

Course Title: Environmental Forestry
Course Code: FRW-606
Course Credit Hour: 2(1-1)
Course Incharge: Prof. Dr Tanveer Hussain

THEORY

Forests and Climate Control: Greenhouse effect, forest and climatic change. Climatic change in Pakistan. Vegetation zones of Pakistan. Mountain and climate change. Afforestation: Benefits of home and urban tree planting. Developing green belts in urban areas for improvement of environment. Forest Fires and Control: Nature of forest fire, detection of forest fire, methods of control of forest fire by different mechanical and chemical methods and effects. Impact of desertification and Control: Management and control of desertification, soil and water erosion, water logging and salinity, soil, water and air pollution, floods. Trees and noise. Importance of forests in protecting Watersheds and providing clean water for drinking and controlling erosion, increasing life spans of water reservoirs through reduction of silt depositing in reservoirs and canal system, mitigating environmental pollution, sound and dust pollution. Identification of tree species for improving environment in different zones. Developing forest management plans for improvement of environment.

PRACTICALS

Field: Visit to study impact of forests on environment. Lab: Develop forestry projects for different areas for improvement of environment.

BOOKS RECOMMENDED

1. Centre for Applied Economics Studies (1989). Proceedings on Problems of Environmental Protection in Pakistan. University of Peshawar in Collaboration with Federal Republic of Germany.
2. Desh Bandhu and N.L. Ramnathan (1982). Education for environmental planning and conservation. Natraj Publishing Co. Ltd., New Delhi.
3. Khoshoo, T.N. (1987). Perspective in Environmental Management, Indian Science Congress, Oxford and IBH Publishing Co. Ltd., New Delhi.
4. Govt. of Pakistan & IUCN: (1991) The Pakistan National Conservation Strategy. Environment and Urban Affair Division, GOP, Islamabad.
5. Sapru, R.K. (1987). Environmental Management in India. Vol.I and Vol.II. Ashosh Pub. Hon. New Delhi.

Forests for Climate Control:

Forests play a vital role in the climate control global and local climate equations and must obviously be an important element in a post-Kyoto package. However, much uncertainty is still connected to how forests and forestry can be utilized as a tool for combating climate change.

A multitude of proposals have already been launched, ranging from carbon sequestration through replanting deforested areas with oil palms to simplify protection of natural forest. There are lots of ideas and questions on incentives for tackling deforestation, pricing of credits and so forth. Last year, the governments of Papua New Guinea and Costa Rica proposed the inclusion of national commitments to reduce emissions from deforestation within the next commitment period of the Kyoto protocol.

The countries using such a mechanism would set national targets based on a historic baseline from the 1980s or 1990s forest cover. A reduced deforestation rate would qualify for compensation from some global financial mechanism linked to the carbon quota system, and credits could potentially be interchangeable with industrial emissions.

Although clearly interesting, such a mechanism is complex and has many unknown details. For instance, the climate effects of deforestation versus forest degradation are insufficiently known. It is not clear if a forest mechanism in a post-Kyoto regime could reduce incentives to cut industrial emission in some countries – and there is even no full agreement over what a forest actually is. The November 2006 climate convention conference in Nairobi did not contribute much to the clarification of these issues.

While the WWF welcomes the strong increase in attention being paid to climate issues after the launch of the 2007 report from the UN's Intergovernmental Panel on Climate Change (IPCC), we are also worried by the rush for quick fixes which has followed in its wake. The WWF has pointed out that there is no silver bullet in the quest to control global warming. Bio-energy is a case in point. Although biofuel is potentially carbon neutral, the expansion in palm oil and tropical crops for biofuel production could become a significant new driver of deforestation and result in increased net carbon dioxide emissions. Bio-energy developments must be tightly controlled to prevent further deforestation. As forests obviously do absorb carbon dioxide, increasing forest cover through tree planting can increase carbon sequestration, but the positive impact of this is far outweighed by the negative impact of deforestation on atmospheric carbon dioxide, let alone wider ecosystem impacts.

