

**Report on the 15th International German Summer School on Hydrology
08– 22 September 2021, Bochum**

15th "International German Summer School on Hydrology (IGSH 2021) – Groundwater and Urbanization"

The fifteenth "International German Summer School on Hydrology (IGSH)" was held at Ruhr-Universität Bochum (RUB) from 8th to 22nd September 2021 with this year's focus on "Groundwater and Urbanization". The aim of IGSH is to enhance the knowledge and technical capabilities of early career professionals and academics on hydrology-related environmental issues. Due to the COVID-19 pandemic, IGSH 2021 was held in a hybrid-form, i.e., inperson and virtual classrooms and working groups.

The International German Summer School on Hydrology focuses on training international junior scientists and early professionals from the fields of water and the environment, engineering sciences, as well as from geography, hydrology, chemistry, etc. IGSH provides a program of hydrological training courses which vary each year. In 2021, 22 participants from 15 different countries were selected out of over 100 applicants (list of participants annexed). Most participants were from Asia and Africa. Usually, the number of applicants is increasing year after year and participants are selected on a competitive basis. But in 2021, the applications were below average, probably due to the pandemic. The selection criteria include: the quality of a statement of motivation, relevance of the course to the applicant's present career or research activities, and qualification of the applicants. Also age and gender aspects are taken into account.

Since its inception in 2007, the International German Summer School on Hydrology is held annually with the support of UNESCO. Starting in 2015, IGSH has additionally been sponsored by the German Academic Exchange Service (DAAD) as serial summer school on sustainable water management. The newly implemented DAAD full scholarships have increased the attractiveness of the Summer School course resulting in record numbers of applications.

The lecturers of the International German Summer School on Hydrology are from the Department of Applied Geology of Ruhr-Universität Bochum, invited high-level professionals from the private sector in Germany and international and national partner universities. The lectures included theoretical as well as practical lessons. The field excursions and locations differ from year to year depending on the type of the respective course. It also was supplemented by cultural trips and social events.

The courses of the IGSH 2021 covered the following topics:

- Hydrogeology and groundwater monitoring
- Development of the Ruhr Area (environment, economy, demography)
- Groundwater hydraulics
- Geothermal energy
- Applications of isotopes in hydrogeology
- Impacts of climate change on the urban water cycle
- Flow and transport in urban groundwater systems
- Water supply management
- Urban water management and isotope applications
- 3D geological modelling: From conceptual model to the hydrogeological model
- Groundwater monitoring and sampling techniques
- Urbanization: consequences for agricultural development
- Trace organics in the urban water cycle

The following lecturers were involved this year: Prof. Dr. Stefan Wohnlich (Ruhr-Universität Bochum, Hydrogeology), Prof. Dr. Matthias Kiese (Ruhr-Universität Bochum, Human Geography), Prof. Dr. Frank Eulenstein (Leibniz Center for Agricultural Landscape Research, Müncheberg), Prof. Dr. Steffen Bender (Climate Service Center, Hamburg), Dr. Thomas Heinze (Ruhr-Universität Bochum, Hydrogeology), Dr. Andrea Hachenberg (Ruhr-Universität Bochum, Hydrogeology), Dr. Rolf Schiffer (Ruhr-Universität Bochum, Hydrogeology), Dr. Rodolfo Christiansen (Ruhr-Universität Bochum, Hydrogeology), Dr. Faye Seynabou Cissé (University of Cheikh Anta Diop, Dakar, Senegal), Dipl.-Geol. Christian Skark (Institute for Water Research, Schwerte), and Dr. Ali Mahdavi Mazdeh (Iman Khomeini International University Qazvin, Iran).



Participants and some lecturers of the IGSH 2021 visiting the Zeche Zollverein, Essen.

