UNIT #12: MULTIPLE GEOLOGIC HAZARDS AND LIFELINE NETWORK MAPPING

OBJECTIVE: Introduce hazards mapping applied to geologic phenomena, and basic and service infrastructure lifeline network mapping. Familiarize participants with the basic procedures and terminology. Provide an understanding of the scientific and technical aspects of cartographic analysis and its application in integrated development planning.

TIME ALLOTMENT: 8 hours

CONTENTS:

1.- Problems and opportunities of multiple hazards mapping techniques

   a.- scientific versus planning information

      1.- producers and users perspective
      2.- scientific and planning language
      3.- single theme and multiple theme maps

   b.- applications of multiple hazards and lifeline network mapping

      1.- general urban development planning
      2.- general rural and agricultural development planning
      3.- specific investment project formulation

2.- A methodology for multiple geologic hazards diagnostic map

   a.- multiple hazards diagnostic map

      1.- multiple hazards concept
      2.- scope and approach

b.- geotechnical macrozonation map

1.- lithologic map
2.- geomorphologic map
3.- hydrologic map

c.- geotechnical microzonation map

1.- clinometric map
2.- structure map
3.- talus geometrical stability and orientation map

d.- supporting studies

1.- soils
2.- climate
3.- human activities
4.- current and proposed spatial development strategies
5.- other

3.- Lifeline network mapping

a.- lifeline network map

1.- lifeline network concept
2.- scope and approach

b.- identification of the lifeline network elements

1.- transportation, energy and communication systems (basic infrastructure)
2.- medical, educational and public safety facilities
3.- food supply chains
4.- emergency shelters
5.- other

c.- lifeline network vulnerability assessment

1.- assessment of previous events
2.- multiple hazards and lifeline network map overlays
3.- structural assessment of buildings and installations

CLASSROOM EXERCISE: (See Annex III.12.1)

RECOMMENDED INSTRUCTOR'S READINGS:

1.- California Department of Conservation, Division of Mines and Geology, (1982). Earthquake Planning Scenario For a Magnitude 8.3 Earthquake on the San Andreas Fault in Southern California. Special Publication 60, State of California, Sacramento, California.

ADDITIONAL SUGGESTED BIBLIOGRAPHY:

Puerto Rico Department of Natural Resources, (1974). Sensitivity of Coastal Environments and Wildlife to Spilled Oil: Puerto Rico, A Coastal Atlas. San Juan, Puerto Rico.

St. Helen, L., (1986). "Natural Hazards Risk Assessment of Coastal Settlements in Saint Lucia, West Indies." OAS/DRD - Government of Saint Lucia.

Matteuci, S.D., A. Colma and L. Pla, (1982). "Desertification Maps of Falcon State, Venezuela" in Environmental Conservation, Vol. 9, No. 3, Autumn, the Netherlands.

EXAM QUESTIONS:

1.- Discuss the gap that exists between the scientific information that is generally available about natural hazards phenomena and the information required by development planners.

2.- Providing examples, list the principal applications of multiple hazards mapping in integrated development planning.

3.- Describe what you would consider as a comprehensive methodology for preparing a multiple geologic hazards diagnostic map for a given geographical area.

4.- Explain the concept of lifeline network, pointing out its relevance to development and natural hazards mitigation planning.

5.- Describe what you would consider as a comprehensive methodology for preparing a lifeline network map of a given geographical area.

END OF UNIT #12

UNIT #13: NATURAL HAZARDS INFORMATION SYSTEMS AND SOURCES

OBJECTIVE: Summarize natural hazards information sources presented in the technical units of the course. Review different systems and techniques for obtaining and processing natural hazards information for use in integrated development planning.