Deforestation is responsible for 20% of global greenhouse gas emissions. Today, 10 countries account for 87% of global deforestation, with Brazil and Indonesia alone accounting for 54% of emissions. Tropical forests hold over 210 gigatonnes of carbon, and almost 500 gigatonnes in their soils (which is often released with land use change). Deforestation rates have remained constantly high over the past two decades. Without significant concerted action, these rates will prevail and result in annual emissions of 10 gigatonnes of carbon dioxide for 50-100 years.

The WWF's conclusion is therefore that, whilst restoring forest cover is a benefit, the primary focus should be on reducing deforestation. The causes of deforestation are wide ranging, and vary by country. They include agricultural expansion, cattle ranching, infrastructure development and logging, driven by

population pressures, and helped by poor governance and inadequate land-use planning. Governments and the wide range of market players must be effectively influenced to reduce these threats.

At present, available data are provided by national governments and are not globally consistent. Establishing accurate data, and in particular agreeing new globally consistent definitions of deforestation and degradation at a forest biome level, is essential.

The impact of reducing deforestation rates on carbon emissions is much more significant than even massive tree planting efforts. If we were able to halve the rate of deforestation by 2015, and further reduce it to zero in 2020, the cumulative emission reductions would be 55 gigatonnes by 2020 and 155 gigatonnes in 2030. In contrast, planting fast-growing trees at the rate of three million hectares per year (equal to current rates) would result in a cumulative carbon absorption of about 10 gigatonnes by 2020.

To put this into context, current (2005) global carbon emissions are 36 gigatonnes. To stabilise atmospheric carbon below 400 ppm and the “danger threshold” of an average 2 °C rise in global temperature, emissions should be reduced by 30% by 2020 and 60-80 % in 2050. Large scale deforestation reduction would therefore make a very important contribution to the global carbon emission cuts needed.

The WWF will focus on four key measures to reduce atmospheric carbon through forest-based activities:

- International policy must provide new, efficient provisions and incentives in the post-2012 period to reduce deforestation rates. Baselines, national targets and biome based monitoring will be necessary.
- Governments must be engaged in developing national policies for curbing deforestation. National action plans will be needed to take account of local drivers. The WWF will focus particularly on engaging society in six-ten countries, especially Brazil and Indonesia.
- Fiscal incentives such as compensation payments for reducing deforestation and (as a secondary focus) increasing carbon sequestration must be establishing and facilitated.
- Finally the WWF will focus on market incentives and engage with companies to set ambitious environmental commitments.

FORESTS AND FORESTRY IN PAKISTAN - STRATEGY FOR SUSTAINABLE DEVELOPMENT

4.26 million hectares of patchy, poorly-stocked slow growing forests scattered over only 4.8% of the total land area do not make any country proud. Far less Pakistan, where tree cover has to be an essential guarantee against erosion, land slides, movement of sand, crop damage, watershed depletion, and to assure food production and environmental stability. The per capita forest area is 0.05 ha compared to a world average of 1.0 hectare. Importing wood and wood products costs the resource poor country more than Rs.4,700 million annually. The reasons for this situation are both natural as well as man made. About 75% of the land area of Pakistan falls under the arid and semi arid zone and the lack of availability of moisture for growth and perpetuation of Pakistan of vegetation is a big constraint.

