PART III.- COURSE CURRICULUM

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This part of the manual is divided into 24 sections, each of which corresponds to a thematic unit of the course curriculum. While the course curriculum presented herein has been tested in the first two pilot courses presented in Merida, Venezuela, during 1986, its components, structure and sequence should be revised and adjusted for future course offerings to ensure that it fulfills the specific course interests and intended orientation.

The 24 unit summaries are presented following a common format to facilitate their understanding and include, when applicable, the following information:

1.- Unit sequence number and title

2.- Objective

3.- Time allotment

4.- Contents

5.- Classroom and/or homework exercises

6.- Recommended instructor's reading

7.- Additional instructional material

8.- Additional suggested bibliography

9.- Sample exam questions

Selected support materials for the Course Curriculum section of this manual are presented in **Vol II.-COURSE MANUAL: ANNEXES.**

UNIT #1: COURSE INTRODUCTION

OBJECTIVE: Introduction of the course, the sponsoring organizations and the collaborating institutions. Explanation of the course objectives, structure, schedule, and requirements.

TIME ALLOTMENT: 2 hours

CONTENTS:

1.- Description of the institutions that are participating in the organization and presentation of the course

2.- Description of the evolution of the course

3.- Presentation of the course objectives

Within an integrated development planning context and through an interdisciplinary approach, the basic objectives of the course are:

a.- to familiarize the participants with available information on natural hazards, including an understanding of its generation, content, orientation, and potential uses in development planning activities;

b.- to generate an awareness among the participants concerning the importance of natural hazard management in development planning;

c.- to familiarize the participants in the use of natural hazards information in the formulation and evaluation phases of the preparation of investment projects; and,

d.- to expose the participants to a multidisciplinary working group and to provide them the opportunity to develop the necessary technical attitude and language to address natural hazards and development planning issues in such groups.

4.- Explanation of the course structure

a.- principal weekly topics

b.- brief description of the course units

c.- classroom and homework exercises

d.- participants case studies

e.- course case study

f.- technical field trips

g.- evaluations systems (examinations, classroom and homework exercises, individual case studies, course case study, and field trip reports)

h.- academic requirements (attendance, approval, etc.)

i.- course evaluation by participants

5.- Question and answer period

END OF UNIT #1

UNIT #2: NATURAL HAZARDS AND THE PROCESS OF INTEGRATED DEVELOPMENT PLANNING

OBJECTIVE: Introduction of terms and concepts relevant to natural hazards issues within an integrated development planning perspective

TIME ALLOTMENT: 3 hours

CONTENTS:

1.- Natural Hazards

a.- types of natural hazards

1.- geologic
2.- atmospheric
3.- hydrologic

b.- relationship between disciplines and natural hazards information

1.- producers
2.- users

c.- basic types of information about natural hazards and the components which characterize those hazards

1.- event: presents natural phenomena in terms of geographic location and historic records

2.- hazard: presents estimated recurrence and/or geographic locations of possible and/or probable events

3.- risk: presents concepts of geographic location, magnitude, return period (frequency), and identification of event impacts

4.- vulnerability: presents risk information plus a determination of expected losses due to an event

d.- concepts related to the terms, "hazard mitigation," "hazard prevention," and "hazard reduction"

1.- the modification of the magnitude or frequency of an event
2.- the reduction of the hazard posed by an event
3.- the lessening of vulnerability of population and property at risk from an event
4.- the use of preparedness and emergency response measures to reduce losses should an event occur

2.- The "vicious cycle" of disasters

Reflecting on the natural disaster occurrences and hazard management activities that come to pass in most countries, a vicious cycle is discernable that does not permit the design and implementation of adequate hazard mitigation. The principal factor is the lack of integration between the different hazard management activities and the development planning process. The principal elements of that cycle are **(See Annex III.2.1)**:

a.- occurrence of a disaster;

b.- emergency response;

c.- rehabilitation (recovery);

d.- reconstruction;

e.- mitigation and prevention;

f.- emergency preparedness; and,

g.- pre-event anticipation with or without monitoring and alert.

3.- Principal protagonist in natural hazards management

There are three general protagonist groups which are different in nature but through whose efforts effective hazard management can take place:

a.- scientific research (universities, research centers, government agencies, etc.)

b.- disaster preparedness and emergency response entities

c.- integrated development planning and sectorial agencies

4.- Principal elements of an integrated development planning process

a.- evaluation of natural resources, including natural hazards, and of social, economic and institutional aspects

b.- definition of development strategies and identification of regional and sectorial investment projects

c.- formulation of investment projects and their implementation

5.- Important aspects of natural hazards information

a.- relationship between the type of information and the uses to which it will be put in terms of priorities, presentation, terminology, etc.

b.- geographic, administrative, and political focus

c.- temporal context

d.- geographic scale

e.- content

f.- use of the information in the different stages of an integrated development planning process

6.- Priority areas in natural hazards research and disaster management

a.- prevention and mitigation within an integrated development planning context

b.- increased attention to atmospheric and hydrologic events concurrent with geological event research

c.- development of natural hazard assessment methodologies for use within the planning process

d.- restructuring of the project formulation process to amplify use of hazards information

e.- training of development planners, particularly project formulation specialists, in the use of natural hazards information

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RECOMMENDED INSTRUCTOR'S READINGS:

1.- **Bender, Stephen O.,** (1985). "Disaster Mitigation as Part of Integrated Regional Development Planning," in Proceedings of the International Conference on Disaster Mitigation Program Implementation, College of Architecture and Urban Studies, Virginia Polytechnic Institute and State University. **(See Annex III.2.2)**

2.- **Bender, Stephen O.,** (1985). "Natural Hazards Assessment in Integrated Regional Development." OAS/Dept. Regional Development. **(See Annex III.2.3)**

ADDITIONAL SUGGESTED BIBLIOGRAPHY:

Cuny, Frederick, (1983). Disasters and Development. Oxford University Press.