TIME ALLOTMENT: 5 hours

CONTENTS:

1.- Natural hazards and the development planning process

   a.- Review of basic elements of the preliminary mission, development diagnosis and strategy formulation, project identification and formulation, and action plan

      1.- objectives
      2.- effect on development patterns
      3.- information use

2.- Information organization according to hazard type and its proposed use

   a.- event monitoring and alerts: information for prediction and emergency alerts

   b.- phenomena investigation: information for scientific and engineering investigations

   c.- translated information: transforming scientific and engineering information into a format and with the content needed for risk and vulnerability assessment

   d.- synthesized information: translated mapped information for macro and micro hazards and risk zonification maps, and vulnerability maps for disaster prevention and emergency preparedness

3.- Application of different information sets to produce useful products for the integrated development planning process

a.- assigning priorities (geographic focus, use of maps, graphs, tables, etc., mapping scale, content, format and level of detail)

b.- summary of remote sensing information and techniques (aerial photography, radar imagery, satellite imagery)

c.- overview of computerized mapping systems and techniques

d.- defining the type of translated information needed and the appropriate techniques for its preparation

e.- use of the prepared information in the corresponding stage of the integrated development planning process

4.- Relationship between the different information sets and mitigation techniques

a.- techniques to modify or reduce an event

b.- techniques to control or guide the physical course of an event

c.- techniques to control or guide development activities to avoid the impact of an event

d.- techniques to withstand the impact of an event

e.- techniques to evacuate the population and reduce to the extent possible material damage

RECOMMENDED INSTRUCTOR'S READINGS:

1.- **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.

2.- **Kockelman, W.,** (1983). "Examples of the Use of Geological and Seismological Information for Earthquake Hazard Reduction in Southern California." USGS Open File Report 83-82, USGS, Menlo Park, California.

3.- **UNDRO,** (1977). Disaster Prevention and Mitigation, Vol. 1. Volcanological Aspects. United Nations, Geneva, Switzerland.

4.- **UNDRO,** (1976). Disaster Prevention and Mitigation, Vol. 2. Hydrological Aspects. United Nations, Geneva, Switzerland.

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

6.- **UNDRO,** (1978). Disaster Prevention and Mitigation, Vol. 4. Meteorological Aspects. United Nations, Geneva, Switzerland.

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

ADDITIONAL SUGGESTED BIBLIOGRAPHY:

Additional bibliography can be found in the listings for Units 4, 5, 6, 7, 10, 11, and 12.

UNIT #13 HOMEWORK EXERCISE

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

"DESCRIPTION AND USE OF NATURAL HAZARDS INFORMATION BY TYPE IN DEVELOPMENT PLANNING STUDIES"

INSTRUCTIONS: Complete the table with the title of a specific information piece (map, table, etc).

HAZARDS	PROJECT FORMULATION STAGE		
	PRELIMINARY MISSION (EVENTS)	PROJECT IDENTIFICATION (RISK)	PROJECT FORMULATION (VULNERABILITY)
1.- Geologic Hazards			
Earthquakes			
Volcanic Eruptions			
Tsunami			
Landslides			
2.- Atmospheric and Hydrologic Hazards			
Hurricanes			
Floods			
Drought			
Desertification			
Frost and freezes			
Fires (Forest, etc.)			

EXAM QUESTIONS:

1.- Describe the four basic types of information organization according to hazard type and proposed use.

2.- Describe the three primary considerations in applying different information sets to produce useful products for the integrated development planning process.

3.- List the five principal types of mitigation techniques with one example of each.

4.- Describe the principal characteristics and natural hazards information applications of:

a.- aerial photography

b.- radar imagery

c.- satellite imagery

5.- Describe the principal characteristics and natural hazards information applications of:

a.- computerized mapping systems

b.- geo-based information systems (GIS)

END OF UNIT #13

UNIT #14: COURSE CASE STUDY PRESENTATION (PART II)

OBJECTIVE: Present to the participants a detailed review of the specific natural hazards issues of the case study area and their actual and/or potential impact in the natural resource, social, and economic context.

TIME ALLOTMENT: 1 hour

CONTENTS:

To be determined in accordance to the specific case study selected for the course.