Whatever vegetation has been available has been exploited mercilessly to meet the ever increasing demand of a fast growing population. Heavy incessant grazing and lopping does not give any respite to natural regeneration or young saplings planted in afforestation/reforestation campaigns. Forest sites have deteriorated almost to the point of no return due to misuse and mismanagement. The people living in the watersheds and deserts are forced to cut trees for their survival as no substitutes are available for heating, cooking, construction of huts, and for rearing their livestock. To cap it all, forestry projects are given low priority by people who matter and there is sub-optimal investment in development programs. There is total lack of awareness of the problem and there is weak, ineffective ill-equipped extension service to motivate the people to plant and protect trees. If requisite funds and manpower are made available, against the current very low productivity of 0.7 and 4.0 m³/ha/annum from the coniferous forests and irrigated plantations, it is possible to increase to yields of upto 1.5m³ and 15m³/ha/annum, respectively. Several approaches could be made for conservation and development of the resource. These include ensuring adequate regeneration; protection of the growing stock; management on a sustained yield basis; genetic improvement of specific/tree species; reduction of waste generated in harvesting and conversion; treatment of wood before use; standardization of end products and use of substitute materials. Other measures could be purchase and extinction of rights, discouraging encroachment and demarcation of forests. Several kinds of incentives could be provided to people duly backed up by extension programs to encourage tree planting on private lands. Side by side the existing forest policy and legislation have to be revised to bring them up to par with the current requirements of forests, forestry, and ancillary disciplines. The present critical situation of the tree cover in Pakistan is thus the result of the combined affect of climatic, biotic, edaphic and socio-economic factors on the one hand and administrative and political disinterest on the other. It is high time to take forthright and practicable decisions, as suggested above, to perpetuate and develop this fast dwindling but renewable resource.

ENVIRONMENTAL IMPACTS OF ENERGY PRODUCTION FROM BIOMASS

In Pakistan there are three major sources of biomass energy: fuelwood, agricultural residues, and livestock manure. As a matter of fact biomass meets about 86% of the total domestic energy requirements. 90% of the rural and 50% of the urban population depend on biomass fuels. Fuelwood accounts for 50% of the total biomass fuel supply. It has been widely accepted that the production and conservation of biomass, especially forests, considerably improves the environment. Its ruthless exploitation greatly damages the land and water resources of a country and strangles its aesthetic values, leading to total destabilization of the ecological landscape.

CHANGING ENVIRONMENTAL AWARENESS AND ENVIRONMENTAL DEMANDS

(1) Growing Environmental Concerns: Whereas environmental, ecological, and biodiversity issues relating to the maintenance of forests particularly for those located in mountainous areas, gained more and more international importance in the 1970s, the public awareness on the importance of such aspects was lagging in Pakistan except the earlier efforts for watershed management and soil conservation. The sustainability of forests found its roots since introduction of scientific management of

forests in 1901 through regular working plans and the environmental considerations gained further emphasis after the National Conservation Strategy (NCS) approved in 1992.

In Pakistan the situation in the forestry sector changed significantly after the floods of 1992 when intensive public discussions took place on the environmental functions of the forests. However, discussions on such forest functions did not expand to biodiversity, carbon sequestration and other environmental services. Even the action plan of the initial harvesting ban in direct response to the floods and the public discussion thereafter did not make any reference to environmental functions of the forests. All items of this action plan were geared towards a traditional perception of forest management. In the following years, though, the Federal Ministry of Environment (MoE) and its various organs through the Office of the Inspector General of Forests (IGF) became more active in integrating environmental concerns into national forest policies and management strategies. Hence, the directives following the first extension of the ban in 1997 included some – though still unspecific – actions requiring forest planning and management to address environmental and biodiversity aspects.

A larger impact on enhancing the awareness of environmental issues in the FD was made during the process of preparing the Sarhad Provincial Conservation Strategy (SPCS) in the mid 90s and thereafter. Some of the conceptual and practical implications of observing environmental principles as laid out in the SPCS also became part of the FSP/ITC project documents which were prepared in parallel with the SPCS. Later on these principles were also incorporated in the NWFP Forest Policy of 1999. The practical implementation of forest management in NWFP though, was largely accomplished without much reference to such considerations. However, the Forest Department was already incorporating the importance of watershed and soil conservation functions of the forests in its planning and management systems, but such prescriptions were not being fully implemented due to paucity of funds and limited capacity in the FD.

Other environmentally relevant awareness building processes were also initiated and promoted by the up-coming activities of NGOs in the early 90s., initially and mainly by the SUNGI Development Foundation. Besides advocacy for social justice, poverty alleviation, and women rights, the leading NGOs also raised awareness among the villagers about the harvesting ban and the concurrent environmental needs of protecting the forests. Later on, the local NGOs were supported by international agencies as well as by ongoing donor funded forestry projects in NWFP.

