Ecological aspects of urbanization in mountain areas

Coordinator	Jürgen Breuste
Credits	3 ECTS (optional course), 20 in-class hours
Lecturers	**Jürgen Breuste**, expert on urban ecology and urban sustainability strategies (Paris Lodron University of Salzburg, Austria) **Marc Gimenez Maranges**, expert on rainwater management and urban sustainability strategies (Paris Lodron University of Salzburg, Austria) **Prakash C. Tiwari**, expert on urbanisation, tourism and sustainable development in the Indian Himalaya (Kumaun University, India) **PK Joshi**, expert on urbanisation, disaster management and planning strategies in the Indian Himalaya (Jawaharlal Nehru University, India) **Om Katel**, expert on urbanisation and sustainability policy in the Himalaya in Bhutan (Royal University of Bhutan, Bhutan)
Level	MSc., PhD.
Host institution	Royal University of Bhutan, Bhutan
Course duration	The specific period of time has not yet been set up

Summary

This 3 ECTS course serves as an introduction to urbanisation in mountain areas, and related socio-ecological issues and sustainability strategies. The course provides in-depth knowledge on mountain areas, including ecological processes and anthropogenic impacts. It provides students coming from various backgrounds with a basic understanding of urbanisation processes, their strains on socio-ecological systems, and the role of nature-based solutions as a strategy to address current environmental issues. A critical perspective is offered on the solutions already implemented and possible alternative paths are critically analysed. Mountain environments are assessed from a biophysical and social perspective. A particular focus is put on urbanisation, the evolution of urban settlements in mountain areas and the challenges and risks that they face. The course includes discussions, group work assignments and field work. Through group work assignments, the socio-ecological reality in mountainous cities is captured from different perspectives.

Target student audiences

Master and doctoral students from various study programmes

Prerequisites

Basic understanding of ecological processes
Basic understanding of social processes

Aims and objectives

The main course objective is to introduce the students to ecological aspects of urbanisation in mountain areas, with a focus on socio-environmental issues and solutions. The particular aims are to understand:

- The weaknesses and strengths of the responses provided to the environmental crises, including the eco-city concept.
- The alternative approaches for a more sustainable city.
- The role of urban nature as a strategy for the attainment of sustainable cities.
- The potential of ecosystem services to promote urban nature.
- The natural basis of mountain areas and mountain dynamics.
- The human-nature relation in mountain areas and its evolution in time.
- The issue of urbanisation in mountain areas.
- The risks and challenges of settlements in mountain areas, and adequate measures of dealing with them.
- Strategies for sustainable mountain cities.

The explanations are mainly based on examples from the Central European Region, the Himalayas, the Caucasus, and the Rocky Mountains.

General learning outcomes:

By the end of the course, successful students will:

- understand urbanisation processes,
- be aware of human impacts on mountain areas,
- critically reflect on different approaches of developing sustainable cities (in general and within mountainous areas),
- be able to develop a multi-disciplinary project about a real site,
- be able to analyse complex socio-ecological systems in mountainous areas using different perspectives,
- be able to develop solution strategies for environmental issues,
- be capable of constructing own opinions based on different ideas and approaches,
- to be able to work in a team and communicate the outcomes of conducted research.

Overview of sessions and teaching methods

The course will use both interactive and self-reflective methods of teaching and, where possible, avoid standing lectures and presentations. Lectures will be complemented with videos and group in-class assignments. The course will include some field work, with related discussions. It will start with an introduction to ecological aspects of urbanisation, with a special focus on the eco-city concept and alternative sustainability transition pathways. Theories and concepts will be further developed through a case study on urban nature and urban rainwater management. These introductory lectures will lead to an outline of the complex bio-physical reality of mountain environments and the issue of urbanisation in mountain areas. This part will lead to the development of a small group-project after the completion of the in-class sessions focused on four sites located in divergent socio-ecological contexts. The whole module will lead to a final discussion on ecological aspects of urbanisation in mountain towns.

Course workload

The table below summarizes course workload distribution:

Activities	Learning outcomes	Assessment	Estimated workload (hours)
In-class activities			
Lectures	Understanding theories, concepts and tools	Class participation	8
(Moderated in-class) discussions	Understanding the problematics of urbanisation and sustainability strategies	Class participation and preparedness for discussions	0.5
(In-class) assignments	Deepening the knowledge of sustainability transition processes, rainwater management in cities, mountain dynamics, and urbanisation processes in mountains	Class participation and preparedness for assignments	7.5
Field work	Strengthening the understanding of urban nature, ecosystem services and urban rainwater management	Active participation	4
Independent work			
Group work: - Contribution to the group case-study projects - Contribution to the preparation and delivery of presentation	Ability to analyse complex socio-ecological systems in mountainous areas from different perspectives Capability to develop solution strategies for environmental issue Teamwork capability, responsibility	Quality of group assignment and final presentation, creativity and contribution to the role play	50
Preparation for lecture	Understanding the strengths and weaknesses of eco-city concept, the services provided by urban nature, and the effects, risks and challenges associated to urbanisation in mountain areas	Class participation, creative and active contribution to discussion	20
Total			***90***