END OF UNIT #14

UNIT #15: ECONOMIC PLANNING AND NATURAL HAZARDS

OBJECTIVE: Introduce the economic analysis section of the course, including an explanation of its basic orientation and contents. Discuss the relationship between economic development planning and natural hazards, and introduce economic analysis of natural disasters and their consequences.

TIME ALLOTMENT: 2 hours

CONTENTS:

1.- Difference between scientific and economic understanding of natural hazards and their impacts

   a.- scientific approach

      1.- natural phenomena
      2.- objective evaluation

   b.- economic approach

      1.- identification of economic trade-offs
      2.- socio-political evaluation

2.- Impact of natural hazards in economic development planning

   a.- economic development planning vis-a-vis overall development planning

   b.- description of the economic development planning process **(See Annex III.15.1)**

      1.- macro-planning
      2.- micro-planning

c.- policy determination and economic "reality"

1.- general policy tools
2.- natural hazards mitigation policy

d.- "Planning-implementation-results" chain

1.- without natural hazards mitigation
2.- with natural hazards mitigation

3.- Economic trade-off analysis **(See Annex III.15.2)**

a.- event magnitude versus survival capacity

1.- absence of human and/or economic interest
2.- presence of human and/or economic interest

b.- problems and opportunities of implementing natural hazards mitigation measures

1.- economic interests
2.- social and cultural interests
3.- political interests
4.- scientific/technical knowledge
5.- financial constraints
6.- other

RECOMMENDED INSTRUCTOR'S READINGS:

1.- Todaro, M.P., (1981). Economic Development in the Third World. 2nd edition. Longman, New York.

ADDITIONAL SUGGESTED BIBLIOGRAPHY:

Blitzer, C.D., et al., (1977). Economy-Wide Models and Development Planning. Oxford University Press, Oxford, England.

Bendavid-Val, A., (1980). Local Economic Development Planning: From Goals to Projects. American Planning Association, Chicago, Illinois.

Dixon, J., et al., (1986). Economic Analysis of the Environmental Impacts of Development Projects. Asian Development Bank, Manila, Philippines.

Gant, G., (1979). Development Administration: Concepts, Goals, and Methods. University of Wisconsin Press, Madison.

Gilbert, A., Ed., (1983). Development Planning and Spatial Structure. John Wiley and Sons, New York.

EXAM QUESTIONS:

1.- Describe the economic development planning process.

2.- Describe the principal policy tools available at the macro-planning level.

3.- What is the relationship between specific investment projects and economic development planning?
What are the linkages between investment projects and natural hazards?

4.- What is the relationship between the magnitude of a natural hazard event and the actual level of destruction that it can cause?

5.- Describe the principal problems and opportunities of incorporating natural hazards mitigation techniques into economic development planning.

END OF UNIT #15

UNIT #16: MULTICRITERIA ANALYSIS AND INTEGRATED DEVELOPMENT PLANNING

OBJECTIVE: Introduce multicriteria analysis and its potential applications in integrated development planning. Provide participants with an understanding of the mechanisms of multicriteria analysis and show how it can be used to incorporate natural hazards considerations into planning at the macro and micro analysis levels.

TIME ALLOTMENT: 4 hours

CONTENTS:

1.- Development planning

a.- economic development planning philosophies

1.- market economies
2.- non-market economies

b.- levels of economic development planning

1.- national
2.- sub-national (regional or sectorial)
3.- local (micro-regional or sub-sectorial)

c.- necessity to define investment criteria

1.- definition of objectives
2.- definition of parameters

d.- standard techniques for investment evaluation

1.- financial
2.- economic
3.- socio-economic
4.- integrated development

2.- Multicriteria analysis

a.- components of the technique

1.- objectives
2.- attributes
3.- coefficients
4.- matrixes and sub-matrixes

b.- operation of the technique

1.- common denominator units
2.- utilization of the technique
3.- application of the results in the decision-making and development planning processes

c.- problems and opportunities of the technique

1.- subjectivity in the selection of attributes
2.- subjectivity in the determination of coefficients
3.- qualitative aspects of the analysis technique
4.- other

RECOMMENDED INSTRUCTOR'S READINGS

1.- **Vira, C. and Y.Y. Haimes,** (1983). Multiobjective Decision Making: Theory and Methodology. North Holland, New York.