During the course, the participants also worked in small groups on questions relevant to their own projects with the help of the methods learned during IGSH. In this special year, a hybrid-form, i.e., inperson and virtual classroom with *moodle* was created for the participants to work on their group projects. At the end of the course, the participants were given the opportunity to evaluate and comment on the different aspects of the Summer School course (such as their expectations from the course, scientific competence of the lecturers and the organization of the course). We consider a suchlike quality control very important for successive optimization of the IGSH goals. Those who wanted to gain four Credit Points to use in their study and doctoral programs were tested by means of a successful written final examination. Finally, participants were awarded with a certificate by Prof. Dr. Stefan Wohnlich and Prof. Dr. Tobias Licha. Although the course was held both inperson and online, the atmosphere was very friendly, cooperative and productive, which allowed the participants to establish contact to each other and to the lecturers as well. This opened

opportunity for future collaboration to establish scientific cooperation and social networks, and to extend the IGSH scientific community. Generally, the Summer School course provided knowledge transfer and exchange on hydro(geo)logical processes relevant in energy production and management.

The IGSH organizers would like to thank the DAAD and the German IHP/HWRP National Committee of UNESCO for the financial and ideal support of IGSH.

Lecturers, fieldwork directors and field assistants:

Prof. Dr. Stefan Wohnlich

Ruhr University Bochum, Applied Geology, Hydrogeologist

Prof. Dr. Matthias Kiese

Ruhr University Bochum, Human Geography, Geographer

Prof. Dr. Steffen Bender

Climate Service Center, Natural Resources Department, Science officer, Hamburg

Prof. Dr. Frank Eulenstein

Leibniz Centre for Agricultural Landscape Research, Müncheberg, Agricultural Engineer

Dr. Thomas Heinze

Ruhr University Bochum, Applied Geology, Numerical modeler

Dr. Andrea Niedermayr

Ruhr University Bochum, Applied Geology, Geochemist

Dr. Rolf Schiffer

Ruhr University Bochum, Applied Geology, Hydrogeologist

Dr. Faye Seynabou Cissé

University, Senegal, Hydrogeologist

Dr. Rodolfo Christiansen

Ruhr University Bochum, Geophysicist

Dr. Ali Mahdavi Mazdeh

Imam Khomeini International University, Qazvin, Iran, Hydraulic Engineer

Dipl.-Geol. Christian Skark

Institute for Water Research, Schwerte

Annexes:

1. Course Program
2. List of Participants
3. Statistics of Participants
4. Participants' comment collection sheet
5. Statistical evaluation of questionnaire
6. Photos

Annex-1: IGSB 2021 Course Program

Program of IGSB 2021 "Groundwater and Urbanization", 08 – 22.09.2021

Date	Time	Activities	Speakers/Lead
Wednesday, 8-09-2021		Arrival of Participants	
	17:00	Campus Tour and Welcome Dinner – Filou	Applied Geology group, RUB
Thursday, 9-09-2021	08:30 – 09:30	Welcome lecture: Brief introduction to the course, organizational affairs and the Ruhr University	Prof. Dr. Stefan Wohnlich, Applied Geology, RUB
	09:30 – 10:15	Welcome lecture: Knowledge Metropolis Ruhr - From Research Infrastructure to Knowledge-based Economy?	Prof. Dr. Matthias Kiese, Human Geography: Urban and Regional Economics, RUB Dean of the Faculty of Geosciences
	10:30 – 12:00	Workshop: Introduction of participants and short presentations by participants	All participants and lecturers
	13:15 – 16:45	Workshop: Introduction of participants and short presentations by participants	All participants and lecturers
	17:00	City tour: Visit to the city of Bochum	Applied Geology group, RUB
Friday, 10-09-2021	08:30 – 12:00	Lecture/Exercise: Basics of urban Hydrogeology and Monitoring	Prof. Dr. Stefan Wohnlich, Applied Geology, RUB
	13:15 – 14:45	Lecture/Exercise: Basics of urban Hydrogeology and Monitoring	Dr. Thomas Heinze, Applied Geology, RUB
	15:00	Workshop: Group forming and project discussion	All participants and group leaders
Saturday, 11-09-2021	09:00 – 13:00	Field trip: Mining heritage in the Ruhr Area: Zeche Zollverein	Guided tour in former mine; Applied Geology group, RUB
Sunday, 12-09-2021		Free day	