David, Ian, (1983). Disasters as Agents of Change ? or: Form Follows Failure. HABITAT INTL., No. 5/6, Great Britain.

Hagman, Gunnar, (1984). Prevention Better Than Cure. Swedish Red Cross, Stockholm.

Hewitt, K., Ed., (1983). Interpretations of Calamity. Allen & Unwin, Boston.

Independent Commission on International Humanitarian Issues, (1985). Famine: A Man Made Disaster? Vintage Books, New York.

Sen, Amartya, (1981). Poverty and Famines: An Essay on Entitlement and Deprivation. Clarendon Press, Oxford.

Wijkman, A. and L. Timberlake, (1984). Natural Disasters Acts of God or Acts of Man? Earthscan, London.

UNIT #2 HOMEWORK EXERCISE

COURSE ON THE USE OF NATURAL HAZARDS INFORMATION IN THE PREPARATION OF INVESTMENT PROJECTS

Instructions: Complete the table by identifying the relevant agencies that work in these areas in your country.

HAZARDS	SCIENTIFIC INVESTIGATION (1)	TRANSLATION (2)	IMPLEMENTATION (3)
1.- Geologic Hazards			
Earthquakes			
Volcanic Eruptions			
Tsunami			
Landslides			
2.- Atmospheric and Hydrologic Hazards			
Hurricanes			
Floods			
Drought			
Desertification			
Frost and Freezes			
Fires (Forests, etc.)			

Notes: (1) Agencies responsible for basic and applied research.
(2) Agencies responsible for assessment and information translation and dissemination.
(3) Agencies responsible for the introduction and use of the information in the formulation of programs and projects.

EXAM QUESTIONS:

1.- Define the following terms as they relate to natural hazards:

   a.- event

   b.- hazard

   c.- risk

   d.- vulnerability

   e.- hazard management

2.- Describe the differences between the following types of natural hazard information:

   a.- event information

   b.- hazard information

   c.- risk information

   d.- vulnerability information

3.- For the case of earthquakes, describe the thematic content of one type of map which corresponds to each of the following types of natural hazards information:

   a.- event information

   b.- hazards or risk information

   c.- vulnerability information

4.- Identify the three principal protagonist groups which should participate in natural hazard management.

5.- Which are the three most important information components necessary to characterize a natural hazard ?

END OF UNIT #2

UNIT #3: ENVIRONMENTAL MANAGEMENT AND NATURAL HAZARDS

OBJECTIVE: Introduction of terms and concepts relevant to methods of environmental management planning which specifically generates and includes natural hazards information.

TIME ALLOTMENT: 3 hours

CONTENTS:

1.- A brief discussion of the currently used definitions of "human environment" and of the on-going debate on "environment and development"

a.- environment as defined by the dictionary:

"Set of natural, social, and cultural values which exist in a given place and point in time that influences the material and psychological life of man."

"The aggregate of all external conditions and influences affecting life and development."

b.- environment as defined by the Cocoyoc, Founex and Stockholm Conferences

c.- environment as defined by The World Bank, SCOPE and the OAS

d.- conclusion: There are an infinite number of environments (equal to the number of all human beings and their past, present and future groupings) and that it is much more than nature and/or natural resources.

2.- The concept of ecosystem and its use in environmental management planning, **(See Annex III.3.1)**

a.- Any ecosystem has biotic and abiotic portions.

b.- All ecosystems have structure and function.

1.- flow and storage of energy
2.- recycling of materials
3.- accumulation of information through generic adaptation

c.- Succession and change are significant characteristics of ecosystems.

1.- They occur when photosynthesis or the input of energy is greater than respiration.
2.- By holding an ecosystem at the earlier stages of succession, it is possible to harvest the excess energy.

d.- Goods, services and hazards are the economic, cultural, social and political manifestations of ecosystem's structure and function, **(See Annex III.3.2 and Annex III.3.3)**. They have value or are a problem for the following reasons:

1.- Certain characteristics of ecosystem structure and function have economic, cultural, or social utility and therefore are of value for current development.
2.- Certain characteristics of ecosystem structure and function have scientific utility and therefore are of value for future development.
3.- Certain characteristics of ecosystem structure and function are important for the control of that system and there for are of value for long-term development.
4.- Certain characteristics of ecosystem structure and function are important because they are dangerous to the activities of development within the same or allied systems, and their control or mitigation is important for actual, future and long-term development.

3.- Quality of life and environmental quality

a.- The quality of an environment is measured in terms of its capacity to offer goods and services that satisfy the needs of the individuals and groups which belong to that environment.

b.- needs

While necessities (and desires) change according to culture, race, age, sex, seasons, climate, education, income levels, etc., their satisfaction normally generates conflicts in terms of resource allocation. Something can be considered a necessity if:

1.- its absence causes illness;
2.- its presence prevents illness;
3.- its reintroduction heals illness; and,
4.- if the deprived person prefers it to other satisfactions.