ADDITIONAL SUGGESTED BIBLIOGRAPHY:

Haimes, Y.Y., et al., (1978). Multiobjective Optimization in Water Resource Systems. E.S.P. Corp., New York.

Keeney, R.C. and H. Raiffa, (1976). Decision Analysis with Multiple Conflicting Objectives: Preferences and Value Trade-Offs. John Wiley and Sons, New York.

Edwards, W. and J.R. Newman, (1982). Multiattribute Evaluation. Sage Publications, Beverly Hills, California.

UNIT #16 HOMEWORK EXERCISE

MULTICRITERIA ANALYSIS AND INTEGRATED DEVELOPMENT PLANNING

Based on the material presented in class prepare a simplified multicriteria analysis matrix, i.e., define a set of objectives and attributes for the incorporation of flood hazard considerations into the process of selecting agricultural development projects. Your analysis matrix should be useful for both orienting the formulation of projects and the selection of already formulated projects or project alternatives. Provided that you present the corresponding assumptions in terms of economic, social, technical, political, and "environmental" goals and criteria , you may choose to base your exercise on a particular country or region with which you are familiar.

EXAM QUESTIONS:

1.- Briefly describe the difference between a market economy and a non-market economy.

2.- Describe the traditional techniques used in the evaluation of investment projects, indicating which are used in the private and public sectors, respectively.

3.- Describe the multicriteria analysis technique specifying its different components.

4.- Describe the principal problems and opportunities of applying the multicriteria analysis technique.

5.- Explain, giving a specific example, how would you go about utilizing multicriteria analysis for incorporating natural hazard considerations into the analysis of an investment project.

END OF UNIT #16

UNIT #17: GENERAL ECONOMIC ANALYSIS THEORY

OBJECTIVE: Introduce the principal project appraisal methods used in the private and public sectors, and provide participants with an understanding of their concepts, terminology and basic mechanisms.

TIME ALLOTMENT: 5 hours

CONTENTS:

1.- Foundations of project appraisal

a.- historical background

b.- principal currents in project appraisal

1.- financial analysis
2.- economic analysis
3.- socio-economic analysis

2.- Structure and components of the project cycle

a.- project phases

1.- project idea identification
2.- project profile
3.- prefeasibility
4.- feasibility
5.- implementation
6.- operation and control

b.- technical and economic elements

1.- market study
2.- determination of size and location
3.- project engineering
4.- investment calculation
5.- cash flow analysis
6.- financing assessment
7.- organization and implementation

c.- special types of projects

1.- integrated projects (multiple)
2.- service output projects (non-commodity)

3.- Principal issues in project appraisal

a.- determination of benefits

1.- direct and indirect
2.- quantifiable and non-quantifiable
3.- double accounting problems

b.- determination of costs

1.- direct and indirect
2.- quantifiable and non-quantifiable
3.- double accounting problems

c.- externalities

1.- positive
2.- negative

d.- accounting measurements and standards

1.- internal rate of return (IRR)
2.- net present value (NPV)
3.- cost-benefit ratio (CB)
4.- other

e.- shadow pricing applications

1.- project inputs (natural and capital resources)
2.- project outputs
3.- wages
4.- taxation and subsidies
5.- foreign exchange and border prices
6.- other

f.- income distribution effects

1.- welfare criteria
2.- regional/sectorial impacts
3.- socio-economic impacts
4.- savings versus consumption trade-offs

g.- evaluation of uncertainty

1.- general concepts
2.- elements of uncertainty in a project's structure
3.- decision making under conditions of uncertainty

RECOMMENDED INSTRUCTOR'S READINGS:

1. - Squire, L. and H.G. Van der Tak, (1981). Economic Analysis of Projects. 4th. printing. The Johns Hopkins University Press, Baltimore, Maryland.

