



Models for Environmental Risk Assessment

Fall semester, 2021-2022

The course is proposed for students in the academic year 2020-2021 as an optional one.

Coordinator	Alla Nekos
Credits	3 ECTS (optional course), 30-in-class hours
Lecturers	Alla Nekos (Karazin Institute of Environmental Sciences, V.N. Karazin Kharkiv National University, Ukraine) Inna Bodak (Karazin Institute of Environmental Sciences, V.N. Karazin Kharkiv National University, Ukraine)
Level	PhD students
Host institution	Karazin Institute of Environmental Sciences, V.N. Karazin Kharkiv National University, Ukraine
Course duration	October - January

Summary

This 3 ECTS course aims to deepen knowledge about environmental risk. It provide students with detailed information about the core concepts, principles and techniques underlying environmental risk assessment which can be applied on a national and global platform. The course contains individual and group assignments aimed at developing in-hand practical skills in applying basic environmental and health risk assessment methods in case of air, food, soil and drinking water pollution, exposure to radiation, introduction of GMOs and transgenic plants to the environment.

Target student audiences

PhD students, study program – Constructive Geography and Sustainable Use of Natural Resources; Earth Sciences (Code No. 103)

Prerequisites

Required courses (or equivalents):

- Environmental Risk Basics,
- Environmental Risk Management,
- Environmental Toxicology,
- Biogeochemistry,
- Normalization of Anthropogenic Load on Environment.

Aims and objectives

The main course objective is to introduce the students to the key elements of risk assessment methodology, and to give a better understanding of how environmental risk is defined, as well as how risks may be evaluated and managed. In particular, the course will discuss the core concepts, principles and stages of risk assessment, providing students with the ability to identify, explain, and make decisions about risks to public health and nature. The students will learn how risk analysis is done, how it is interpreted, and how it influences regulatory decision-making.

To support the understanding of relevant tools and mechanisms, this course will provide the knowledge and skills necessary to analyze how environmental hazards affect human health. The



course program uses case studies and lectures that focus on specific risks: air pollution, soil, drinking water and food; exposure to radiation; introduction of GMOs and transgenic plants to the environment. The individual assignments, included in the course, represent hypothetical situations, close to reality, associated with the impact of different pollutants on human health and environment. Depending on the nature of pollutants and the ways they affect human body, there are exercises for calculating the risk associated with the impact of threshold and non-threshold (carcinogenic) toxicants, as well as the assessment of radiation risk, taking into account possible external and internal exposure. Lively discussions during in-class small-group work will allow students to share their own relevant professional experience and benefit from that of others.

During this course, students will explore the legal and policy framework which will inform the direction of risk analysis in the coming years, gain the skills needed to perform a quantitative risk assessment, discuss key factors influencing the effectiveness of risk assessment, and apply these concepts in different settings. A special attention is given to the ability to determine whether hazards pose an unacceptable risk to public health and utilize risk analysis to improve decision-making.

In general, this course focuses on applying modern concepts to diverse risk assessment issues, as well as finding the possible ways of improving the effectiveness of current risk assessment practices.

General learning outcomes:

By the end of the course, successful students will:

- understand the environmental risk assessment principles, including detailing steps in the risk assessment process,
- evaluate the role of causality, uncertainty and probability in environmental risk analysis,
- be aware of main conceptual models in risk assessment,
- be aware of risk assessment methodologies and procedures and be able to apply them to specific health and environmental risks (contamination of food, air, drinking water, soil ect., radiation impact),
- be able to identify factors that alter people's perception of risk,
- understand the role of government policy with regard to environmental risk assessment and management,
- understand the use of scientific data to identify and characterize risk for both humans and ecosystems,
- have general understanding of the role of government in developing compliance standard and public policies,
- understand the particular challenges related to environmental risk assessment.