4.- Environmental management concepts:

a.- Development: is the use, improvement and/or conservation of system goods and services and the mitigation of hazardous events.

b.- Environmental management: is the planning and implementation of actions geared to improve the quality of human life.

c.- Negative environmental impacts: are the result of any activity of development (or the result of any hazardous event) which prohibits the use of, deteriorates, or destroys goods and services which could be used or are being used to improve the quality of human life. **(See Annex III.3.4).**

5.- Erroneous concepts and terms in the "environmental" literature

It is very common to find certain terms in the current literature which, in the absence of a previous and well defined concept, lack meaning and lead to unappropriate understanding and treatment of environmental management issues. Some of these are the following:

a.- "the environment": Whose environment?

b.- "fragile ecosystems": A term used in the popular press but which has not been studied and to date has no scientific basis.

c.- "environmental problem": All problems except for those which arise from within are environmental problems.

d.- "environmental project": All development projects are designed to improve someone's environment.

e.- "environmental expert": Given the nature of environments, there can never be an environmental expert.

f.- "sustained development": Has not been defined and probably cannot be defined satisfactorily. A better phrase would be sustained flow of a system good or service.

HOMEWORK EXERCISE: (See Annex III.3.5).

RECOMMENDED INSTRUCTOR'S READINGS:

1.- **United Nations Environmental Program,** (1981). In Defense of the Earth; The Basic Text on Environment: Founex, Stockholm, Cocoyoc. Executive Series 1.

2.- **Munn, R.E.,** (1975). Environmental Impact Assessment. Scope 5. International Council of Scientific Unions. Scientific Committee on Problems of the Environment.

3.- **Ehrenfeld, D.W.,** (1976). "The Conservation of Non-resources," in American Scientist. Vol. 6:648-656.

ADDITIONAL SUGGESTED BIBLIOGRAPHY:

Gosselink, J.G., E.P. Odum, and R.M. Pope, (1973). "The Value of the Tidal Marsh". Center for Wetland Resources, Louisiana State University. Baton Rouge. L8U-8G-74-03.

Lugo, A.E., (1978). "Stress and Ecosystems," in J.H. Thorp and J.W. Gibbons, Eds., Energy and Environmental Stress in Aquatic Systems. Department of Energy of the United States, DOE Symposium Series.

Maslow, A.H., (1962). Towards a Psychology of Being. D. Van Nostrand Co., New York.

Organization of American States, (1984). Integrated Regional Development Planning: Guidelines and Case Studies from OAS Experience. Department of Regional Development. Secretariat for Economic and Social Affairs. Washington, D.C.

Odum, E.P., (1962). "Relationship Between Structure and Function in Ecosystems", in Japanese Journal of Ecology 12:108-118.

Streetton, P. and S. Burki, (1978). "Basic Needs: Some Issues", in World Development. Vol. 6:411-21.

Saunier, R.E., (1983). "Environment and Development ... a Future Together?" in Development Forum, XI No. 8. Nov-Dec.

Saunier, R.E., (1984). "Regional Approaches Utilized in Development Planning." Natural Resource Technical Bulletin. AID-NPS Natural Resources Project No. 5.

EXAM QUESTIONS:

1.- Define and comment on the term and concept of "human environment."

2.- Define and comment on the term and concept of "ecosystem" in terms of its significance for "environmentally sound development."

3.- Explain what is a human need, and what determines the quality of an environment.

4.- What can be considered an "environmentally sound development strategy?"

5.- Explain how are natural and anthropic hazards related to environmental management and to development planning.

END OF UNIT # 3

UNIT #4: ATMOSPHERIC AND HYDROLOGIC HAZARDS

OBJECTIVE: A general introduction to atmospheric and hydrologic hazards including principal phenomena and concepts. Familiarize participants with basic terminology. Generate an awareness as to the importance of atmospheric and hydrologic hazards in integrated development planning.

TIME ALLOTMENT: 3 hours

CONTENTS:

1.- Atmospheric and hydrologic hazards

a.- origin of the hazards

b.- characteristics of the hazards, (general considerations, causes, and effects)

1.- floods
2.- droughts
3.- frost
4.- winds

c.- available information and the integrated development planning process

1.- sources
2.- mitigation measures
3.- use of information in planning

2.- The "El Nino" Phenomenon

a.- general considerations

b.- nature of the phenomenon

c.- effects of the phenomenon

d.- information necessary for integrated development planning

3.- Desertification

a.- definition of the problem

b.- method for the identification and evaluation of desertification hazards

1.- necessary information
2.- desertification indicators
3.- desertification evaluation
4.- desertification monitoring

c.- preparation and use of desertification maps in development planning

1.- criteria for the preparation of the maps
2.- use of computer mapping techniques

d.- desertification prevention and control

RECOMMENDED INSTRUCTOR'S READINGS:

1.- **Lopez O., Carlos,** "Meteorological Hazards and Desertification," (lecture notes), Merida, Venezuela, 1986.

ADDITIONAL INTRUCTIONAL MATERIAL:

1.- **Video tape (Spanish),** "El Nino." Available through the Centro de Investigaciones de Zonas Aridas (CIZA), Universidad Nacional Agraria - La Molina, Casilla Postal 330, Lima 1, Peru.

2.- **Video tape (English),** "Planet Earth Series: The Climate Puzzle." Available through Films Incorporated, 5547 North Ravenswood, Chicago, Illinois 60640-1199.

ADDITIONAL SUGGESTED BIBLIOGRAPHY:

Dregne, H.E., (1983). Desertification of Arid Lands. Hardwood Academy Publishers, New York.