Since most of the biodiversity related projects have been under the NWFP Wildlife Department, this department has developed an understanding of environmental and biodiversity issues both conceptually and technically and is focusing on formal and informal training of its staff and village communities. A new wildlife law has been drafted which is in the process of enactment by the Provincial Assembly. This is in contradiction to the federal and provincial forest policies which refer to the holistic management of natural resources. The delineation between the ‘forest’ and ‘biodiversity’, which appears to be the case in the overall approach of the two administratively separated departments and their respective legislation, is not in the interest of the resource as such. Forests are as important for peoples’ livelihoods as they are for biodiversity and environmental concerns.

In the course of the growing environmental awareness of state institutions, NGOs, and within the civil society and local communities a number of policy documents, guidelines and checklists on environmental issues were prepared by various agencies⁴³.

(2) International Commitments: The environmental awareness created additional societal demands on forests for environmental services as well as making Pakistan become a party to a range of Multilateral Environmental Agreements (MEAs)⁴⁴ and some other forest related non-legally-binding instruments (NLBI). NLBI aim at strengthening political commitment and action at all levels to implement sustainable management of all types of forests to achieve the shared global objectives on forests as well as providing a framework for national action and international cooperation⁴⁵.

(3) Summing Up: With the expanded environmental awareness, national and provincial policy statements on environmental issues and internationally binding and non-binding environmental agreements that Pakistan has signed or ratified with respect to sustainable management of natural resources, additional demands have been placed on the forests. However, apart from producing policy papers of high professional standards and entering into international commitments it is important first to analyze whether under given local circumstances such new demands and challenges can be accomplished on the ground or not.

Environmental Impacts⁵¹

The analysis above has shown that deforestation and degradation of forests continued despite the harvesting ban. In order to substantiate environmental impacts of the forest degradation, a qualitative assessment of the forest and environmental conditions through a field survey was undertaken in the course of the present study. In order to do so, 36 plots were selected based on several criteria and using satellite imagery as reference.

The assessment revealed that the degradation of forests goes together with an environmental and biodiversity degradation of most forests and a destruction of the forest eco-systems in general. As a result, except for some patches at higher altitudes there are hardly any areas left that represent an intact natural forest eco-system. Consequently, the other environmental functions (watershed, soil conservation, carbon sequestration and recreational potential) cannot be performed. In addition, the process of deterioration is faster than what was projected by PFRI.

Generally, biodiversity declined further during the ban. Populations of some of the species reduced significantly or were even wiped out from the deforested areas. Almost everywhere the human/livestock conflict with wildlife has emerged.

There are numerous environmental demands that are to be served by the forests and an equally pressing environmental commitment resulting from Pakistan's ratification of international environmental agreements. However, the present conditions of the forests in NWFP – with very few exceptions – and the ongoing trends of depletion and degradation are not conducive to serve these requirements.

Forest and Carbon Sequestration

Links between Climate Change, Carbon Dioxide and above Ground Tree Biomass

Climate change is a change in the statistical distribution of weather patterns, especially, when that change lasts for an extended period of time (i.e., decades to millions of years). Changes in climate are happening which are unparalleled. Global warming is among the greatest terrible horrors of the modern times. It is believed that carbon is among the most significant causal factors which cause global warming. The mean concentration of CO₂ in the atmosphere was 280 μ mol mol⁻¹ before the development of industries. And in the year of 1994 after industrial development it has reached up to 364 μ mol mol⁻¹. Now-a-days, the rate at which concentration is increasing is about 1.5 μ mol mol⁻¹ year⁻¹ (Kerr, 2007). It has strengthened the importance to understand the terrestrial global carbon cycle. Trees store up to 90% of the global plant biomass and are therefore a very important variable in the global carbon cycle. This above mentioned fact tells us about the significance of forest ecosystem and the importance of determining the accurate amount of carbon which is being stored in these forest ecosystems.

