INTERACTIVE E-COURSE:

Sustainability & Water – Ecohydrological Processes

Institution	National University of Mongolia
Credits	3 ECTS (optional course), 30 in-class hours
Course type	Required course
Lecturers	**Dorjsuren Batsuren**
Level	MSc and PhD courses
Course duration	16 weeks
Type	General skill
Developed date	05 December 2019

Summary (main concept and understanding)

This 3 ECTS course serves as an introduction to Sustainability & Water on Ecohydrological Processes. In order to properly estimate and understanding the services in water ecosystems, it is important to assess and determine the ecohydrological processes the different environmental and socioeconomic settings and scales. This will help to improve the ecosystem balance of the water environment and to improve the relationship between the environment and human activities and to make decisions. It intends master and doctoral students studying from natural science and hydrological disciplines. The course includes data collection, data analysis, individual and group assignment, field work, seminar presentation, and report writing.

Key word (5-8 words)

Ecohydrological processes, Watershed, Climate, Hydrological cycle, Water management

Target audience

MSc and Ph.D. students in environmental science, hydrology and water management

Prerequisites

Required courses (or equivalents):

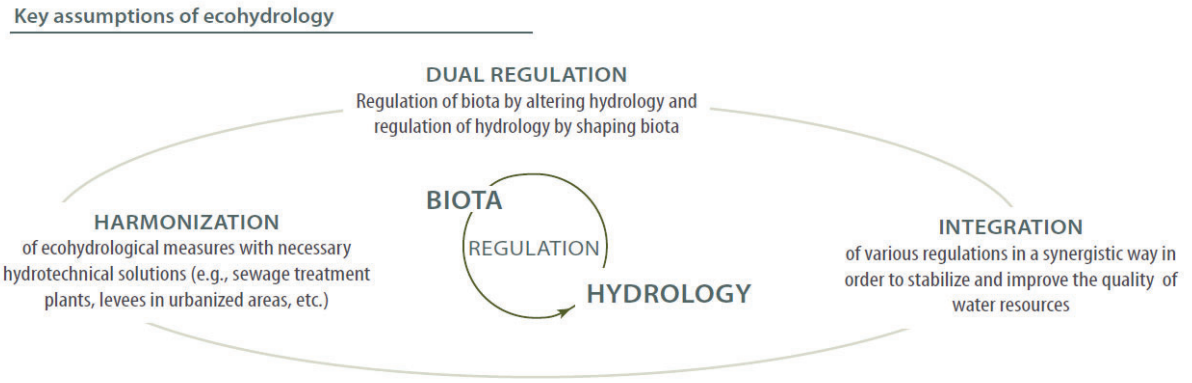
- Environmental Science
- Hydrology

Aims and objectives

The objective of the training is to explore the intimate connections between the ecosystem and water-related services in environment, ecological, and human activities in the eco-hydrological processes.

1. To investigate spatial-temporal changes and relationship in hydro-climatic variables in different environmental scales.
2. To investigate the relationship between the water environment and ecological processes in the ecosystem.
3. To improve and manage water environment balance in ecosystems.

Ecohydrology is an integrative science that focuses on the interaction between hydrology and biota. The concept emerged as a transdisciplinary approach to find solution-oriented methods for reducing anthropogenic impacts on ecosystems. Indeed, the transformation of landscapes in recent decades, from pristine ecosystems to novel or highly-impacted systems has entailed negative effects on their natural processes. It is with the aim of reversing these that Ecohydrology seeks to reinforce ecosystem services in these modified landscapes.



Additionally, a summary of the development of the concept of Ecohydrology is will be learning through a review of the UNESCO Ecohydrology documents and of some major publications, establishing a data set that contains the year of publication, authors and abstracts.

- Quantification of the hydrological processes at the catchment scale and computation the impacts.
- Identification of potential areas for enhancement of sustainability potential (carrying capacity).
- Managing biota to control hydrological processes and vice versa (ecological engineering).