Monday, 13-09-2021	08:30 – 12:00	Lecture/Exercise: Groundwater Hydraulics	Prof. Dr. Stefan Wohnlich Applied Geology, RUB
	13:15 – 16:30	Lecture/Exercise: Water Supply and Management in Teheran/Iran	Dr. Ali Mahdavi Mazdeh Imam Khomeini International University, Qazvin, Iran
	16:45	IGSH Barbecue around Lake Kemnade, Bochum	All participants and lecturers
Tuesday, 14-09-2021	08:30 – 09:30	Lab tour: Hydrogeochemistry lab	Dr. W. Warner Hydrogeochemistry, RUB
	09:30 – 12:00	Lecture/Exercise: Future of urban energy supply? Possibilities based on geothermal energy and selected water related applications	Dr. Rolf Schiffer, Applied Geology, RUB
	13:15 – 16:30	Lecture/Exercise: Flow and Transport in Urban Groundwater Systems	Dr. Thomas Heinze Applied Geology, RUB
	16:45	Field trip: Hydrological and cultural visit to Cologne city center	Dr. Thomas Heinze Applied Geology, RUB
Wednesday, 15-09-2021	08:30 – 12:00	Lecture/Exercise: Urban water resources characterization: use of isotopes	Dr. Andrea Hachenberg Applied Geology, RUB
	13:15 – 16:30	Lecture/Exercise: 3D geological modelling: From conceptual model to the hydrogeological model	Dr. Rodolfo Christiansen Applied Geology, RUB
	16:45	Workshop: Discussions in working groups and evaluation of first results	All participants and group leaders
Thursday, 16-09-2021	08:15 – 12:00	Field exercises Groundwater monitoring and sampling techniques Lake Kemnade well field, Bochum	Dr. A. Hachenberg, T. Gökpınar Applied Geology, RUB
	13:15 – 17:00	Field trip: Water Management in the Ruhr- Metropolitan Area: Emscher Project, Phoenixsee Project	Prof. Dr. Stefan Wohnlich Applied Geology, RUB