Garcia, R.V., (1981). Drought and Man: The 1972 Case History. Pergamon Press, New York.

Hall, A.L., (1978). Drought and Irrigation in North-East Brazil. Cambridge University Press, New York.

National Geographic Society (U.S.), (1978). Powers of Nature. Special Publications Division, N.G.S., Washington, D.C.

Reining, P., Ed., (1982). Handbook on Desertification Indicators. AAAS, Washington, D.C.

Sears, P.B., (1981). Deserts on the March. University of Oklahoma Press, Norman, Oklahoma.

Spooner, B. and H.S. Mann, Edts., (1982). Desertification and Development: Dryland Ecology in Social Perspective. Academy Press, New York.

Stiles, D., (1984). "Desertification: A Question of Linkage." in Desertification Control No. 10, UNEP.

Tolba, M.K., (1984). "A Harvest of Dust." in Desertification Control No. 10, UNEP.

Walls, J., (1980). Land, Man and Sand: Desertification and its Solutions. Macmillan Pub. Co., New York.

UNIT #4 HOMEWORK EXERCISE

ATMOSPHERIC AND HYDROLOGIC HAZARDS

Based on the material presented in class prepare a brief essay (approximately 150 words) on each of the following topics:

a.- The most predominant atmospheric and hydrologic hazards by geographic region in your country (you can follow either a topographic zoning or a transversal section of the country).

b.- The incipient and/or evidence of desertification processes that can be found in your country, and their respective social and economic impacts (examples of desertification processes: soil losses due to salinization, hydrologic and eolic erosion, poor drainage and floods, losses in the quantity and quality of surface and underground waters, reduction of the vegetal cover due to anthropic intervention, etc.)

EXAM QUESTIONS:

1.- Explain what are atmospheric and hydrologic hazards and what are their basic causes.

2.- Briefly explain which are the impacts of:

   a.- floods

   b.- winds

3.- What is the "El Nino" phenomenon?

4.- Briefly explain:

   a.- What is desertification?

   b.- Which are the principal anthropic causes of the desertification hazard?

   c.- Which are the principal atmospheric and hydrologic hazards that assist in the intensification of the desertification hazard?

   d.- What constitutes desertification prevention and monitoring?

5.- Explain how would you go about gathering and utilizing meteorological hazards information in the integrated development planning process.

END OF UNIT #4

UNIT #5: FLOOD HAZARDS

OBJECTIVE: Provide participants with an overview of flood hazards. Familiarize participants with the principal concepts and basic terminology, and with an understanding of the methodologies used in the evaluation of flood hazards for formulating investment projects. Generate an awareness about the importance of floods in integrated development planning.

TIME ALLOTMENT: 5 hours

CONTENTS:

1.- Basic concepts

a.- flood

b.- floodplain

c.- controlled floodway

d.- design flood

e.- flood severity

f.- vulnerability

g.- elements under risk

h.- specific risk

i.- risk

j.- frequency and magnitude

2.- Causes of floods

a.- tropical cyclones

b.- strong local storms

c.- combined atmospheric, hydrologic, and geologic factors

d.- artificial obstructions

3.- Analysis of flood events

a.- water depth

b.- water volume

c.- sediment content

d.- flood duration

e.- seasonal factors

f.- rate of water elevation

g.- return period (frequency)

h.- information sources

i.- time of occurrence

4.- Vulnerability analysis

a.- critical factors

1.- water depth

2.- flood frequency
3.- water volume
4.- topography

b.- basic criteria

1.- loss of life and injuries
2.- capital investment losses (infrastructure and production facilities)
3.- disruption of infrastructure and production facilities functions

c.- flood vulnerability classification

1.- frequent and infrequent floods
2.- low, medium, and high vulnerability

5.- Limitations in the use of lands and infrastructure

a.- application of standards and codes

b.- vulnerability index matrix

c.- vulnerability matrix for frequent floods

d.- vulnerability matrix for infrequent floods

6.- Flood damages

a.- damage evaluation method

b.- economic classification

1.- direct damages
2.- indirect damages
3.- secondary damages

7.- Annual damage and risks cost

a.- expected annual damages estimation

b.- flood frequency analysis

c.- risks cost

8.- Flood mitigation measures

a.- types of measures

1.- measures that reduce severity
2.- measures that reduce vulnerability
3.- emergency measures
4.- flood-proof construction
5.- flood insurance
6.- floodplain zoning
7.- flood warning system
8.- public education

b.- information requirements

1.- river geometry
2.- flow and elevation
3.- economic data
4.- value of expected damage

RECOMMENDED INSTRUCTOR'S READINGS:

1.- **Amisial Roger A.**, "Flood Hazards," (lecture notes), Merida, Venezuela, 1986.

2.- **Smith, K. and G. Tobin,** (1979). Human Adjustment to Flood Hazards. Longman, New York.

3.- **Southeastern Wisconsin Regional Planning Commission,** (1968). Floodland and Shoreland Development Guide, Wankesha, Wisconsin.

4.- USGS, (1984). Proceedings of the Geologic and Hydrologic Hazards Training Program. Open File Report 84-760. USGS, Reston, Virginia.

ADDITIONAL INTRUCTIONAL MATERIAL:

1.- Video tape (English), "Planet Earth Series: The Blue Planet." Available through Films Incorporated, 5547 North Ravenswood, Chicago, Illinois 60640-1199.