Demonstration education in ecohydrology

This is also necessary in order to validate and quantify the effectiveness of ecohydrological solutions.

The objectives of the demonstration projects in ecohydrology are:

- Demonstrating the application of the ecohydrology approach to solving issues surrounding water, environment, and people;
- Contributing to the development of research on ecohydrology, increasing scientific knowledge to implement integrated watershed management and identifying solutions for sustainable development in ecological and social systems in which water acts as the main driver;
- Qualitative and quantitative validation of the effectiveness of the ecohydrological approach in practice, using methodologies identified by members of UNESCO's Scientific Advisory Committee on ecohydrology and participating scientists.

General learning outcomes:

By the end of the course, successful students will:

- Understanding ecohydrological processes
- Determine the causes of direct and indirect effects of the ecohydrological processes
- Identifying and analyzing changes in aquatic ecosystems in different environments
- Compare different ecohydrology processes results of different countries
- Identify and analyze impacts on the ecological process for water ecosystems
- Conduct stakeholder interview and analyze results
- Prevention of water-based analysis and prevention of potential problems in different environments

Applicable learning outcomes:

- Be aware of ecohydrological processes
- Demonstration of field surveys and laboratory research methods on ecohydrological processes
- Critically reflect the importance of water management and environmental management
- Write a report, group discussion, conduct interview
- Be able to develop summaries for policy-makers
- Be able to understand the contents of calls for project proposals and to provide a meaningful contribution to the development of a project application.

Overview of sessions and teaching methods

The course will be using interactive and self-reflective methods of teaching and learning and, where possible, avoiding standing lectures and presentations. It will open with an extended introduction to relevant ecohydrological processes basic concepts, issues, definitions, and a brief introduction to the component as fields of studies. (Lectures will be dispatched for quick group discussions aimed to put the specific issue or an example from the component and environmental changing into the general problem). The second part of the course will discuss the specific surveys and assessment of the ecohydrological processes agenda, usually taking a specific case in the different environment as an example, and analyzing possible options using case studies in the different places. As the third part of the course, the students will be work in groups analyzing the legacy of the management and addressing different issues developing all kinds of mechanisms for promoting the study outputs and ensuring follow-ups in water issues. Finally, the full determination of ecohydrological process will be done. This will be assessed by evaluating ecological and hydrological processes, final results will be reported and presented.

Course workload

The table below summarizes course workload distribution:

Activities	Learning outcomes	Assessment	Workload (hours)
In-class activities			
Lectures	Understanding theories, concepts, methodology and tools.	Class participation	10
Moderated in-class discussions	Understanding various policy and management contexts and common problems in communication in ecohydrological processes	Class participation and preparedness for discussions	10
In-class assignments	Understanding various policy and management contexts and common problems in communication in ecohydrological processes	Class participation and preparedness for assignments	10
Independent work			
Paper review and discussion	Familiarity with an ability to critically and creatively discuss key concepts, tools, and methods as presented in the literature	Class participation creative and active contribution to discussion	30
- Basic Concepts & Definitions - Surveys & Assessment	- To understand basic concepts and its application, components. This will include the collection of data, calculations, report writing and make the presentation - To understand surveys and assessment of ecohydrological processes, and its	Group discussion and self-work Individual report and presentations	30

- Management	application, components. This will include the collection of data, calculations, report writing and make the presentation - To understand management, and its application, components. This will include an interview with stakeholders, collection of data, report writing and make the presentation		
Fieldwork	Familiarity with the real situation, communicate with field experts, photo taken, collect relevant data and information	Participation and preparedness for discussions	30
Application of ecohydrological processes analysis	To understand ecohydrological processes affected for issues of the environmental. This will include analysis of ecohydrological processes, report writing and make the presentation	Class participation and preparedness for discussions	30
Total			150

Grading

The students' performance will be evaluated based on the following criteria:

~ Level of preparedness for participation in class discussions and seminars (30% from 100% for active participation and demonstrated familiarity with the course readings to 0% for completely ignoring in-class discussions);

~ Contribution to group assignments and demonstration of individual work (30% from 100% for clearly demonstrated input to 0% for non-participation);

~ Quality of the approach application and reporting and presenting (40% from 100% for clearly shown the report and presentation to 0% for non-participation);

- correct application of the approach +20%
- write report +10%
- make presentation +10%

Course schedule

Class	Duration	Topic	Type	Lecturer
1	60 minute	~ Introduction to ecohydrological processes	Lecture Video	D.Batsuren O.Altansukh
2	60 minute	~ Basic Concepts & Definitions o Watershed o Climate o Hydrological cycle	Lecture E-materials	D.Batsuren O.Altansukh
3	60 minute	~ Basic Concepts & Definitions o Biogeochemical cycles o Landscape structure and vegetation cover o Streams and rivers	Lecture E-materials	D.Batsuren O.Altansukh
4	60 minute	Basic Concepts & Definitions o Lakes and reservoirs o Permafrost o Freshwater Biota	Lecture E-materials	D.Batsuren O.Altansukh
5	60 minute	~ Surveys & Assessment: Landscapes: Defining Critical Areas in Watersheds	Seminar and Fieldwork	D.Batsuren O.Altansukh
6	60 minute	~ Surveys & Assessment:	Seminar and Fieldwork	D.Batsuren O.Altansukh

		Land-Water Interactions: How to Assess their Effectiveness		
7	60 minute	~ Surveys & Assessment: Streams & Rivers: Defining their Quality & Absorbing Capacity	Seminar and Fieldwork	D.Batsuren O.Altansukh
8	60 minute	~ Surveys & Assessment: Lakes & Reservoirs: Defining their Ecosystem Status	Seminar and Fieldwork	D.Batsuren O.Altansukh
9	60 minute	~ Surveys & Assessment: Coastal Areas: How & What to Measure	Seminar and Fieldwork	D.Batsuren O.Altansukh
10	60 minute	~ Management: Landscape Management: Regulating Pollution Exports & Hydrological Cycles	Group and self-work	D.Batsuren O.Altansukh
11	60 minute	~ Management: Land-Water Interactions: Reduction of Contamination Transport	Group and self-work	D.Batsuren O.Altansukh
12	60 minute	~ Management: Management of Streams & Rivers: How to Enhance Absorbing Capacity against Human Impacts	Group and self-work	D.Batsuren O.Altansukh
13	60 minute	~ Management: Reservoir & Lake Management: Improvement of Water Quality	Group discussion	D.Batsuren O.Altansukh
14	60 minute	~ Management: Coastal Areas: How to prevent degradation and restore	Group discussion	D.Batsuren O.Altansukh
15	60 minute	~ Management: Other Aspects Of Watershed Management (Socio-economic, Political and Global)	Group discussion	
16	60 minute	~ Presenting final results Your ecohydrological analysis	Presentation	

Course assignments

Course assignments will constitute a multi-part project:

- ~ Assignment #1 – Introduction: 2 pages of review note in 1 class
- ~ Assignment #2 – Basic Concepts & Definitions: includes 2-4 classes
- ~ Assignment #3 – Surveys & Assessment: includes 5-9 classes
- ~ Assignment #4 – Management: includes 10-15 classes
- ~ Assignment #5 – Presenting: Full report 16 class

Assignment #1 Will help students to understand the water environment, ecological process, and impact of human, its relationship, components, and ecohydrological processes. Students will work individually at home and make a maximum of 2 pages of review note. Students must submit their notes prior to class 3, and review understanding will be discussed during class 3.

Assignment #2 Will require a greater level of self-organized work from students. It will help students to understand Basic Concepts & Definitions, and its application, components. This will include the collection of data, report writing of each component and make a presentation. On average 9 pages of the basic concepts and definitions assessment results need to prepare as a report and must submit their report prior to class 5, and the result will be discussed during class 5.