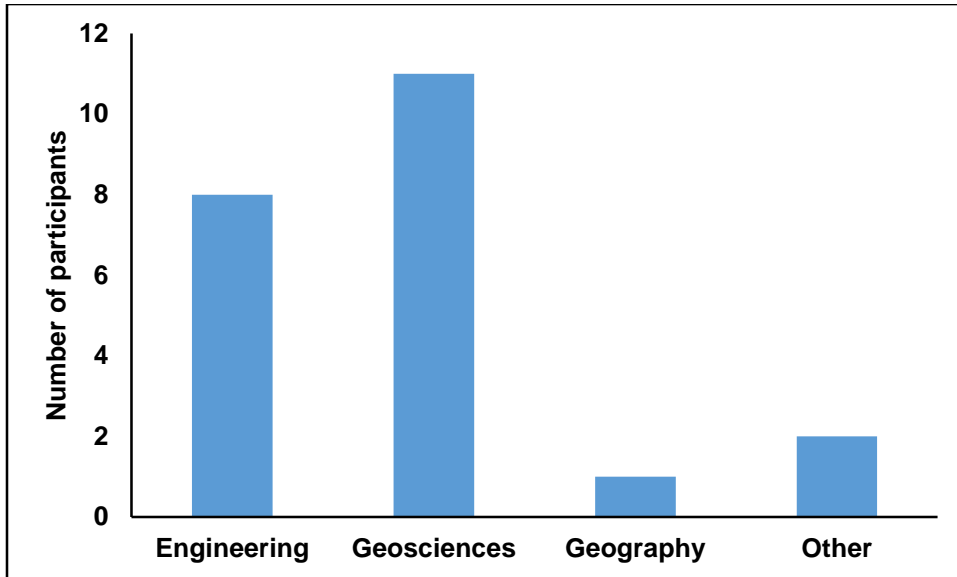
Friday, 17-09-2021	08:30 – 12:00	Lecture/Exercise: Urbanization: consequences for agricultural development	Prof. Dr. Frank Eulenstein Leibniz-Zentrum für Agrarlandschafts- forschung, Müncheberg
	13:15 – 16:30	Lecture/Exercise: Impacts of climate change on the urban water cycle	Prof. Dr. Steffen Bender Climate Service Center Germany, Hamburg
Saturday, 18-09-2021		Free day	
Sunday, 19-09-2021	12:45 – 19:00	Cultural field trip: History, architecture and landscape in the Münsterland and eastern Westphalia	Applied Geology, RUB
Monday, 20-09-2021	08:30 – 11:45	Case study: Senegal	Dr. Seynabou Cisse Dakar University, Senegal
	13:00 – 15:45	Lecture/Exercise: Trace organics in the urban water cycle	Mr. Christian Skark Institute of Water Research, Schwerte
	16:00	Workshop: Discussion in working groups: open questions and presentation of concepts	All participants and group leaders
Tuesday, 21-09-2021	08:30 – 09:00	Presentation: Introducing UNESCO's International Centre for Water Resources and Global Change	Mr. Saile International Centre for Water Resources and Global Change (UNESCO)
	09:00 – 12:30	Workshop: Participants present their group project, and final discussion Course evaluation by participants Final written examination	All participants and lecturers
	13:00 – 15:00	Award of certificates Departure ceremony – Farewell lunch Trattoria Falcone	
Wednesday, 22-09-2021		Departure of participants	

Annex-2: IGSB 2021 Participants List

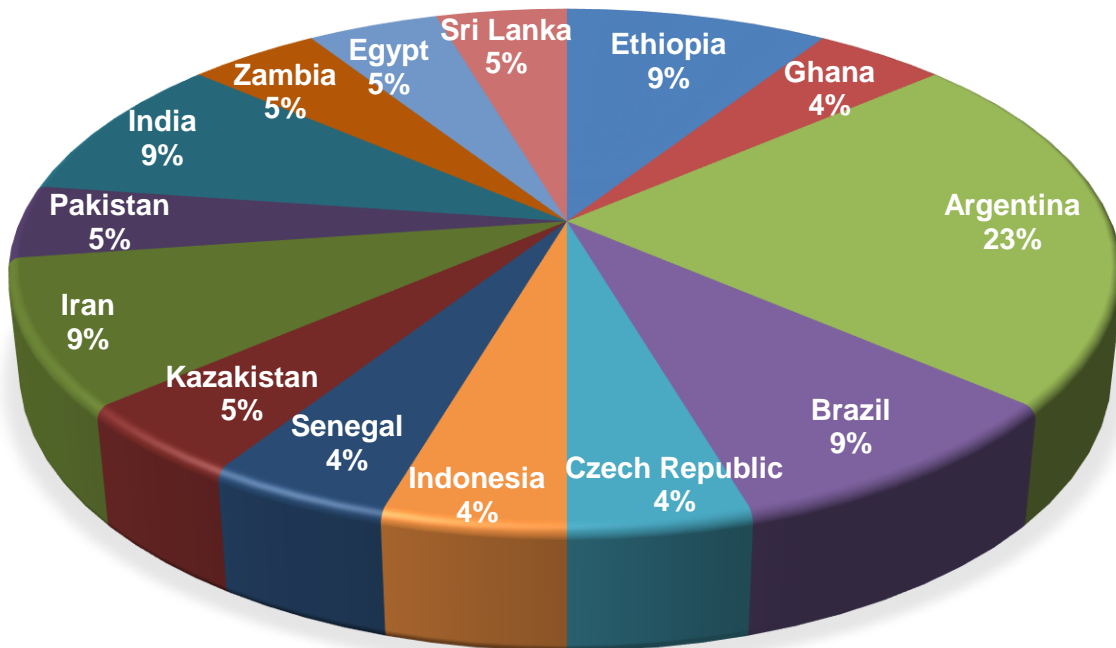
S/No.	Title	Last Name	First Name	Country
1	Ms.	Tadesse	Kidist Hailu	Ethiopia
2	Mr.	Diene	Mandiaye	Senegal
3	Ms.	Moghimi Nezhad	Somayeh	Iran
4	Ms.	Tyapi	Shipra	India
5	Ms.	Yugay	Irina	Kazakhstan
6	Mr.	Rochman	Achmad Darul	Indonesia
7	Mr.	Rathnayake	Rathnayakelage Anjana	Sri Lanka
8	Mr.	Langah	Iftikhar-Ahmed	Pakistan
9	Mr.	Mahmmud	Rebar	Czech Republic
10	Dr.	Ramadan	Ahmed	Egypt
11	Mr.	Hollo de Andrade	Guilherme	Brazil
12	Dr.	Noury	Mojtaba	Iran
13	Mr.	Gentili	Rodrigo	Argentina
14	Dr.	Ayach Anache	Jamil Alexandre	Brazil
15	Mr.	Nugus	Geleta Guta	Ethiopia
16	Mr.	Singogo	Julius	Zambia
17	Mr.	Osei	Gilbert	Ghana
18	Mr.	Joshi	Pranjay	India
19	Ms.	Florencia Tereso Rochas	Maria	Argentina
20	Ms.	Malisia	Carolina	Argentina
21	Dr.	Beatriz Pérez Luján	Sofía	Argentina
22	Dr.	P. Garcia	Hector	Argentina