Overview of sessions and teaching methods

The course combines interactive group and individual self-reflective methods of teaching and learning. It will start with interactive lectures combined with multimedia presentations aimed at highlighting the basic concepts, principles and tools of environmental risk assessment. An overview of the four core parts of a risk assessment will be given: hazard assessment, dose-response assessment, exposure assessment and risk characterization. Methods of measurement and modeling will be discussed, along with key questions concerning uncertainty. Differences in the risk characterizations of substances under different use conditions and legal requirements will



be studied. In order to master practical skills of conducting risk assessment, individual exercises are provided, which allow students to apply the acquired knowledge in practice on the example of different situational cases. Also, in order to develop the skills of self-analysis and critical thinking, the course includes group assignments that stimulate students to work in a team, discuss and argue their own opinion. The level of acquired knowledge and quality of personal achievements of the students will be assessed by testing and oral interviewing.

Course workload

The table below summarizes course workload distribution:

Activities	Learning outcomes	Assessment	Estimated workload (hours)
In-class activities			
Lectures	Understanding theories, concepts, methodology and tools of risk assessment	Class participation	4
Moderated in-class discussions and oral interviews Group work assignments (Seminars)	Ability to identify, explain, and make decisions about risks to public health and nature	Class participation and preparedness for discussions and oral interviews	14
In-class individual assignments (Practical works)	Understanding of main conceptual models in risk assessment	Class participation and preparedness for assignments	8
Midpoint and final tests	Deep knowledge of theories, concepts, methodology and tools of risk assessment	Preparedness for midpoint and final tests	4
Independent work			
Group work assignments: - Contribution to the group case-study projects - Contribution to the preparation and delivery of presentation	Ability to find related literature and data, to interpret data, to identify factors that alter people's perception of risk. Understanding the particular challenges related to environmental risk assessment.	Quality of group assignments and individual presentations	20
Individual assignments	Ability to apply risk assessment methodologies and procedures to specific health and environmental risks	Quality of prepared assignments	20
Reading and discussion of assigned papers for seminars and preparation for lectures, oral interviews and tests	Familiarity with and ability to critically and creatively discuss key concepts, tools and methods as presented in the literature	Class participation, creative and active contribution to discussion, quality of test and interviews	20



Total		90
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Grading

The students' performance will be based on the following:

- Level of preparedness for participation in class discussions – 4 (from 4 for active participation and demonstrated familiarity with the course readings to 0 for completely ignoring in-class discussions);
- In-class group work at seminars: participation in class discussions and input to reports on group assignments – 5 for each seminar (up to 20 altogether for 4 seminars);
- Level of preparedness for an oral interview – 5 ;
- Quality of Individual assignments – 7 for each assignment (up to 21 altogether for all 3 individual assignments);
- Current test – 10;
- Final test control – 40.

At the end of the course the student will have an pass. Grading system is presented below:

Scores	Mark
50-100	Passed
1-49	Not passed

Course schedule

Dates and time will be provided later.

The overall schedule is provided below:

Day	Time	Topic	Lecturer
Day 1	2 hours	- Guide to the course – purpose, objectives, learning outcomes, assignment and grading - Risk assessment: key definitions, indicators and steps – Lecture 1	A. Nekos
Day 2	2 hours	- Hazard identification as a part of risk assessment – in-class group work (Seminar 1)	I. Bodak
Day 3	2 hours	- Principles and methods for the risk assessment of chemicals in natural components – Lecture 2	A. Nekos
Day 4	2 hours	- Assessing of health risk in case of exposure to chemicals having a threshold dose – an individual assignment (Practical work 1)	I. Bodak
Day 5	2 hours	- Assessing of health risk in case of exposure to non-threshold chemicals – an individual assignment (Practical work 2)	I. Bodak
Days 6-7	4 hours	- Methods for radiation risk assessment – a brief introduction - Assessing of health risk in case of exposure to radiation – an individual assignment (Practical work 3)	I. Bodak
Day 8	2 hours	Midpoint test	I. Bodak



Day 9	2 hours	- Methods for risk assessment of introduction of GMOs and transgenic plants into the environment – a brief introduction - Stages of the risk assessment process for GMOs (Seminar 2)	I. Bodak
Days 10-11	4 hours	- Identification of risk factors of GMOs and transgenic plants for human health and environment – in-class group work (Seminar 3)	I. Bodak
Days 12-13	4 hours	- Bioindication methods and ecotoxicological tests in environmental risk assessment – in-class group work (Seminar 4)	I. Bodak
Day 14	2 hours	- Risk assessment: fundamental issues, challenges and perspectives – in-class discussion and oral interviews (Seminar 5)	I. Bodak
Day 15	2 hours	Final test	I. Bodak

Course assignments

The course includes both group and individual assignments.

