

# Syllabus for M.A./M.Sc. Environmental Studies

## Paper-4

### METHODOLOGIES FOR ENVIRONMENTAL STUDIES

**Preamble:** This paper introduces the students to various methods used in the collection of data and analysis for environmental studies. Simulation model are increasingly used to investigate the complexity of environmental processors. The paper introduces the students to the basics of modeling along with the application of remote sensing and GIS in different aspects of environmental studies.

Data collection, survey and processing including social and cultural parameters. Statistics: Normal and binomial distribution. Hypothesis testing, t and chi square tests. Correlation and regression. Introductory analysis of variance. Multi-criteria analysis.

Modeling: Types of models: Mechanistic, economic, simulation etc. Fundamentals of building a model. Treatment of 2 or 3 environmental related models: Eutrophication model, global climate change model, wildlife habitat suitability model, air pollution model, ground water pollution model.

Remote Sensing: definition, principles, satellites and sensors. Aerial photography to Satellite Remote Sensing. Digital Image processing and image interpretation. GPS principles and applications. Geographic Information System: concepts, database generation and analysis.

Applications of Remote Sensing-GIS for environmental studies. Case studies, such as,

- a. Land use / land cover change, Forest degradation, Urban sprawling.
- b. Mining Hazards / Impacts.
- c. Forest Fire / Coal Fire Monitoring.

#### **Suggested Readings:**

Demers, Michael N., 2005, M.N. Fundamentals of Geographic Information Systems. Wiley & Sons, 2<sup>nd</sup> Ed.  
Freund. R.J., Wilson W.J., 2003, Statistical Methods, Academic Press.

Lillesand. T.M. and Kiefer. R.W., 1999, Remote sensing and image interpretation. 4<sup>th</sup> Ed. Wiley & Sons.

Wainwright. J. & Mulligan. M., 2004, Environmental Modeling. John Wiley & Sons Ltd.

## Paper-5

### ENVIRONMENTAL RISK AND IMPACT ASSESSMENT

**Preamble:** This paper is an introduction to EIA, a systematic process that examines the environmental consequences of development actions, in advance. This process is firmly on the agenda of all environmental agencies as a result of introduction of legislations in various countries.

Introduction: Defining environmental risk in different perspectives.

Principles and procedures: Nature and purpose of environmental impact assessment (EIA). Characteristics of big project. Current issues in EIA. Worldwide spread of EIA. EIA regulations in India. Risk Assessment v/s Environmental Impact Assessment. Life cycles Assessment. Strategic Environmental Assessment.

Process and Methods of EIA: Stages, Scoping, Alternatives, Impact Identification, Establishing the Environmental base line. Impact prediction, evaluation and mitigation. Criteria and standards for assessing significant Impact. Cost- Benefit Analysis and valuation of Environmental Impacts. Public Participation, presentation and review. EIA monitoring and auditing.

Practice: Air quality Assessment; Water Impact Assessment; Social Impact Assessment; Ecological Impact Assessment; Landscape and visual Impact Assessment; Environmental Impact of surface and underground mining of metals, minerals and fossil fuels. Cumulative Effects Assessment.

Issues and problems in environmental assessment.

#### **Suggested Readings:**

Glasson J., Therivel R., Chadwick. A., 1994, Introduction to environmental impact assessment- Principles and procedures, process, Practice and prospects. Research Press, Delhi.

Morris. P. & Therivel. R., 2001, Methods of environmental impact assessment, 2<sup>nd</sup> Ed. Spon Press, New York, With a chapter on GIS and EIA by A.R. Bachiller & G. Wood, p. 381-401.

Petts Judith, 1999, Handbook of environmental impact assessment. Vol. 1, Blackwell Science.

# **M.A. Stream**

## **Paper-9 (M.A.)**

### **ENVIRONMENTAL AND RESOURCE ECONOMICS**

**Preamble:** Economics & ecology must be completely integrated in decision making & law making processes and there should be an effort to increase understanding of intriguing policy problems. Environmental and resource economics makes use of ideas and tools developed in other branches of economics to make significant contribution to valuation techniques, design of policy instruments for pollution control and management of commons.