Climate Change

The climate on Earth is driven by interactions between incoming solar radiation and the Earth's atmosphere and surface. Incoming solar radiation is partially filtered by the upper atmosphere with the majority continuing on to be absorbed or reflected by the Earth's surface. Reflected radiation predominantly returns to space, with the absorbed solar radiation being re-emitted back into the atmosphere as lower energy radiation. This low energy radiation is partially trapped within the troposphere (lower atmosphere) by greenhouse gases before finally making its way back into space (Figure 12.1). The amount of low energy radiations trapped by the troposphere determines the climatic conditions of earth (Gribbin 1982; IPCC 2001a; Kininmonth 2004).

After water vapour, carbon dioxide (CO₂) is the most important greenhouse gas (IPCC 1996). Average atmospheric CO₂ concentrations have increased from 280 ppm (in CA 1750) to 401 ppm (as of 2005; CO₂ Now, 2014). These increases have been attributed to human activities predominantly relating to burning of fossil fuels and land clearing (IPCC 1996; Schlesinger 1997). Climate models indicate that increasing concentrations of greenhouse gases have trapped additional radiation, leading to increases in global temperatures and causing climate change (Gribbin 1982; IPCC 2001b; Schlesinger 1997). Global climate change threatens water supplies, food production and ecosystem health and viability (Lowe 2005; Oldfield 2005; Schneider et al. 2007).

Carbon (C) Cycle

Carbon cycle comprises of those natural processes which are involved in the storage and transfer of Carbon between different spheres of earth. These spheres S.M. Nizami, G. Yasin and M.T.B. Yousaf 263 include biosphere, geosphere, hydrosphere and hydrosphere (IPCC 2001b; Schlesinger 1997; SCOPE 1984). The rates and amounts at which carbon is being transferred between these stores is different at different intervals of time. Different types of biological processes, geological phenomena and climatic

conditions are responsible for controlling the rates and amounts of Carbon (Figure 12.2; IPCC 2001b; Schlesinger 1997). Terrestrial ecosystems are one store that has the ability to sequester C in a short time-frame that is relevant in addressing climate change. It is also a store that can and has been altered by human activity (IPCC 2001b; Schlesinger 1997).

Forest C and Forest Components

Of all terrestrial ecosystems, forests contain the largest store of C (Table 12.1; IPCC 2001b; Schlesinger 1997; SCOPE 1984). The term forest has been defined as vegetation with a minimum height of 2 m and minimum crown cover of 10% in the Marrakesh Accords, which specify the rules that are to be used in the Kyoto Protocol (UNFCCC 2001). Worldwide, forests covers 4x10⁹ ha (30% of land area) and, relative to non-woody vegetation, have a large biomass per unit area of land (FAO 2005). Carbon is mainly stored in the plant biomass whether it is above ground or below ground, woody debris which is abrasive in nature, litter and soil (containing organic and inorganic C; Figure 12.2; IPCC 2003; Richards & Evans 2004). These are the major carbon sinks in the forest ecosystem. The amount of carbon stored in these carbon pools continues to rise as the life cycle of forests increases until it reaches up to the state of equilibrium. When equilibrium state is gained then the amount of CO₂ which is released by plants and soil in the process of respirational and degradation of biomass equals the growth rate (e.g. Acker et al. 2002; Smithwick et al. 2002).

Managing Carbon in Forests Where the forest growth is disturbed or the forest is destroyed, CO₂ and other greenhouse gases (i.e. Methane 'CH₄', nitrous oxide 'N₂O') are released back into the atmosphere via respiration, combustion or decomposition (IPCC 2003; Richards & Evans 2004; Schlesinger 1997). Forests have the capability of both sequestering and releasing greenhouse gases. Moreover, the rate at which forests are being removed are the main factors to include the forests and land use change in the United Nations Framework Convention on Climate Change (UNFCCC) and in the Kyoto Protocol (KYOTO 1997; UNFCCC 1992).