Grading

The evaluation of the students' performance will be based on the following:

- Active participation for in-class discussions and assignments (30%). Evaluation: from 100% for active participation and comprehension of the course contents to 0% for non-participation.
- Contribution to the eco-urbanism assignments (30%). Evaluation: from 100% for creative, well-argumented and originally presented contributions to 0% for absence of contribution.
- Creativity and quality of the group project (40%), in terms of: 1) the capacity to integrate the distinct concepts learned and apply them in a practical case; 2) the analytical abilities demonstrated; 3) the originality of the ideas and solutions exposed; and 4) the ability to share and develop ideas and tasks with other people. Evaluation: from 100% for projects meeting the principles mentioned above to 0% for absence of contribution.

Course schedule

Day	Time	Topic	Lecturer
Before the start of the course	5 hours	- Independent work: reading of papers and preparation for lectures	-
Day 1	1 hour	- Lecture 1: Conceiving the city of the future - towards a new urban paradigm? (part 1): urbanization - from the diffused city to the eco-city model	Marc Gimenez Maranges
	1 hour	- Exercise related to lecture 1: quiz on strategies for the sustainability of cities	Marc Gimenez Maranges
	0.5 hour	- Discussion preceding lecture 2: strengths and weaknesses of the eco-city concept	Marc Gimenez Maranges
	1 hour	- Lecture 2: Conceiving the city of the future - towards a new urban paradigm? (part 2): transitioning towards a more sustainable urban paradigm	Marc Gimenez Maranges
	2 hours	- Exercise related to lecture 2: transitions network	Marc Gimenez Maranges
	5 hours	- Independent work: reading of papers and preparation for lectures	-
Day 2	1 hour	- Lecture 3: urban nature	Jürgen Breuste
	1 hour	- Lecture 4: urban rainwater management	Marc Gimenez Maranges
	4 hours	- Field work and discussion related to lectures 3 and 4: urban green spaces and ecosystem services, and rainwater management in 2 distinct urban contexts	Jürgen Breuste and Marc Gimenez Maranges
	5 hours	- Independent work: reading of papers and preparation for lectures	-

Day 3	0.5 hours	- Exercise preceding lecture 5: main characteristics of mountainous areas	Prakash C. Tiwari, PK Joshi and Om Katel
	1 hour	- Lecture 5: Introduction to mountain areas	Prakash C. Tiwari, PK Joshi and Om Katel
	1 hour	- Exercise related to lecture 5: quiz on the main bio-physical traits of distinct mountain areas of the world	Prakash C. Tiwari, PK Joshi and Om Katel
	1 hour	- Lecture 6: Urbanisation in mountain areas	Prakash C. Tiwari, PK Joshi and Om Katel
	1.5 hour	- Exercise related to lecture 6: effects of urbanisation in mountain areas (video and discussion)	Prakash C. Tiwari, PK Joshi and Om Katel
	5 hours	- Independent work: reading of papers and preparation for lectures	-
Day 4	1 hour	- Lecture 7: risks, challenges, and sustainability strategies in mountainous towns	Prakash C. Tiwari, PK Joshi and Om Katel
	1.5 hour	- Exercise related to lecture 7: interpretation of scientific literature on the risks and challenges faced in mountain towns located in distincts socio-ecological contexts	Prakash C. Tiwari, PK Joshi and Om Katel
	1 hour	- Conclusion	Jürgen Breuste, Prakash C. Tiwari, PK Joshi, Om Katel and Marc Gimenez Maranges

Course assignments

The course assignments will be largely discussion based which will require in-class assignments and will lead to a final group project. All assignments will build upon core components of the course objectives, and will synthesize the learning outcomes in the final project.

In-Class Assignments, Discussions & Fieldwork: *Introduction to ecological aspects of urbanisation and to mountain areas*

- **Assignments & discussions**

Assignment 1 will reflect the achievement of sustainability goals in cities with particular focus on ecological measures of enhancement in worldwide leading towns [quiz]. **Assignment 2** will continue to build an understanding of the sustainable urban paradigm by outlining the strengths & weaknesses of the Eco-City Concept. **Assignment 3** will allow students to take a closer look at sustainable urban development by identifying alternative strategies to the Eco-City Concept through the lens of grassroots

initiatives [group presentation]. Once basic knowledge on urbanisation processes and sustainability strategies is gained, **assignments 6 and 7** will contextualize the ecological aspects of urbanisation by introducing the major biophysical characteristics of mountainous areas [group presentation and quiz, respectively]. **Assignment 8** will explore the human-nature dynamic in mountainous areas by looking at the effects of urbanisation [video + discussion]. Finally, **assignment 9** will enable a detailed study of the risks and challenges in mountainous areas, as well as related coping strategies [interpretation of scientific literature].