ADDITIONAL SUGGESTED BIBLIOGRAPHY:

James, D.L. and R.R. Lee, (1971). Economics of Water Planning. McGraw-Hill, New York.

Ministry of the Environment, (1975). Canada Water Year Book 1975. Information Canada, Ottawa.

UNDRO, (1977). Analysis of Combined Vulnerability: Methodology and Study of Manila's Metropolitan Zone. United Nations, Geneva, Switzerland.

UNDRO, (1978). Disaster Prevention and Mitigation, Vol. 2 Hydrological Aspects. United Nations, Geneva, Switzerland.

UNDRO, (1979). Natural Disaster and Vulnerability Analysis. United Nations, Geneva, Switzerland.

U.S. Water Resource Council, (1978). "Floodplain Management Guidelines for Implementing E.O. 11988." Washington, D.C.

Whipple, W., et al., (1983). Stormwater Management in Urbanizing Areas. Prentice Hall, New Jersey.

White, G.F., (1974). "Natural Hazards Research: Concepts, Methods and Policy Implications," in Natural Hazards, Local, National, Global, Ed. G.F. White, Oxford University Press, New York.

Wood, D.W., T.C. Gooch, P.M. Pronovost, and D.C. Noonan, (1985). Development of a Flood Management Plan, in Journal of Water Resource Planning and Management, ASCE, 111:4(417-433).

UNIT #5 HOMEWORK EXERCISE

FLOOD HAZARDS

Based on the material presented in class prepare a brief discussion essay (approximately 250 words) on one of the following topics:

a.- The principal measures that could be implemented to reduce flood severity and flood vulnerability in a flood prone urban settlement in your country.

b.- The principal "artificial" and anthropic causes for the occurrence of floods and the corresponding mitigation measures that could be implemented to avoid or reduce such events.

c.- The use of flood and flood mitigation information in the integrated development planning process.

EXAM QUESTIONS:

1.- Explain which are the causes of floods.

2.- List the three most important factors that determine the severity of a flood, explaining how each of those factors causes damage.

3.- Define the following terms:

a.- floodplain

b.- controlled floodway

c.- flood

d.- design flood

4.- List the basic criteria that are used in the evaluation of flood vulnerability and the different flood classifications that are commonly used in vulnerability evaluations.

5.- Enumerate the different types of flood mitigation measures that are commonly used and explain how flood hazards and flood mitigation information can be used in the integrated development planning process.

END OF UNIT #5

UNIT #6: INTRODUCTION TO GEOLOGIC HAZARDS

OBJECTIVE: Introduce the science of geology including principal concepts and theories. Familiarize participants with basic terminology.

TIME ALLOTMENT: 2 hours

CONTENTS:

1.- Introduction to geology

    a.- the science of geology

    b.- basic principles

        1.- geologic eras
        2.- principal theories of geologic evolution

    c.- the earth's crust

        1.- the four spheres
        2.- elements, minerals, and rocks

2.- Plate tectonics and geologic phenomena

    a.- introduction to plate tectonics

        1.- oceanic trenches, central-oceanic ridges, and faults
        2.- plate formation and displacement

    b.- types of faults

        1.- slip (lateral)
        2.- normal
        3.- reverse

c.- hazard implications of plate tectonics

1.- earthquakes and areas of seismic activity
2.- volcanoes and areas of volcanic activity

RECOMMENDED INSTRUCTOR'S READINGS:

1.- **Zumberge, J., and C.A. Nelson,** (1972). Elements of Geology. (Chapters 3 and 4). 2nd. edition. John Wiley and Sons, New York.

2.- **Flint, R.F., and B.J. Skinner,** (1974). Physical Geology. John Wiley and Sons, New York.

ADDITIONAL SUGGESTED BIBLIOGRAPHY:

Cattermole, P.J. and P. Moore, (1985). The Story of the Earth. Cambridge University Press, New York.

McKenzie, G.D. et al., Eds., (1975). Man and His Physical Environment: Readings in Environmental Geology. Burgess Publishing Company, Minneapolis, Minnesota.

Mears, B., (1977). The Changing Earth: Introduction to Geology. 2nd edition. D. Van Nostrand Co., New York.

Parker, R., (1984). Inscrutable Earth: Explorations Into the Science of Earth. Scribner, New York.

Van Andel, T.H., (1985). New Views on an Old Planet: Continental Drift and the History of the Earth. Cambridge University Press, New York.

EXAM QUESTIONS:

1.- List the different geologic eras of the earth's evolutionary process.

2.- Explain the continental drift theory.

3.- What are the layers of the earth's crust and of what elements is the crust composed?

4.- Define the following terms:

a.- tectonic plate

b.- oceanic trench

c.- central-oceanic ridge

d.- seismic fault

5.- Explain the formation and movement of tectonic plates.

END OF UNIT # 6

UNIT #7: SEISMIC AND VOLCANIC HAZARDS

OBJECTIVE: Introduce seismic and volcanic hazards including principal phenomena and concepts. Familiarize participants with the basic terminology. Provide a general understanding of the scientific and technical aspects of seismic and volcanic hazards. Present the principal long term mitigation techniques and systems. Generate an awareness about their importance in integrated development planning.