Introduction: Overview of Central Issues; Refresher on Supply and Demand

Basics of Welfare Economics: Producer and Consumer Surplus, Market failure, Externalities, Public Goods, Pareto Optimality

Cost-Benefit Analysis and Valuation: Discounting, Principles of Cost-Benefit Analysis, Estimation of Costs and Benefits, Techniques of Valuation

Non-Renewable Resources: Economics of Fuels and Minerals, Hotelling's rule and Extensions, Taxation, Recycling, Waste Management

Renewable Resources: Economics of water use, Management of Fisheries and Forests

Pollution Control: Policies for Controlling Air and Water pollution, Disposal of Toxic and Hazardous Waste- Standards vs. Emissions Charges

Regional and Global Concerns: Acid rain, Ozone depletion, Greenhouse Effect, WTO and environment, Natural Disaster Management.

Growth, Resources and the Environment: Resource Scarcity, Poverty, Sustainable Development, Foreign Aid.

#### **Suggested readings:**

Baumol, W.J. and Oates, W.E., 1988, *The Theory of Environmental Policy* Cambridge University Press.

Bhattacharya, R.N. (Ed.), 2001, *Environmental Economics: An Indian Perspective*, O.U.P.

Bromley, D.W. (Ed.), 1995, *Handbook of Environmental Economics*, Blackwell.

Kadekodi, G.K., (Ed.), 2004, *Environmental Economics & Practice*, O.U.P.

Kolstad, Charles, 2000, *Environmental Economics*, Oxford University Press.

Tietenberg, Tom, 2003, *Environmental and Natural Resource Economics* (sixth edition) Pearson Education.

## Paper-15 (M.A.)

### ENVIRONMENTAL COMMUNICATIONS AND EDUCATION

**Preamble:** This paper focuses on methods of communication to the masses and consumers for environmental issues. It also provides an overview of the scenario of environmental education and communication at the national and international levels.

Environmental education and environmental literacy: Need for public awareness.

Fundamentals of Mass communication: What is communication? Defining Communication; Types of Communication; Mass Communication: an introduction; Role of Mass media.

Basics of Science & Technology (S&T) Communication: Role of Communication in Modern Science; 'Public' nature of science; Science and Public: Historical overview; Why communicate S&T; When public meets science

Channels of S&T Communication: What are channels; Broadcast media and S&T; Print media and S&T; Telecast Media and S&T; Science through little media; Use of group media for S&T communication.

Pragmatic aspect and contexts of science & environmental communication: Strategies for Communication; Use of analogies; Metaphor and Simile; Human and With Examples and illustrations; Anecdotes and personalizing; Context for science and environmental communication; Human interest; Cultural needs; Survival needs; Sources of information; ethics in reporting & fundamentals of media laws.

Educating Consumers: Consumer Behavior and Environment: Role of Information, Eco- Labeling  
Environmental communication Today: Introduction; Over view of the scenario in the country; International scenario; Canonical texts (Critical reading of Books on Environmental communications such as Silent spring); case studies of media reports that had impact; Analysis of mass media coverage of complex environmental issues and the media's effects on public opinion and government environmental policies.

#### **Suggested Readings:**

- Greenough, Paul et al., 2003, Nature in the Global South: Environmental Projects in South and South-East Asia, Orient Longman.
- Krarup, S. and Russell, C. S., 2005, Environment, Information and Consumer Behaviour (Ed.), Edward Elgar, UK.
- Orr, D., 1994, Earth in mind: on education, environment and the human prospect, Island Press, Washington, D.C.
- Saberwal, Vasant et al., 2001, People, Parks, Wildlife: Towards Co-Existence, Orient Longman.
- Valdiya, K.S., 2004, Geology, Environment and Society, Universities Press.

## Paper-16 (M.A.)

### TECHNOLOGY, ENVIRONMENT AND SOCIETY

**Preamble:** A study of the relationship between technology and environment with the aim to understand the role and contribution of different types of economic and social mechanisms that the contemporary societies have been able to evolve to shape the technological changes in the direction of sustainable development and to achieve ecological and social justice.

Understanding the relationship of technology with environment through the analysis of shifts in the perceptions of societies in the countries of technologically advanced and developing world.

Study of “technological innovation as a solution/ remedy for environmental problems”, “technological impacts / innovation and technology adoption effects of environmental policies”;

Environmental policy assessment for the evaluation of impact on environmental costs, assessment of the effectiveness of alternate policy instruments in containing environmental damage, the encouragement to technology transitions and environmental technology innovations for the achievement of ecological and social justice.

Assessments of the developments within the relevant fields of science and technology for the achievement of sustainable development in the world in general and in India in particular; the management of transition to environmentally and socially just futures for energy, transportation, climate change, handling of toxics, agriculture, water, forests, etc.