ADDITIONAL SUGGESTED BIBLIOGRAPHY:

Gittinger, J.P., (1982). Economic Analysis of Agricultural Projects. 2nd. edition. The Johns Hopkins University Press, Baltimore, Maryland.

Little, I.M.D. and J.A. Mirrlees, (1974). Project Appraisal and Planning for the Developing Countries. Heinemann Educational Books, Maryland.

Ray, A., (1984). Cost-Benefit Analysis: Issues and Methodologies. The World Bank. The Johns Hopkins University Press, Baltimore, Maryland.

UNIDO, (1978). Guide to Practical Project Appraisal. United Nations, New York.

UNIT #17 HOMEWORK EXERCISE

GENERAL ECONOMIC ANALYSIS THEORY

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

a.- The principal differences and similarities between financial, economic, and socio-economic analyses.

b.- The principal problems that exist in your country in terms of the identification, formulation and preparation of investment projects in the public sector, and the problems that you can identify in trying to incorporate natural hazards considerations into such projects.

EXAM QUESTIONS:

1.- Describe the principal methods that have been developed for project appraisal clearly stating their similarities and differences in terms of their objectives, criteria, and procedures.

2.- List and describe the structure and components of the project cycle.

3.- Discuss the principal issues in the appraisal of investment projects.

4.- Describe the principal accounting measures and standards used in the appráisal of investment projects.

5.- Describe the principal elements of uncertainty that can be found in investment projects, and explain how are they normally dealt with at the appraisal stage.

END OF UNIT #17

UNIT #18: COURSE CASE STUDY PRESENTATION (PART III)

OBJECTIVE: Present a review of the financial and economic data of the investment project(s) of the course case study. Provide participants with the necessary data and information for group discussion and analysis.

TIME ALLOTMENT: 1 hour

CONTENTS:

To be determined in accordance to the specific case study selected for the course.

END OF UNIT #18

UNIT #19: PROJECT FORMULATION AND NATURAL HAZARDS

OBJECTIVE: Provide participants with a detailed understanding of the project formulation process and the different ways to incorporate natural hazards considerations. Generate an awareness of the importance of adequate project formulation for economic development planning.

TIME ALLOTMENT: 9 hours

CONTENTS:

1.- Introduction

a.- scope of the project formulation phase

b.- relevance of the project formulation phase

1.- with respect to the specific project
2.- with respect to global development planning

2.- Market studies

a.- general description

b.- standard practices

c.- issues which should include natural hazards considerations

1.- determination of market areas
2.- product's supply and demand analysis
3.- price analysis
4.- commercialization strategies
5.- project's market range
6.- other

3.- Determination of size and location

a.- general description

b.- standard practices

c.- issues which should include natural hazards considerations

1.- current and expected demands
2.- technical-economical constraints to plant size
3.- geographical and temporal availability of inputs
4.- geographical and temporal cost of inputs
5. regional development policies
6.- market proximity
7.- transportation and communications
8.- other

4.- Project engineering

a.- general description

b.- standard practices

c.- issues which should include natural hazards considerations

1.- selection of the production technology
2.- specification of equipment and floor location
3.- infrastructure and buildings design and location
4.- production process flexibility
5.- operating schedule
6.- other

5.- Investment calculations

a.- general description

b.- standard practices

c.- issues which should include natural hazards considerations

1.- capital investment
2.- equipment and buildings
3.- land and natural resources
4.- engineering and administration
5.- implementation
6.- other

6.- Cash flow analysis

a.- general description

b.- standard practices

c.- issues which should include natural hazards considerations

1.- inputs and other materials
2.- energy and fuels
3.- insurance and taxes
4.- depletion of natural resources
5.- other

7.- Financing assessment

a.- general description

b.- standard practices

c.- issues which should include natural hazards considerations

1.- financing sources
2.- financing conditions
3.- other

8.- Organization and implementation

a.- general description

b.- standard practices

c.- issues which should include natural hazards considerations

1.- legal dispositions
2.- installation and operation
3.- other

RECOMMENDED INSTRUCTOR'S READINGS:

1.- UNDRO, (1979). Disaster Prevention and Mitigation, Vol. 7. Economic Aspects. United Nations, Geneva, Switzerland.