TIME ALLOTMENT: 7 hours

CONTENTS:

1.- Evaluation and monitoring of seismic activity

a.- earthquake hazards

1.- ground shaking
2.- surface fault rupture
3.- landslides
4.- liquefaction
5.- tsunamis
6.- other

b.- summary of major seismic event impacts

1.- loss of life or injuries
2.- capital losses (infrastructure and production facilities)
3.- disruption of infrastructure and production facilities functions

c.- seismic evaluation

1.- earthquake parameters
2.- dynamic parameters of seismic waves
3.- macroseismic observation
4.- geotectonic and geophysical features

d.- monitoring and information systems

1.- institutional structures
2.- components and equipment of a seismologic monitoring network
3.- monitoring and prediction capability

e.- process of information generation

1.- event
2.- hazard
3.- risk
4.- vulnerability

2.- Evaluation and monitoring of volcanic activity

a.- types of volcanoes and eruptions

1.- Hawaiian
2.- cinder cones
3.- Vesuvian
4.- other phenomena (calderas and fissure eruptions)

b.- volcanic hazards

1.- volcanic ash
2.- pyroclastic phenomena
3.- mudflows
4.- secondary effects of mudflows
5.- volcanic gases
6.- lava flows
7.- debris flows and
8.- other

c.- monitoring and information systems

1.- institutional structures
2.- components and equipment of a volcanologic monitoring network
3.- monitoring and prediction capabilities

d.- process of information generation

1.- event
2.- hazard
3.- risk
4.- vulnerability

e.- summary of major volcanic event impacts

1.- loss of life and injuries
2.- capital losses (infrastructure and production facilities)
3.- disruption of infrastructure and production facilities functions

3.- Seismic and volcanic hazards reduction programs and mitigation techniques

a.- general planning techniques

1.- integrated urban and rural development planning
2.- criticals facilities including life-line network identification
3.- development of alert and emergency response plans

b.- education techniques

1.- formal hazards education in academic institutions (schools and universities)
2.- mass-media education and awareness programs
3.- creation of civilian response coordination groups
4.- design and implementation of emergency situation simulation exercises
5.- other

c.- engineering techniques

1.- safety evaluation and strengthening of existing buildings, and cost and levels of seismic upgrading: Aseismic strengthening of "existing buildings" is an effective and efficient measure to mitigate possible seismic calamities and forms the indispensable part of the urgent task for the control of urban earthquake disaster.
2.- codes, practice and judgement: For structures not yet built it is important to point out that the design and construction process needs improvement in: (1) codes and state-of-the-art practice, (2) independent peer review (special structures, critical facilities and dams), (3) plan-checking and inspection, and (4) construction performance and quality control.
3.- lifeline systems and their risk analyses: Water and sewage, telecommunications, transportation, and energy systems are recognized as essential

lifelines whose continued service following a major earthquake is indispensable for implementing emergency operations to mitigate the immediate consequences of the earthquake. Effort should be made to include in this particular section of the program the study of lifeline systems as an investment project and their corresponding risk analyses.

d.- regulatory techniques

1.- urban and rural land-use macro-zoning
2.- urban and rural land-use micro-zoning
3.- real estate development and construction codes, regulations, ordinances and laws
4.- other

e.- financial and economic techniques

1.- taxation incentives and penalties
2.- non-subsidized insurance
3.- lending and insuring policies
4.- other

f.- direct government techniques

1.- public acquisition of hazard prone areas
2.- expropriation of hazard prone areas
3.- relocation of endangered population
4.- other

4.- The use of information in integrated development planning

a.- problems in the use of seismic and volcanic hazards information

1.- social and cultural
2.- economic
3.- technical
4.- political
5.- other

b.- opportunities for the use of seismic and volcanic hazards information

1.- avoidance of losses (human, financial, etc.)
2.- contribution to economic stability
3.- formulation and implementation of safer investment projects and programs

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RECOMMENDED INSTRUCTOR'S READINGS:

1.- **Blong, R.J.,** (1984). Volcanic Hazards. Academic Press, New York.

2.- **Brown, R.D. Jr., and W.J. Kockelman,** (1983). Geologic Principles for Prudent Land Use. U.S. Geological Survey Proffesional Paper 946.

3.- **Decourt, J., and J. Paquet,** (1985). Geology: Principles and Methods. **(Chapter 7).** Graham & Trotman, London.

4.- **Kockelman, W.J.,** (1979). "Examples of Use of Geologic and Seismologic Information for Earthquake Hazards Reduction in Southern California." U.S. Geological Survey, Open-file Report 83-82.

5.- **USGS,** (1984). Proceedings of the Geologic and Hydrologic Hazards Training Program. Open File Report 84-760. USGS, Reston, Virginia.

ADDITIONAL INSTRUCTIONAL MATERIAL

1.- **Video tape** (English), "Mexico Earthquake, September 19, 1985," available through the U.S. National Bureau of Standards, Washington D.C.

2.- **Movie** (16mm) (English), "When The Earth Moves," available through the U.S.G.S., Reston, Virginia.

ADDITIONAL SUGGESTED BIBLIOGRAPHY:

Crandall, D.R., et al., (1984). "Sourcebook for Volcanic Hazards Zonation." Natural Hazards 4, UNESCO, Paris.

Decker, R. and B. Decker, (1981). Volcanoes. W.H. Freeman and Company, San Francisco, California.

Lambert, M.B., (1980). Volcanoes. University of Washington Press, Seattle, Washington.

Nichols, D.R., and J.M. Buchanan-Banks, (1974). "Seismic Hazards and Land Use Planning." U.S. Geological Survey, Circular 690, USGS Washington, D.C.