Impacts of social movements for the achievement of ecological and social justice in India; corporate responsibility movement, appropriate technology movement, environmental groups and movements, citizen groups, etc.; developments within the field of integrated technology assessment, innovation policy tools, pathways creation for sustainable development, etc.

#### **Suggested Readings:**

- Elliot David, 2003, Energy, Society and Environment, Technology for a Sustainable Future, Routledge
- Jasanoff Sheila, 2002, New Modernities: Reimagining Science, Technology and Development, In Environmental values.
- Jasanoff Sheila, 2003, Technologies of Humility: Citizen participation in governing science, In Minerva.
- Juma. C, Konde. V, 2002, Technical change and sustainable development, Developing country perspectives, American association for the advancement of science (AAAS).
- Makofske, W.J. and Karlin, E.F., 1995, Technology and Global Environmental issues, Addison Wesley Longman, Toronto.
- Mawasley. E, 2004, India's middle classes and the environment development and change.
- Vernon W. Ruttan, 2000, Technology, Growth, and Development: An Induced Innovation Perspective, Oxford University Press, New York.
- Visvanathan Shiv, 2000, Environmental values, Policy and conflict in India, Carnegiecouncil.org

## **Paper-10 (M.Sc.)**

### **NATURAL & MANAGED ECOSYSTEMS**

**Preamble:** This paper deals with some important aspects of Ecology. The course also emphasizes the distinction between natural and managed ecosystems which calls for different management approaches and strategies for sustainable development.

Introduction to Ecosystems: concepts; components; flow of energy; productivity, cycling of materials and nutrients, Food chain.

Communities: concept; development; structure; niche; regulation of community structure.

Ecosystem dynamics and functioning: role of biodiversity in patterns and processes of communities and ecosystems; stability, disturbance and resilience.

Ecosystem types and their distribution. Classification; Major ecosystems of the world (forests, grasslands, wetlands, oceans, rivers and lakes, deserts). Managed Ecosystems; Agri-Ecosystems, Aquaculture, Urban Ecosystems and Community Forests.

Ecosystems and Human well-being: Ecosystem services; Natural and Human induced changes in Ecosystems and their consequences on human well-being.

Sustainable Management: Concept of sustainability; Mechanisms to ensure sustainability of Ecosystems – Changes in institutional and Environmental governance framework; Economic and financial interventions; Social and Behavioral changes; Technological options; Design of effective decision making process; Vision for an ecologically sustainable future.

#### **Practicals:**

Projects/Practicals based on field visits to:

Natural ecosystems, one or two managed ecosystems.

Viva-Voce based on these two project reports.

#### **Suggested Readings:**

Clapham Jr., W.B., 1983, Natural Ecosystem: Chapters I, II, III and IV. Macmillan Publishers, London  
Gadgil Madhav, 2004, Ecological Journeys. The Science and Politics of conservation in India, Permanent black, Delhi.

Heywood, V.H. (Executive Editor), 1995, Global Biodiversity Assessment: Chapters 5 and 6. UNEP, University Press, Cambridge

Jennifer, A., Burch. W.R., Conover, B. and Field, D., 1998. Ecosystem Management: Adaptive strategies for Natural Resources organizations in the 21<sup>st</sup> Century. Taylor and Francis, London.

Reid, W.V. et al (Ed.), 2005, Ecosystems and Human well-being: Synthesis. p.1-37. Millennium Ecosystem Assessment, World Resource Institute, Island Press, Washington DC.

Samson, B.F, and Knoff, F.L., 1996, Ecosystem Management. Springer-Verlag, New York.

## BIODIVERSITY AND CONSERVATION BIOLOGY

**Preamble:** This course entails the study of diversity existing at different levels of Biological organization and understanding the essential ecological and biological processes which ensures long terms stability of ecosystems. The course highlights the values of biodiversity and scientific approaches to conservation which only can lead to sustainable development and safeguard the interests of future generations.

### Section A. Biodiversity:

Concepts: Organic Evolution through geological time scale. Ecosystems, Biomes etc.

Levels of Biodiversity: Community diversity (alpha, beta and gamma biodiversity), Gradients of Biodiversity (latitudinal, insular), Ecosystems diversity: biomes, mangroves, coral reefs, wetlands and terrestrial diversity (equilibrium mix of *G* and *W*).