ADDITIONAL SUGGESTED BIBLIOGRAPHY:

Cohan, H., (1975). "Introduccion al Tema Proyectos." Lecture Notes (Mimeo #48). IICA, Montevideo, Uruguay.

Dasgupta, P. et al., (1972). Guidelines for Project Evaluation. United Nations, New York.

FAO - World Bank Cooperative Programme, (1977). Guidelines for the Preparation of Agricultural Investment Projects. FAO, Rome.

UNDRO, (1980). Disaster Prevention and Mitigation, Vol. 9. Legal Aspects. United Nations, Geneva, Switzerland.

UNIT #19 HOMEWORK EXERCISE

PROJECT FORMULATION AND NATURAL HAZARDS

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

a.- The principal elements of a market study related to an agricultural development project for the production of an essential national consumption or export product in which you would explicitly incorporate natural hazards considerations (Start by specifying the project that you will consider.)

b.- The principal elements of a size and location study related to an integrated hydro-power plant/irrigation system project in which you would explicitly incorporate natural hazards considerations (Start by specifying the project that you will consider.)

c.- The principal elements of a project engineering study related to a capital intensive industrial project in which you would explicitly incorporate natural hazards considerations (Start by specifying the project that you will consider.)

EXAM QUESTIONS:

1.- Describe the principal elements of the project formulation process, providing examples of their components.

2.- Describe the principal components of a market study which should incorporate natural hazards considerations. Briefly explain, for each case, how would you go about doing so.

3.- Describe the principal components of an investment project location study which should incorporate natural hazards considerations. Briefly explain, for each case, how would you go about doing so.

4.- Describe the principal components of an engineering study which should incorporate natural hazards considerations. Briefly explain, for each case, how would you go about doing so.

5.- Explain in which components of a project's investment calculations should natural hazards be considered. Be sure to justify your answer.

END OF UNIT #19

UNIT #20: REVIEW OF PROBABILITY THEORY

OBJECTIVE: Review the basic statistical concepts that are required to work with probabilistic data within project appraisal.

TIME ALLOTMENT: 3 hours

CONTENTS:

1.- Probabilistic nature of natural hazards

    a.- moderate event models

    b.- extreme event models

    c.- rapid versus slow on-set hazards

2.- General probability theory

    a.- probability

    b.- random variables

    c.- accumulated probability

    d.- probability density functions

3.- Representation of probability distributions

    a.- general representation

    b.- general representation for extreme values

c.- theoretical distribution for extreme values

d.- derivation of probability distribution

e.- three point distribution

f.- use of probabilistic information in project appraisal

RECOMMENDED INSTRUCTOR'S READINGS:

1.- Irvin, G., (1978). Modern Cost-Benefit Methods: An Introduction to Financial, Economic and Social Appraisal of Development Projects, (Chapter III). Harper and Row Publishers, Inc., London, England.

ADDITIONAL SUGGESTED BIBLIOGRAPHY:

Billingsley, P., (1986). Probability and Measure. 2nd Edition. John Wiley and Sons, New York.

Hamett, D. and J.L. Murphy, (1980). Introductory Statistical Analysis. 2nd Edition. Addison Wesley Publishing Co., Reading, Massachusetts.

Larson, H.J., (1974). Introduction to Probability Theory and Statistical Inference. 2nd Edition. John Wiley and Sons, New York.