Annex-3: Statistics of Participants

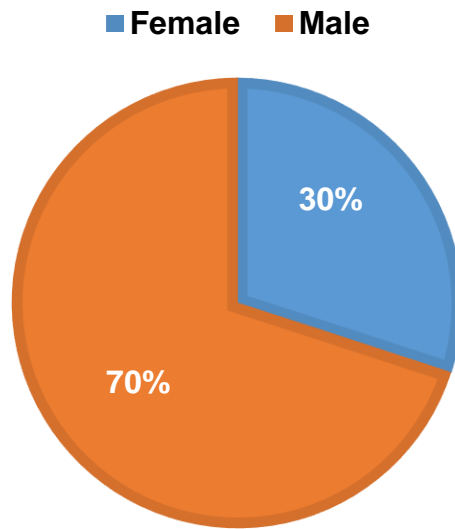
Professional background



Participants per Country



Gender Distribution



Selection of participants

Priority applications

- 1 – Self sponsored applicants (with relevance of academic background to the course to be given, and submission of complete application documents)
 - 2 – Course scholarship applicants (with a relevant background and complete application document)
 - 3 – Partial scholarship applicants with relevant background, motivation letter, experience
 - 4 – Full scholarship applicants with very relevant background and experience, very strong motivation letter, mainly from Sub-Saharan Africa, South America and Asian countries
- One from each country (no two applicants from the same country is given a full scholarship unless special cases are considered)

Excluded applications

- 1 - Professors and Doctors with over 12 years experience
- 2 - Applicants with over 20 years of experience
- 3 - Applicants older than 50 and younger than 23
- 4 - Applicants with BSc and very limited experience

- 5 - Applicants with farthest academic and industry background from the course
- 6 - Applicants who participated in the same course in the previous years organized by IGSH
- 7 - Applicants who participated three or more times in the past may not be given a chance to take part in this course
- 8 - Applicants who failed to submit their CV and addresses of their referees (incomplete application)
- 9 - No two persons from the same country are allowed to take part in the course unless special conditions govern the situation
- 10 - Full scholarships for applicants from Europe, USA, Canada, Australia etc. should not be given unless special conditions govern the situation
- 11 - Applicants who failed to meet the application deadline (applications may be considered based on the type of scholarship they are applying for and their academic background)