Political Responses to Climate Change

The UNFCCC was developed at the 1992 Rio 'Earth Summit' (Kininmonth 2004). It was the first international political response to the threat of climate change (ICSU 2006; SCOPE 2004), and was based on scientific conferences preceding the summit (Kininmonth 2004; SCOPE 2004). Scientific evidence arose from research that S.M. Nizami, G. Yasin and M.T.B. Yousaf 265 stretched back to the 1960s when the Global Atmosphere Research Programme (GARP) – a joint initiative of the International Council of Scientific Union (ICSU) and the World Meteorological Organization (WMO) – was initiated to understand global weather (Bierly 1988; ICSU 2006). GARP was a result of technical advancements and political requirements relating to long-term weather forecasts that were needed to improve food security (Bierly 1988; ICSU 2006). The Kyoto Protocol is the highest international agreement ever developed for greenhouse gases (GHGs), and builds on the UNFCCC by setting binding targets for GHG emissions from industrialised countries. Development of the Kyoto Protocol involved extensive negotiations from its initial adoption in 1997 to its enforcement in 2005 (SCOPE 2004). These negotiations were needed to clarify protocol coverage, and to address the political concerns of a sufficient number of countries to

ensure the protocol was ratified (SCOPE 2004). Nonetheless, a number of countries did not sign the protocol, notably the United States of America (largest GHG emitter) and Australia (largest GHG emitter per capita). Similar political concerns prevented inclusion of binding targets in the UNFCCC thirteen years earlier (Kininmonth 2004). This meant that there were more UNFCCC signatories than the Kyoto Protocol, but that the UNFCCC had minimal impact on GHG emissions (Kondratyev et al. 2003; SCOPE 2004).

The Role of Climate Policy in Reducing Deforestation

One potential system for explaining deforestation has developed through the worldwide climate negotiations under the United Nations Framework Convention on Climate Change (UNFCCC). Policy incentives to reduce deforestation and forest degradation, or REDD, are being considered as part of a new climate agreement. Real advance was made in Cancun in November, 2010, and will keep on being arranged at the next meetings. “REDD+” goes beyond deforestation and forest degradation and incorporates the part of protection, feasible administration of timberlands and improvement of forest carbon stocks. There are numerous issues that must be considered when outlining arrangements to protect forests either utilizing an asset or carbon markets. Since national, local and local-level would eventually regulate household REDD+ programs, execution challenges in developing world must be considered when assigning funds for REDD+. For governments that have feeble administrative requirement structures, it is hard to screen and implement behavior that preserves carbon stocks of standing forests. Correspondingly, for governments where dishonesty is a big problem, it might be hard to guarantee that REDD+ funding and benefits are impartially circulated to people who are decreasing deforestation on their properties or increasing carbon sequestration through reasonable land use practices. Describing land tenure problems and financial inequities are essential components when instituting official capacity for REDD+. There must be other financial and incentives policies should be developed to manage forests and farming lands for carbon capturing and storage on appropriate basis, for farmers who do not have formal title to their land. It is not clear to date, whether farmers without ownership of land will have access to REDD+ funding or not. One solution may be to advance existing cooperatives and agriculturists' relationship to channel REDD+ assets to small farmers who keep their property forested or who build up agroforestry and silvopastoral systems to enhance carbon storage and sequestration. Cooperatives, agriculturists' affiliations and extension offices additionally could serve as a mechanism to give on REDD+ preparing on REDD+ and to help small farmers in acquiring payments to support reduced forest clearing and other economical land use performs. Though, clear land tenure does not generally prompt clear responsibility for carbon credits from trees and forests. The progress of actual laws and organizations that simplify land tenure and get profits from the sale of carbon credits at the local, provincial and national levels are important to advance decreased deforestation and consider for reasonable access to revenue generated by REDD+. Since REDD+ policies and projects eventually will be directed by national governments, evaluations and changes of opposing government-drove strategies and projects that lead to across the board deforestation in nations additionally should happen before REDD+ can be a fruitful technique. National governments cannot stimulate forests preservation and restoration policies and programs at the same time (i.e., REDD+) whereas in the meantime give

incentives for farming venture into forested zones (either directly or indirectly) by means of sponsorships and laws that promote and advance these practices.