EXAM QUESTIONS:

1.- Explain why most natural hazards are probabilistic in nature.

2.- Using seismic and flood hazards as examples, discuss the incorporation and evaluation of natural hazards in project appraisal strictly from a probabilistic point of view.

3.- Define the following terms:

a.- normal distribution

b.- random variable

c.- three point distribution

d.- accumulated probability function

4.- Describe the principal probability distribution representation forms providing a brief explanation of their main characteristics.

5.- Explain when would you want or need to derive a "subjective" probability distribution and describe the process that you would use to do so.

END OF UNIT #20

UNIT #21: TECHNICAL FIELD TRIP II BRIEFING

OBJECTIVE: Brief participants on the field trip technical content and schedule, including a detailed analysis of the geographic context and location of the sites to be visited, the natural hazards phenomena that are expected to be observed, and corresponding technical information.

TIME ALLOTMENT: 2 hours

CONTENTS:

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

END OF UNIT #21

UNIT #22: TECHNICAL FIELD TRIP II

OBJECTIVE: Provide participants with the opportunity to visit an area with multiple and large scale natural hazards problems, and to assess the level of assimilation of the material presented thus far in the course by the participants.

TIME ALLOTMENT: 36 hours

CONTENTS:

To be determined in accordance to the specific field trip that is selected for the course.

HOMEWORK EXERCISE: Preparation of individual field trip reports containing a chronological schedule of sites visited, principal hazards phenomena observed, and observations related to the planning of social and economic development projects, and observed and desirable hazard mitigation techniques.

END OF UNIT #22

UNIT #23: NATURAL HAZARDS AND PROJECT EVALUATION

OBJECTIVE: Provide participants with a detailed understanding of several techniques for incorporating natural hazards considerations into the process of economic evaluation of investment projects.

TIME ALLOTMENT: 9 hours

CONTENTS:

1.- Risk and uncertainty issues associated to natural hazards

   a.- the question of risk aversion

      1.- individual behavior
      2.- government's behavior
      3.- lending institution's behavior

   b.- economic evaluation of natural hazards

      1.- impact of an event
      2.- probability of occurrence
      3.- vulnerability

2.- Methods for incorporating natural hazards considerations into project appraisal under limited information conditions

   a.- cut-off period

      1.- description
      2.- application
      3.- information requirements
      4.- problems and opportunities

   b.- adjustments in the discount rates

      1.- description
      2.- application
      3.- information requirements
      4.- problems and opportunities

c.- maxi-min (game theory)

1.- description
2.- application
3.- information requirements
4.- problems and opportunities

d.- mini-max regret (game theory)

1.- description
2.- application
3.- information requirements
4.- problems and opportunities

e.- sensitivity analysis

1.- description
2.- application
3.- information requirements
4.- problems and opportunities

2.- Methods for incorporating natural hazards considerations into project appraisal with probabilistic information

a.- mean variance analysis

1.- description
2.- application
3.- information requirements
4.- problems and opportunities

b.- safety first analysis

1.- description
2.- application
3.- information requirements
4.- problems and opportunities

c.- "Monte Carlo" and other special models

1.- description
2.- application
3.- information requirements
4.- problems and opportunities

RECOMMENDED INSTRUCTOR'S READINGS:

1.- **Department of Regional Development**, (1986). "The Use of Natural Hazards Information in the Economic Analysis of Agricultural Projects." Organization of American States, Washington, D.C. **(See Annex III.23.1)**

2.- **Pouliquen, L.Y.**, (1979). Risk in Project Appraisal. The Johns Hopkins University Press, Baltimore, Maryland.

ADDITIONAL SUGGESTED BIBLIOGRAPHY:

Anderson, J.R. et al., (1979). Agricultural Decision Analysis. Iowa State Univesity Press, Ames, Iowa.

Anderson, L.G. and R.F. Settle, (1977). Benefit-Cost Analysis: A Practical Guide. Lexington, Mass. D.C., Heath.