Annex-4:

IGSH 2021 Participants' comment collection sheet

Your reason(s) of attendance?	
General interest in the topic	
Special professional needs	
Practical application	
Knowledge renewal	
Other	

What is your professional background?	
Engineering (please specify)	
Geosciences (please specify)	
Geography	
Other (Please specify)	

Are your expectations fulfilled by the course with respect to:					
	Fully	Yes	Neutral	No	No idea
Quality of contents					
Compressibility					
Practical applicability					
Time for discussions					
Number of examples and exercises					
Quality of exercises					
Field trips					
Duration of the course					
Quality of the course					

Scientific competence	Very good	Good	Average	No idea
Prof. Dr. Stefan Wohnlich				
Prof. Dr. Matthias Kiese				
Prof. Dr. Steffan Bender				
Prof. Dr. Frank Eulenstein				
Dr. Thomas Heinze				
Dr. Andrea Hachenberg				
Dr. Rolf Schiffer				
Dr. Seynabou Cisse Faye				
Dr. Ali Mahdavi Mazdeh				
Dr. Rodolfo Christiansen				
Mr. Christian Skark				

	Yes	Neutral	No
Have you got enough time for questions/discussions?			
Have your questions been satisfactorily discussed?			

Have you been satisfied with the organization of the course?	Very much	Yes	Neutral	No	No idea
Lecture room					
Equipments in the lecture rooms					
Organization of field trips					
Meals and coffee-break services					
Accommodation					

How satisfied were you in general with IGSH-2021 course?