- **Field Work**

Assignment 4 will focus on the importance of nature in urban areas by encouraging students to physically identify the ecosystem services within green spaces in their city [excursion & discussion]. **Assignment 5** will investigate the applied example of urban rainwater management as a strategy for sustainable development by using orthophotos to create a multi-scalar analysis [excursion & discussion].

Final Project

Application in mountainous areas

- ***Basic analysis***

Assignment 10 will synthesize critical bio-physical and social characteristics of mountainous areas (as obtained in previous assignments) by having students analyse case studies of different mountain areas [working groups].

- ***Identification of critical areas***

Assignment 11 will deepen the understanding of critical issues within chosen case studies, as students will conduct further research and create a brief risk assessment to outline framework conditions of urbanisation in mountain areas [working groups].

- ***Development of sustainability strategies***

Assignment 12 will cohere sustainability strategies as students complete sustainable development plans for their case studies, incorporating multi-scalar perspectives as explored through the Eco-City Concept, grassroots approaches and the Urban Nature concept throughout the curriculum [working groups].

Literature

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Annex - Course structure

Activities related to the lecture (lecture 2)
*PREPARATION AT HOME (**5 hours**)* ● *Perform a search in the literature on the strengths and weaknesses of the eco-city concept, so that you are ready to discuss on it in class.*

LECTURE 1 - Conceiving the city of the future - towards a new urban paradigm? - Part 1 (from the diffused city to the eco-city model) (**1 hour**)

- Cities and the attainment of sustainability goals
- Contemporary city model: the diffused and globalized city model
  - Definition: a city without limits but full of limits
  - Principal characteristics: fragmentation, transportation network and material and energy fluxes
  - Environmental dysfunctions
  - Social dysfunctions
- Responses to the environmental crises
  - Response of the United Nations: the emergence of the Agenda 21
  - Response of the private sector: the emergence of the eco-modernisation concept
- The eco-city concept
  - Definition: what is an eco-city?
  - Main principles
  - Trends in the adoption of the eco-city concept worldwide
  - Example 1: Freiburg (Germany)
  - Example 2: Linz (Austria)

Activities related to the lecture (lecture 1)
*IN-CLASS ASSIGNMENT (**1 hour**)* ● *Quiz/game on strategies for the sustainability of cities (energy, water, etc.).*

Activities related to the lecture (lecture 2)
*IN-CLASS DISCUSSION (discussion in small groups and pooling) (**0.5 hour**)* ● *Question 2: do you think this approach suffices for the attainment of a more sustainable urban paradigm? Think about the strengths and weaknesses of the eco-city concept.*

LECTURE 2 - Conceiving the city of the future - towards a new urban paradigm? - Part 2 (transitioning towards a more sustainable urban paradigm) (1 hour)

- Criticisms of the eco-city concept
  - Eco-cities: are they really ecological?
  - Is there a need for change going beyond the principles of the eco-city concept?
- Alternative sustainability paradigms
  - Towards a new paradigm: possible directions of change
  - Example 1: regenerative sustainability paradigm
  - Example 2: adaptive management
- In the transition to a more sustainable city model
  - Key factors for transitioning
  - Action for change
  - A panacea?/ a utopia?
  - Towards a new paradigm - existing initiatives

Activities related to the lecture (lecture 2)
*EXERCISE - VIDEO "TRANSITIONS NETWORK" (**2 hours** – 0.5 hour video; 1 hour group work; 0.5 hour presentation)* • *Think about how you would start a grassroots initiative for a more sustainable urban development of the area where you live. Think of: 1) the topic which you would like to develop (energy, etc.); 2) how you would start with the grassroots process (gathering of people); 3) how you would arrange the decision process; 4) how you would keep people engaged; etc.*

Activities related to the lecture (lecture 3)
*PREPARATION AT HOME (**5 hours**)* • *Read the articles provided on the services offered by urban nature to urban citizens, so that you are ready for the in-class discussions on this topic.*

LECTURE 3 - urban nature (1 hour)

- Definition: what is urban nature?
- Urban blue and green infrastructure
- Urban nature is diverse
  - The four urban natures
  - Examples of urban nature
    - Urban woodlands - remnants of pristine landscapes
    - Public urban parks - designed urban green spaces
    - Urban gardens - the private urban green
    - Urban waters - the urban blue infrastructure