Assignment #3 Will require a greater level of self-organized work from students. It will help students to understand Surveys & Assessment, and its application, components. This will include the collection

of data, calculations, report writing and make a presentation. On average 5 pages of the ecohydrological assessment results need to prepare as a report and must submit their report prior to class 9, and the result will be discussed during class 9.

Assignment #4 Will require a greater level of self-organized or group work from students. It will help students to understand Management, and its application, components. This will include an interview with stakeholders, collection of data, report writing and make a presentation. On average 6 pages of the ecohydrological assessment results need to prepare as a report and must submit their report prior to class 15, and the result will be discussed during class 15.

Assignment #5 Will require a greater level of self-organized or group work from students. It will help students to understand the ecohydrological issue and improvement opportunities. This will include report writing, analysis and make the presentation. Maximum 5 pages of the report assessment results need to prepare as a report and must submit their report prior to class 16, and the result will be discussed during class 16.

Literature-compulsory

1. Zalewski Maciej, Wagner-Lotkowska, Iwona, Integrated watershed mangement: ecohydrology & phytotechnology. Manual. Venice, UNESCO. 2004, p. 1-246.
2. Luis Chicharo, Iwona Wagner, Maria Chicharo, Malgorzata Lapinska, Maciej ZalewskiL, Practical Expreiments Guide for Ecohydrology. Book. UNESCO Regional Bureau for Science and Culture in Europe. 2009, p. 1-114.
3. International Hydrological Programme, Ecohydrological processes in small basins. Sixth Conference of the European Network of Experimental and Representative Basins (ERB) Strasbourg (France), 24-26 September 1996. 1997, 14: p. 1-197.
4. Peter H. Gleick, Michael Cohen, Heather Cooley, Kristina Donnelly, Julian Fulton, Mai-Lan Ha, Jason Morrison, Rapichan Phurisamban, Heather Rippman, and Stefanie Woodward, The World's Water. The Report on Freshwater Resources. The Pacific Institute for Studies in Development, Environment, and Security Oakland, California. 2017, p. 1-260.
5. D. R. Steward, W. J. de Lange, X. Yang, S. L. Vasak, and T. N. Olsthoorn, Groundwater Ecohydrology: GIScience tools to forecast change and sustainability of global ecosystems, studies in Africa, Europe and North America. Hydrology and Earth System Sciences Discussions. 2009, 6: p. 2795–2844.

Literature-recommended

6. International Hydrological Programme, Ecohydrology A new paradigm for the Sustainable Use of Aquatic Presources. Book. UNESCO Regional Bureau for Science and Culture in Europe. 1997, p. 1-56.
7. International Hydrological Programme, Ecohydrology A list of Scientific Activities of IHP-V Projects 2.3/2.4. International Conference Proceedings. 1998, p. 1-54.
8. Batsuren Dorjsuren, Denghua Yan, Hao Wang, Sonomdagva Chonokhuu, Altanbold Enkhbold, Xu Yiran, Abel Girma, Mohammed Gedefaw, Asaminew Abiyu, Article. “Observed Trends of Climate and River Discharge in Mongolia's Selenga Sub-Basin of the Lake Baikal Basin”, Water. 2018, 10, 1436, doi:10.3390/w10101436
9. Batsuren Dorjsuren, Denghua Yan, Hao Wang, Chonokhuu Sonomdagva, Altanbold Enkhbold, Davaadorj Davaasuren, Abel Girma, Asaminew Abiyu, Lanshu Jing, Mohammed Gedefaw, Article. “Observed trends of climate and land cover changes in Lake Baikal basin”, Environmental Earth Science. 2018, 77:725, doi:10.1007/s12665-018-7812-9
10. International Hydrological Programme, Manual. Division of Water Sciences, Ecohydrology for Sustainability. 2011, p. 1-24.