Very satisfied

Very unsatisfied

1

2

3

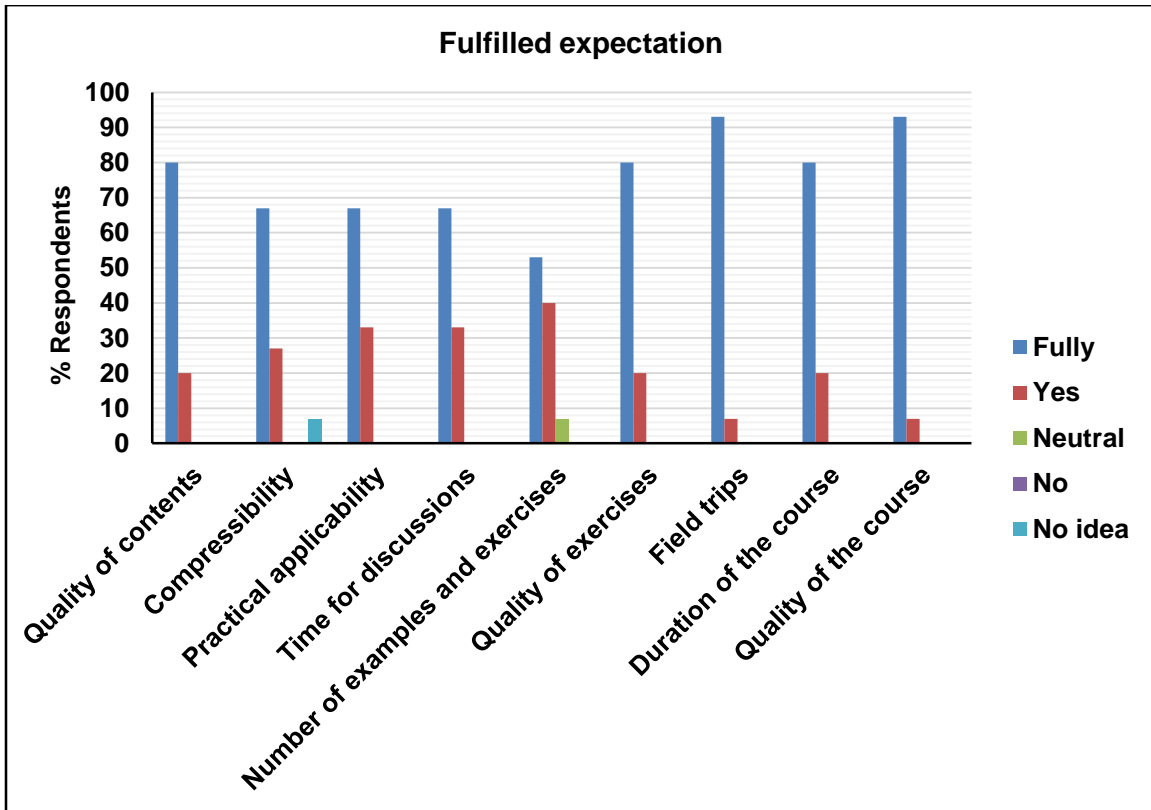
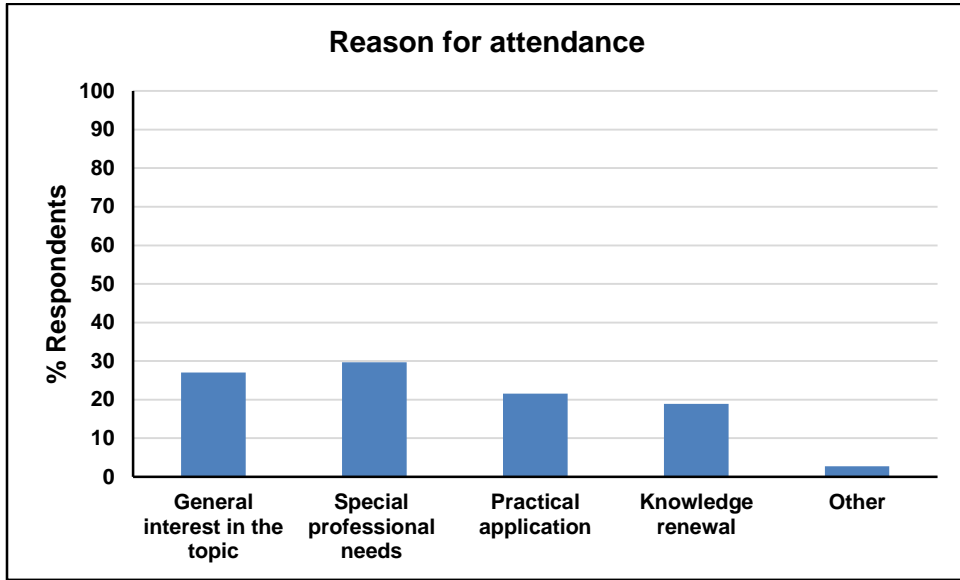
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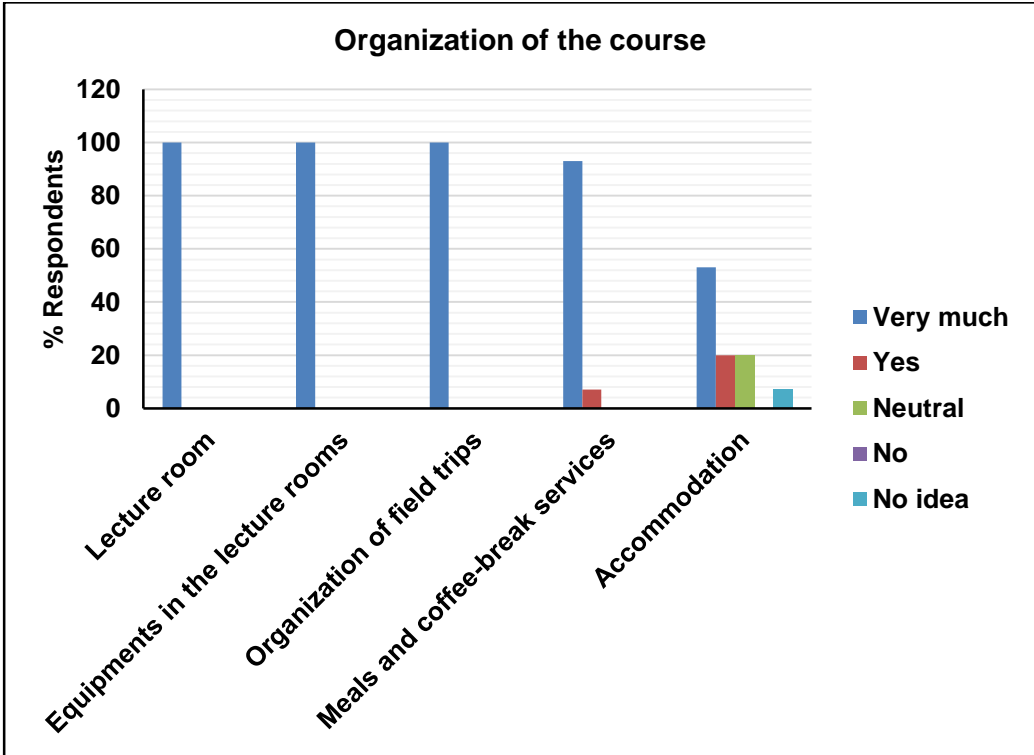
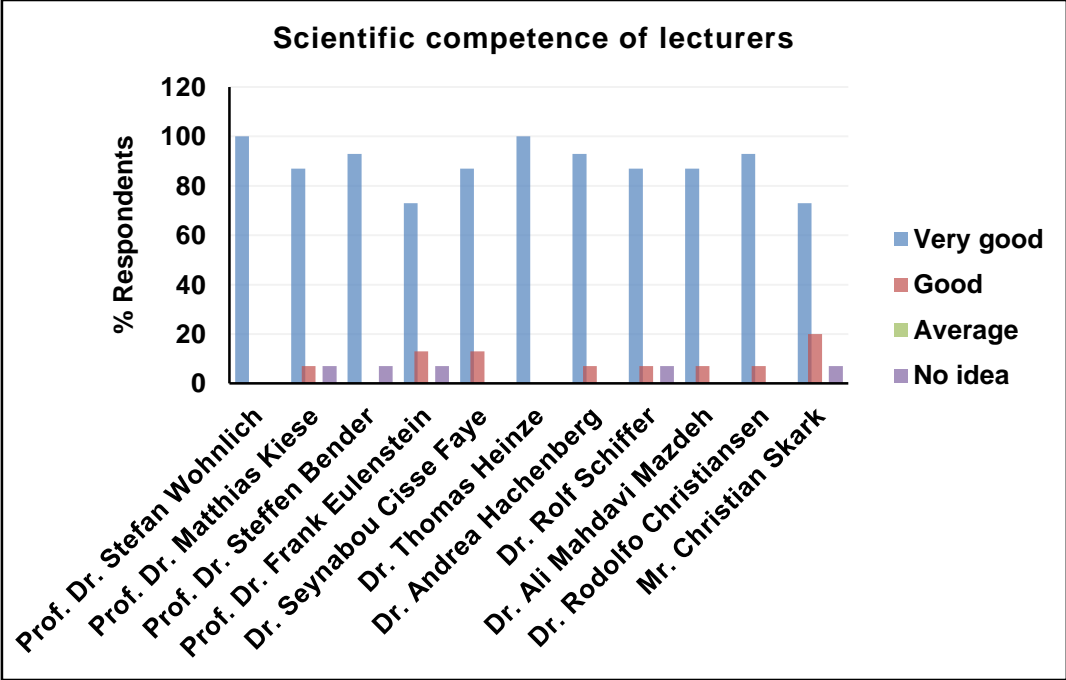
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What other improvements would you like to suggest?

Annex-5:

Statistical Evaluation of Questionnaire





Annex-6:

Photos



Photos during field excursion



Photos during lectures



Photos during the certificate award



Photos during social events and city tours