actors can receive compensation for them.

While deforestation and forest degradation contribute substantial amounts of greenhouse gases to the atmosphere each year, *measures to protect*, *restore*, and *sustainably manage forests* offer significant climate change mitigation potential. Conserving existing forests will keep emissions from deforestation out of the atmosphere. Restoring forests through *planting trees* or *facilitating the natural regeneration of trees* will increase the amount of carbon that forests can remove from the atmosphere and store in their biomass. Finally, sustainably managing forests through measures such as *reduced impact of logging* and more *strategic planning of road construction* can help avoid emissions from forest degradation. All of these measures can make a substantial contribution to the mitigation of climate change. Forestry activities are, therefore, very important tools for mitigating climate change.

Enhancement of forest carbon stocks is likely to include forest restoration, afforestation, and/or reforestation. *Forest restoration* is the process of assisting the recovery of the carbon stocks of an existing forest that has been degraded or damaged ; *Afforestation* is the process of planting trees on land that has not been forested within the last 50 years (or has never been forested) ; and *Reforestation* is the process of planting trees on land that was previously forested but has recently (within the last 50 years) been converted to other uses.

Conservation refers to the conservation of forests that have not historically, and are not currently, under threat. Since these forests are not facing deforestation or degradation, there is no way to reduce emissions from deforestation and degradation and earn compensation. However, many of these forests may face increasing future threats and it is important to provide incentives to continue to conserve them. Therefore, a REDD+ policy framework also include some type of incentives to maintain non-threatened standing forests. These incentives may be the same or different from incentives for REDD.

Sustainable management of forests means that forest areas designated for the production of timber are managed in such a way as to effectively balance social, economic and ecological objectives ; improving the management of such forests offers a significant opportunity to reduce emissions. In order to include sustainable management of forests within a REDD+ program, countries or sub-national actors would need to calculate emissions from existing forest management practices. Those actors can then implement activities to reduce emissions, while continuing to harvest timber. Such strategies may include *reduced impact logging*, *reduction in harvest levels*, and *increased protection of high-value areas such as riparian zones*.

In order to include sustainable management of forests within a REDD+ program, countries or sub-national actors would need to calculate emissions from existing forest management practices. Those actors can then implement activities to reduce emissions, while continuing to harvest timber. Such strategies may include *reduced impact logging*, *reduction in harvest levels*, and *increased protection of high-value areas such as riparian zones*.

However, many of these forests may face increasing future threats and it is important to provide incentives to continue to conserve them. Therefore, a REDD+ policy framework also include some type of incentives to maintain non-threatened standing forests. These incentives may be the same or different from incentives for REDD.

Under a REDD+ framework, a country or sub-national actor could plant trees and/or restore a degraded forest and receive incentives from the international system. The implementer would likely be required to prove that their area would not otherwise have been reforested or would not have recovered on its own.

REDD+ is closely connected with governance of forest management. The concept of governance comprises mechanisms, processes, relationships and institutions through which citizens and groups articulate their interests, exercise their rights and obligations and mediate their differences. It takes into account all the important stakeholders including public, private and civil society actors (including users and communities). REDD+ provides an opportunity for maintaining and increasing national forest resources. In the context of governance, REDD+ demands interconnectivity with development and other objectives of managing forests (e.g. improving livelihoods, income, promoting investments, biodiversity conservation, etc.).There is a need to build a wide-scale understanding on the mechanism within the country. However, this should be a learning-

by-doing process. This engages analyses of drivers and agents of deforestation and degradation ; and starting with development of national strategies including an effective monitoring system to assess deforestation and degradation trends.

Pakistan has only just entered into the arena of REDD+ and is a strong candidate for receiving the REDD+ funds/incentives through reducing degradation and deforestation of forests, conserving and sustainably managing the existing forests and starting massive afforestation, reforestation and regeneration campaigns. This shall not only help offset the climate change impacts but also help reduce the poverty by enhancing livelihood opportunities for forest dependent communities.

References

ADPC.2007. Disaster Preparedness for Pakistan. Asian Disaster Preparedness Centre. GTZ. 2007.

FAO. 2011. The State of World Forestry 2011. FAO Rome.

FSMP. 1992. Forestry Sector Management Plan. 1992. Asian Development Bank, Manila.

GoP-PC 2005.The State of Environment. Pakistan. 2005.

Inter-cooperation. 2010.Natural Resource Management and Climate Change Mitigation, Adaptation and REDD+. Swiss Agency for Development and Cooperation. SDC., Government of KPK.

- Part I : Climate Change and Natural Resource Management – Concepts and Background.
- Part II : Forest and Carbon Sequestration.
- Part III : Policy approaches and incentives for REDD+.
- Part IV : Adaptation to Climate Change

IPCC. 2007. IPCC Fourth Assessment Report (AR4), WG III.

IPOE. 2005. Study on the water escapapages downstream of Kotri. International Panel of Experts cf. Pakistan Flood Commission. 2005.

PFI. 1996. Forestry Statistics of Pakistan. Pakistan Forest Institute Peshawar. 1996.

PFI. 2004a. National Forest & Range Resources Study.PFI.2004.

PFI.2004b. Forestry Statistics of Pakistan. Pakistan Forest Institute Peshawar.2004.