Individual course assignments will be the next:

- Individual assignment #1 (Practical work 1) (partly in-class work and homework) – Assessing of health risk in case of exposure to chemicals having a threshold dose
- Individual assignment #2 (Practical work 2) (partly in-class work and homework) – Assessing of health risk in case of exposure to non-threshold chemicals
- Individual assignment #3 (Practical work 3) (partly in-class work and homework) – Assessing of health risk in case of exposure to radiation

All individual course assignments should be the results of individual work of students. **Individual assignment #1–2** include solving of a series of situational exercises on evaluating the risk to human health from pollution of air, drinking water and food with threshold and non-threshold chemicals. **Individual assignment #3** is focused on solving exercises on evaluation of health risk associated with internal and external exposure to radiation. All assignments are aimed at practical mastering by students of collective and individual risks evaluation methods. The methods recommended by the US Environmental Protection Agency (EPA) are considered.

Group course assignments will be the next:

- Group assignment #1 (Seminar 1) – Hazard identification as a part of risk assessment
- Group assignment #2 (Seminar 2) – Stages of the risk assessment process for GMOs
- Group assignment #3 (Seminar 3) – Identification of risk factors of GMOs and transgenic plants for human health and environment
- Group assignment #4 (Seminar 4) – Bioindication methods and ecotoxicological tests in environmental risk assessment

To complete the group assignments the class will be divided into several groups. **Group assignment #1** is about to the development of an algorithm for identifying threats to public health and ecosystem degradation due to environmental pollution. Each of the groups will be offered different situational cases: toxicants inflow from an imaginary source of pollution to humans through the air, surface water, underground water and soil. By drawing up a scheme for the



migration of toxicants from the natural component to humans, students should determine a list of actions to identify and evaluate possible risk factors for each stage. To complete this assignment, the understanding of the main principles of biogeochemical migration and knowledge of the basics of environmental toxicology are necessary. When compiling the algorithm, students should take into account such aspects as a pollution source analysis, features of the toxicant dissolution, migration and transformation processes, the point of exposure (that is, a pollution spread area), the ways the toxicant affects the body, the characteristics of the recipients, etc. This assignment will help students take into account possible factors that determine how many harmful substances can get into the human body with possible environmental pollution. The results should be in form of an oral report, accompanied by a multimedia presentation.

Group assignment #2 deals with the methods for risk assessment of introduction of GMOs and transgenic plants into the environment. Students will be given a brief algorithm of the risk assessment process of GMOs, consisting of several stages. Each group has to provide a short but focused characteristic of a specific stage of the algorithm mentioned above. Special attention should be paid to the stage's targets as well as activities and data necessary to achieve these targets. Developed figures, charts, tables and schemes will be a plus. The results should be in form of an oral report, accompanied by a multimedia presentation.

Group assignment #3 is based on the plan of expert risk assessment of GMOs and transgenic plants, discussed at the previous seminar on the stages of the risk assessment process for GMOs. Students have to identify factors that determine the possible threats from GMOs and transgenic plants to public health and environment. For this, among other factors, students must take into account the probabilities of transgene migration and changes in the characteristics of natural populations due to transgene introgression. The results should be in form of an oral report, accompanied by a multimedia presentation.

Group assignment #4 is to prepare a report on modern biotesting and bioindication methods that are used to assess environmental risk at the ecosystem level by assessing the state of natural components. Each of the groups will get a different environment: atmospheric air, soil, aquatic environment and bottom sediments. The results of the research should be systematized in form of a table containing the name of the test object, estimated parameters (toxicity criteria), sensitivity to toxicants, researchers who made a significant contribution to the study of this test object, existing approved methods using this test object and countries in which they are applied.

Literature

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