Species diversity: richness and evenness, loss of species. Magnitude of biodiversity (Global and Indian data). Direct and indirect benefits, Bioprospecting (molecular techniques like RAPD, RFLP, AFLP, DNA sequencing etc).

Genetic diversity: sub species, breeds, race, varieties and forms. Variation in genes and alleles at DNA sequence levels (selected case studies). Microbial diversity and useful prokaryotic genes. Speciation (amount of genetic variation is the basis of speciation). Consequences of monotypic agricultural practice (Detailed case studies).

Threats to Biodiversity: Habitat loss and fragmentation; Disturbance and pollution; introduction of exotic species; extinction of species.

Human intervention and Biodiversity loss: Global Environmental changes, land in water use changes.

### Section B. Conservation Biology.

History of Conservation movements: International and National. Ecologically relevant parameters (viable population, minimum dynamic area, effective population size, metapopulations); reproductive parameters in conservation (breeding habitats, mating systems, inbreeding depression, genetic bottlenecks, genetic constraints).

IUCN categorized-endangered, threatened, vulnerable species. Red data book and related documentation.

Methods of conservation. *In situ* (Biosphere reserves, National Parks, Sancturies, Sacred groves etc) & *ex situ* (Botanical gardens, Zoological gardens, Gene banks, Pollen, seed and seedling banks, tissue culture and DNA banks etc) modes of conservation.

Benefits of conservation: Biodiversity as a source of food and improved varieties; source of drugs and medicines; Aesthetics and cultural benefits. Sustainable development. Ecosystems services (maintenance of gaseous composition of the atmosphere, climate control by forests and oceanic systems, Natural pest control, pollination of plants by insects and birds, formation and protection of soil, conservation and purification of water, nutrient cycling).

### Practicals:

Measurement of species diversity (calculation of Diversity Indices from data collected on plant species in the ridge forest.

Measurement of biodiversity at molecular level by RFLP, RAPD, AFLP analyses.

Blast analyses of selected DNA sequences from the International Gene Banks.

### Suggested Readings:

Daily, G.C., Ed., 1997, Nature's Services: Societal Dependence on Natural Ecosystems. Island Press, Washington, D.C.

Dobson, A.P., 1996, Conservation and Biodiversity. Scientific American Library, New York, NY.

Gaston, K J. and J.I. Spicer, 1998, Biodiversity: An Introduction. Blackwell Science, London, UK.

Groom bridge, B., and M. Jenkins, 2000, Global Biodiversity: Earth's Living Resources in the 21<sup>st</sup> Century. World Conservation Press, Cambridge, UK.

IUCN, 2004, Red list of threatened species. A global species assessment. IUCN, Gland, Switzerland

Loreau, M., and P. Inchausti, 2002, Biodiversity and Ecosystem functioning: Synthesis and Perspectives. Oxford University Press, Oxford, UK.

Primack, R.B., 2002, Essentials of Conservation Biology, 3<sup>rd</sup> Edn., Sinauer Associates, Sunderland, Ma. USA

Wilson, Edward O., 1993, Diversity of Life. Harvard University Press, Cambridge, MA.

## Paper-11 (M.A.)

### INDIAN AND INTERNATIONAL ENVIRONMENTAL LAW

**Preamble:** Environmental law is that branch of law for planetary housekeeping, protecting the planet and its people from activities that upset the earth and its life-sustaining capacities. This paper aims to understand and apply a range of regulatory instruments to preserve and protect the environment. It also emphasizes on identifying the strengths and weaknesses in law and its enforcement and develops strategies to overcome the same.

Environmental laws: an introduction. Legal meaning of environment. Forms of pollution-causes and effects. Need for legal control.

International Perspective: Human right to environment. From Stockholm 1972; to Rio 1992 and beyond; Johannesburg Summit 2002, Delhi Summit 2002.

Fundamental principles of environmental protection: sustainable development-Brundtland report 1987. Intergenerational and intra-generational Equity, Polluter pays principle, precautionary principle, Environmental Impact Assessment, Environmental audit, Public Trust Doctrine, Indian judicial response.

Constitutional Perspective: Fundamental right to wholesome environment. Article 14, 19 (1) (g), 21 & 32 of the constitution. Directive principles of state policy-Article 47, 48A of the constitution. Fundamental duty-Article 51A (g) of the constitution. Public interest litigation-Nature, standing and doctrine of Pro Bono Publico, Judicial response.