Simkin, T., et al., (1981). Volcanoes of the World. Smithsonian Institution. Hutchinson Ross Publishing Company, Stroudsburg, Pennsylvania.

UNDRO, (1985). Volcanic Hazards Management. UNESCO, New York.

UNDRO, (1978). Disaster Prevention and Mitigation, Vol. 1. Volcanological Aspects. United Nations, Geneva, Switzerland.

UNDRO, (1982). Disaster Prevention and Mitigation, Vol. 3. Seismological Aspects. United Nations, Geneva, Switzerland.

Urban Regional Research, (1982). Land Management in Tsunami Hazard Areas. NSF, Washington, D.C.

UNIT #7 HOMEWORK EXERCISE

SEISMIC AND VOLCANIC HAZARDS

Based on the material presented in class prepare a brief discussion essay (approximately 250 words) on <u>one</u> of the following topics:

a.- The principal elements of a seismic and/or volcanic hazards public education and awareness program.

b.- The principal problems that normally take place in planning and responding to a seismic and/ or volcanic event in lesser developed countries, considering in particular overall development planning issues and governmental responsibilities.

c.- The process of seismic and/or volcanic hazards information generation and dissemination, and the lack of communication between the scientific and planning communities with respect to such information.

EXAM QUESTIONS:

1.- Describe the principal seismic and volcanic hazards.

2.- List the principal international and national (your country) institutions that are involved in seismic research and information generation, and list the main types of seismologic and volcanologic information that is available at the event, hazard, risk, and vulnerability levels.

3.- Compare the characteristics of a seismologic monitoring network and a volcanologic monitoring network.

4.- Define the following terms:

a.- earthquake magnitude

b.- earthquake damage intensity

c.- return period

d.- liquefaction

e.- mudflow

f.- cinder cone

5.- List the principal seismic and volcanic hazard reduction programs and mitigation techniques.

END OF UNIT #7

UNIT #8: COURSE CASE STUDY PRESENTATION (PART I)

OBJECTIVE: Introduce the case study of the course, presenting the general characteristics of the natural hazards problem, and the overall geographic, social and economic context of the problem-area. Prepare participants for the first technical field trip.

TIME ALLOTMENT: 1 hour

CONTENTS:

1.- Presentation of the basic characteristics of the case study

   a.- basic geographic context

   b.- natural hazards problem

   c.- basic social and economic characteristics

   d.- basic characteristics of the investment project(s) which are to be included in the case study

2.- Introduction to Technical Field Trip I

   a.- general explanation of field trip objectives

   b.- explanation of field trip schedule and points of interest

   c.- distribution of necessary handouts and reference material to participants

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END OF UNIT #8

UNIT #9: TECHNICAL FIELD TRIP I

OBJECTIVE: Provide participants with the opportunity to visit the site(s) of the case study.

TIME ALLOTMENT: 6 hours

CONTENTS:

To be determined in accordance with the specific case study that is chosen for the course.

END OF UNIT #9

UNIT #10: MASS-MOVEMENT HAZARDS

OBJECTIVE: Introduce mass-movement hazards including principal phenomena and concepts. Familiarize participants with the basic terminology. Provide a general understanding of the scientific and technical aspects of mass movements and generate an awareness about their importance in integrated development planning.

TIME ALLOTMENT: 3 hours

CONTENTS:

1.- Mass-movement hazards

    a.- principal types of mass movements

        1.- falls
        2.- topples
        3.- slides
        4.- lateral spreads
        5.- flows
        6.- complex slope movements

    b.- causes of mass movements

        1.- topographic
        2.- geologic
        3.- climatic
        4.- seismic

2.- Mass-movements reduction programs and mitigation techniques

    a.- slope protection and stabilization techniques

        1.- biological stabilization (vegetation)
        2.- biotechnical stabilization
        3.- structural-mechanical stabilization

    b.- education techniques

        1.- formal hazards education in academic institutions (schools and universities)

2.- mass-media education and awareness programs
3.- other

c.- engineering techniques

1.- development and enforcement of construction codes
2.- seismic evaluation of buildings and infrastructure
3.- buildings and infrastructure including lifeline strengthening
4.- water and mudflow containment devices
5.- other

d.- regulatory techniques

1.- urban and rural land-use macro-zoning
2.- urban and rural land-use micro-zoning
3.- real estate development and construction codes, regulations, ordinances and laws
4.- other

e.- financial and economic techniques

1.- taxation incentives and penalties
2.- non-subsidized insurance
3.- lending and insuring policies
4.- other

f.- direct government techniques

1.- public acquisition of hazard prone areas
2.- expropriation of hazard prone areas
3.- relocation of endangered population
4.- other

3.- Use of information in development planning

a.- problems in the use of mass-movement hazards information

1.- social and cultural
2.- economic
3.- political
4.- other

b.- opportunities in the use of mass-movement hazards information

1.- avoidance of losses (human, financial, etc.)
2.- formulation and implementation of adequate investment projects

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CLASSROOM EXERCISE: (See Annex III.10.1)

RECOMMENDED INSTRUCTOR'S READINGS:

1.- **Gray, D.H. and A.T. Leiser,** (1982). Biotechnical Slope Protection and Erosion Control. Van Nostrand Reinhold Company, New York. (Chapters 2, 3, 5, and 7).

2.- **Kockelman, W.J.,** (1986). "Some Techniques for Reducing Landslide Hazard." Bulletin of the Association of Engineering Geologists, College Station, Texas, Vol.23, No.1.