Baum, W.C., (July 1980). "Risk and Sensitivity Analysis." The World Bank Central Projects, Washington, D.C.

Pandey, S., (March 1983). "Incorporating Risk in Project Appraisal: A Case Study of a Nepalese Irrigation Project." A/D/C - APROSC, Research Paper Series #18, Kathmandu, Nepal.

Reutlinger, S., (1979). Techniques for Project Appraisal Under Uncertainty. The Johns Hopkins University Press, Baltimore, Maryland.

UNIT #23 HOMEWORK EXERCISE

NATURAL HAZARDS AND PROJECT EVALUATION

Based on the material presented in class prepare two brief essays (each approximately 150 words) discussing <u>two</u> of the following topics:

a.- The traditional attitude of government agencies and banking institutions in respect to risk considerations in the process of selecting investment projects, and your views on how should they treat the risk and uncertainty associated with natural hazards.

b.- The principal problems and opportunities of the cut-off period, adjustment in the discount rates, maxi-min, mini-max regret and sensitivity analysis methods for considering natural hazards issues in the evaluation of investment projects in the public sector.

c.- The principal problems and opportunities of the mean-variance, safety first, and Monte Carlo methods for considering natural hazards issues in the evaluation of investment projects in the public sector.

EXAM QUESTIONS:

1.- Discuss what are the traditional attitudes of individuals, governments, and lending institutions about risk and uncertainty related to natural hazards.

2.- Which are the three basic types of information that are required to economically assess natural hazards?

3.- Describe, providing practical examples, the methods reviewed in class to incorporate natural hazards into project appraisal under limited information conditions.

4.- Describe, providing practical examples, the methods reviewed in class to incorporate natural hazards into project appraisal with probabilistic information.

5.- Explain why or why not the traditionally used "mean expected analysis" is useful in accounting for natural hazards in the appraisal of development projects.

END OF UNIT #23

UNIT #24: COURSE CASE STUDY WORKSHOP

OBJECTIVE: Provide participants with the opportunity to participate in a multidisciplinary working group on a practical natural hazards problem. Expose participants to the principal difficulties involved in incorporating natural hazards into development planning. Provide participants and instructors with an opportunity to use the knowledge assimilated during the course.

TIME ALLOTMENT: 15 hours

WORKSHOP TECHNICAL OBJECTIVES:

Working groups must analyse the case study area, its natural hazards issues, and the characteristics of the proposed investment project(s), and prepare a report containing:

a.- a detailed description of the general characteristics of the case study area;

b.- a description of natural hazards as they affect the case study area;

c.- a description of the expected impact of natural hazard events on the current and projected human and economic life;

d.- a detailed account of the impacts expected on the specific investment project(s) being considered; and,

e.- a comprehensive set of recommendations for the implementation of economic analysis methods that incorporate natural hazards mitigation techniques into investment project formulation.

END OF UNIT #24

SUMMARY OF THE ANNEXES TO PART III (*)

III.2.1.- Handout on the Vicious Cycle of Disasters

III.2.2.- Handout on Natural Hazards and Integrated Development Planning

III.2.3.- Handout on Natural Hazards and Integrated Development Planning

III.3.1.- Handout on Concept of Ecosystems

III.3.2.- Handout on Natural Goods and Services

III.3.3.- Handout on Natural Hazards

III.3.4.- Handout on Environmental Impacts

III.3.5.- Unit #3 Homework Exercise

III.10.1.- Unit #10 Classroom Exercise

III.12.1.- Unit #12 Classroom Exercise

III.15.1.- Handout on the Economic Planning Process

III.15.2.- Handout on Natural Hazards Trade-Off Analysis

III.23.1.- Handout on Natural Hazards and Project Evaluation

Note: (*) Refer to **VOLUME II: COURSE MANUAL ANNEXES**

Numeration of annexes corresponds to the specific section to which they are related and, thus, the numeration used will not necessarily be consecutive.