Environmental Protection Legislations: The Water (Prevention and control of Pollution) Act 1974; The Air (Prevention and Control of Pollution) Act 1981; The Environment (Protection) Act 1986; Forest Act 1927; Forest Conservation Act 1980; The Wild life Protection Act 1972(2002 Amendment); Biodiversity Act 2002; The Noise Pollution (Regulation) 2000.

Legal control of Hazardous waste – Biomedical waste, genetic waste, e-waste. Industrial accidents-principle of ‘no-fault’ and absolute liability. Public liability insurance-Act 1991. National environment tribunal 1995.

National Appellate Environmental Authority-Act 1997. Constitution, Powers, Functions, Roles.

#### **Suggested Readings:**

Bell Stuart & Mc Gillvray Donal, 2001, Environmental Law, Universal Law Publishing Co.

Diwan Shyam and Rosencranz Armin, 2002, Environmental Law and Policy.

Hughes David, 1992, Environmental Law, Butterworths.

Jariwala C.M., 2004, Environmental Justice, APH Publishing Corporation, N. Delhi

Leelakrishnan. P, 2004, Environmental Law Case Book , Lexis Nexis, Butterworths

Mohanty. S. K., 2004, Environment and Pollution Law, Universal Law Publishing Co. Pvt. Ltd.

Singh Gurdip, 2004, Environmental Law in India, Mcmillan & Co.

Singh Gurdip, 2003, International Environmental Law, in Gurdip Singh, International Law, Macmillan.

Shastri. S. C., 2005, Environmental Law, Eastern Book Company.



## Paper-13 (M.Sc.)

### ECOTOXICOLOGY AND ENVIRONMENTAL HEALTH

**Preamble:** This paper discusses the source, origin and effect of various toxic materials and heavy metals that adversely affect environmental health. In addition, the lectures would focus on the methods to detect and estimate the concentration of toxic chemicals and other contaminating substances that are polluting the environment with an adverse effect on it.

#### **Section A: Ecotoxicology**

Ecotoxicology as a Synthetic Science;

Major classes of Environmental Pollutants; Inorganic, Heavy Metals, Organics, Organometalics, Radioactive Isotopes, Gases

Routes of Entry into Ecosystems – Surface waters, Land, Atmosphere; Long-range movement and global transport of pollutants. Fate of pollutants in Ecosystems: Biotransformation, Bioaccumulation & Biomagnification. Test organisms used in Bioassays. Biomonitoring: Definition of toxicity, F, As, Hg problems

Toxicity Testing, Concept of Dosimetry: lethal, sub-lethal & chronic tests, dose response curves, LC50, MATC-NOEC, Brief statistical methodology

Toxicant Effects: - Cellular, organismic, population & Ecosystem-Level Effects; Global Effects – Acid rain etc.

#### **Section B: Environmental Health**

Toxicology & Epidemiology and occupational health

Sources: Solid & Hazardous wastes, untreated sewage, Automobile exhausts, Industrial Effluents, Industrial emissions into atmosphere, Agricultural run-off of Pesticides

Environmental Carcinogens, Mutagens, Asbestos issues

Human adaptation to cold and hot climates, high altitude environment and man-made environments.

Water pollution – Caused diseases (Gastroenteritis, Hepatitis etc.). Air pollution caused diseases (allergies, respiratory diseases). Food-borne diseases (Food poisoning, parasites etc). Vector transmitted diseases. Radioactive effects. Risk assessment.

#### **Practicals:**

Air quality assessment

Potable water quality assessment

Analysis of toxic heavy metals in soil and water.

#### **Suggested readings:**

##### ***Ecotoxicology:***

Newman, M.C, Lawrence, C.A., and Unger. M.A., 2002. Ecotoxicology: Fundamentals of Ecotoxicology, 2<sup>nd</sup> Ed., CRC Press, Boca Raton, Florida.

Walker, C.H., Hopkin, S.P., Sibly, R.M., and Peakall, D.B. 2001. Principles of Ecotoxicology. 2<sup>nd</sup> Ed. Taylor & Francis, London.

##### ***Environmental Health:***

Moore, G.S., 2002, Living with the Earth: concepts in Environmental Health Science (2<sup>nd</sup> Ed.), Lewis publishers, Michigan.  
Selinus, Alloway, Centeno, Finkelman, Fuge, Lindh, Smedley; 2005, Essential of Medical Geology; Elsevier Academic Press.