3.- **UNDRO,** (1978). Disaster Prevention and Mitigation, Vol. 5 - Land Use Aspects. United Nations, Geneva, Switzerland.

ADDITIONAL SUGGESTED BIBLIOGRAPHY:

Brown, R.D. Jr. and W.J. Kockelman, (1983). "Geologic Principles for Prudent Land Use, A Decision-Maker's Guide for the San Francisco Bay Region." Professional Paper 946, U.S. Geological Survey. Government Printing Office, Washington, D.C.

Morgenstern, N.R. and D.A. Sangrey, (1978). "Methods of Stability Analysis" in Landslides: Analysis and Control, ed. by Shuster, R.L. and R.J. Krizek, Trans. Res. Board Spec. Rept. 176, NAS-NRC, Washington, D.C.

U.S. Geological Survey, (1983). "Goals and Tasks of the Landslide Part of a Ground-failure Hazards Reduction Program." Circular 880.

Varnes, D.J., (1978). "Slope Movement: Types and Processes" in Landslides: Analysis and Control, ed. by Shuster, R.L. and R.J. Krizek, Trans. Res. Board Spec. Rept. 176, NAS-NRC, Washington, D.C.

EXAM QUESTIONS:

1.- Describe the principal types of mass-movements.

2.- Describe the three basic causes of mass-movements.

3.- Describe two instances in which man's intervention can generate mass-movement in otherwise stable slopes.

4.- Define the following terms:

a.- soil creep

b.- foliation

c.- rock topple

d.- retaining structure

5.- Describe using specific examples the three basic measures for slope stabilization.

END OF UNIT # 10

UNIT #11: LAND USE AND SOIL DEGRADATION HAZARDS

OBJECTIVE: Introduce the principal concepts and terminology used in soil science. Provide participants with an understanding of the problems and opportunities associated with soil deterioration and conservation. Generate an awareness about the importance of adopting adequate soil management practices and soil degradation mitigation techniques.

TIME ALLOTMENT: 7 hours

CONTENTS:

1.- Introduction to soil use hazards

    a.- saturated soils

    b.- salinity and alkalinity

    c.- lateritic soils

2.- Characteristics and properties of the soil

    a.- morphology

        1.- color
        2.- texture
        3.- consistency
        4.- acidity

    b.- horizon limits in the soil profile

        1.- organic horizons
        2.- mineral horizons
        3.- lithologic discontinuity

3.- Physical and chemical characteristics

a.- physical characteristics

1.- apparent density
2.- porosity
3.- humidity

b.- chemical characteristics

1.- PH factor
2.- organic matter
3.- cation and base exchange capacity

c.- soil profile

1.- typical pedon
2.- range of characteristics
3.- analysis techniques

4.- Soil classification

a.- scientific classification

1.- classification system
2.- categories of soil classification

b.- land use classification

1.- classification system
2.- categories of soil classification

c.- classification of irrigable soils

1.- classification system
2.- categories of soil classification

5.- Soil studies and development planning

a.- elements of a soils study

1.- preparatory phase
2.- preliminary photo-interpretation

3.- systematic photo-interpretation
4.- field work
5.- laboratory analysis
6.- map compilation and report

b.- types of soil studies

1.- exploratory
2.- reconnaissance
3.- semi-detailed
4.- detailed

c.- development planning applications

1.- general land/soils classification
2.- agriculture planning
3.- non-agricultural planning
4.- engineering studies
5.- soil degradation mitigation techniques

RECOMMENDED INSTRUCTOR'S READINGS:

1.- Davison, D.A., (1980). Soils and Land Use Planning. Longman, New York.

ADDITIONAL SUGGESTED BIBLIOGRAPHY:

Batten, J.W. and J. Sullivan, (1977). Soils, Their Nature, Classes, Distribution, Uses and Care. University of Alabama Press, Alabama.

Birkeland, P.W., (1984). Soils and Geomorphology. Oxford University Press, New York.

Blaikie, P.M., (1985). The Political Economy of Soil Erosion in Developing Countries. Longman, New York.

Buol, H. and M.C. Craken, (1973). Soils Genesis and Morphology. Iowa State University Press, Iowa.

Olson, G.W., (1972). "Engineering Interpretations for Uses of Soils in Developing Countries." Agronomy Mimeo 72-14, Department of Agronomy, Cornell University, Ithaca, New York.

Olson, G.W., (1984). Field Guide to Soils and the Environment: Applications of Soil Surveys. Chapman and Hall, New York.

UNIT #11 HOMEWORK EXERCISE

LAND USE AND SOIL DEGRADATION HAZARDS

Based on the material presented in class prepare a brief essay (approximately 250 words) discussing one of the following topics:

a.- Soil degradation can only occur in poor soils or in areas of accentuated slopes and little forest cover.

b.- In planning agricultural development projects it is essential to first identify the capability measure of the soils. Given that such a measure is so specific, not doing so may result in inappropriate land use schemes, and eventually in severe soil degradation.

EXAM QUESTIONS:

1.- Briefly explain which are the principal characteristics and properties of soils.

2.- Describe the principal types of soil degradation, explaining in detail the corresponding causes and mitigation techniques.

3.- Define the following terms:

a.- saturated soils

b.- salinity and alkalinity

c.- lateritic soils

d.- horizons

4.- Briefly describe the principal elements of a detailed soil study.

5.- Describe the application of soil studies in the integration of natural hazards assesment information in development planning work.

END OF UNIT #11