- New urban wilderness - novel urban ecosystems
  - Urban ecosystem services
    - Definition: what are urban ecosystem services?
    - Categories of ecosystems services
    - Disservices
    - "Units of account" for ecosystem services
    - Assessment tools
  - Urban biodiversity
    - Definition: what is urban biodiversity?
    - Urban biodiversity, ecosystem services and human well-being
  - What has been done so far? - the European experience
    - Example 1: German National Strategy for Biodiversity 2007
    - Example 2: Dresden, Germany

Activities related to the lecture (lecture 3)
*FIELD WORK (**4 hours**)* • *Excursion to several types of green spaces within the city (parks, allotment gardens, river side, squares and urban forests), and identification and discussion of the distinct ecosystem services provided by the distinct types of green.*

LECTURE 4 - urban rainwater management (1 hour)

- **Conventional urban rainwater management practices**
  - Technical solutions
  - Governance structures and processes
  - Associated challenges
- **Alternative solutions - toward a more sustainable management of rainwater in our cities**
  - The water sensitive city model
  - Integrating ideas from distinct alternative paradigms
- **Sustainable Urban Drainage Systems (SuDS) - a strategy for a more sustainable future?**
  - Definition - what are SuDS?
  - Main SuDS typologies
  - The SuDS management train
  - Three pillars of action
- **In the transition to a more sustainable rainwater management?**
  - Current degree of transitioning worldwide
  - Example 1: Malmö, Sweden
  - Example 2: Linz, Austria

Activities related to the lecture (lecture 4)
*FIELD WORK (**4 hours - same excursion as for lecture 3**)* ● *Excursion to 2 areas of the city: one where most surfaces are sealed and another with a high percentage of green spaces. Orthophotos are provided to each of the groups into which the class is divided. Think of and discuss: which measures you would implement in order to manage rainwater in both areas. Take a multi-scalar perspective into account. You can also use the pictures and draw your ideas onto them.*

Activities related to the lecture (lecture 6)
*PREPARATION AT HOME (**5 hours**)* ● *Read the articles provided on the effects of urbanisation in mountain areas, so that you are ready for the in-class discussions on this topic.*

Activities related to the lecture (lecture 5)
*EXERCISE (preparation and oral presentation in small groups, and pooling) (**0.5 hour**)* ● *Fill in the table with the main characteristics of mountainous areas. Think of different aspects of natural conditions, including climate, geomorphology, fauna and flora. Share the findings in class, make one table on the board and discuss.*

Table

mountainous areas	**lowlands**

LECTURE 5 - introduction to mountain areas (**1 hour**)

- Definition: What are mountain areas?
- Biophysical characterisation of mountain areas
  - Geomorphological traits
  - Climate
  - Flora and fauna
  - Study area 1: the Central European Region
  - Study area 2: the Himalaya, Bhutan
  - Study area 3: Russian mountains (Caucasus)

- Study area 4: The Rocky Mountains
- An ecosystem in change: present and future dynamics in the context of climate change

Activities related to the lecture (lecture 5)
*IN-CLASS ASSIGNMENT (**1 hour**)* • *Quiz/game on the main bio-physical traits of distinct mountain areas of the world*

LECTURE 6 - urbanisation in mountain areas (1 hour)

- An evolutionary perspective of urbanisation in mountain areas (historical review)
  - Population trends
  - Urban sprawl: a diffused city model?
  - Urbanism and socio-economic activity, two interrelated spheres
    - Farming
      - Example 1: rise fields in Vietnam, Philippines, China and the Himalaya
      - Example 2: agriculture in the Alps, Austria
    - Mining
      - Example 1: Pecs, Hungary
      - Example 2: Qin-Ba Mountains, China
    - Tourism
      - Example 1: Nainital, India
      - Example 3: Andermatt, Switzerland
- Interrelation nature - inhabitants: a relation in change?
- Cities in mountain areas: distinctive traits
  - Mountain architecture
  - Green spaces in cities

Activities related to the lecture (lecture 6)
*IN-CLASS ASSIGNMENT (**1.5 hours** – 0.5 hour video; 1 hour group work and discussion)* • *Watch several short videos provided on urbanisation processes in distinct mountainous towns and discuss the effects of urbanisation. Complement this with provided articles.*

Activities related to the lecture (lecture 7)
*PREPARATION AT HOME (**5 hours**)* • *Read the articles provided on risks and challenges in mountain towns, so that you are ready for the in-class assignment.*

LECTURE 7 - risks and challenges in mountainous towns, and sustainability strategies to cope with them (1 hour)

- Natural conditions which can cause disasters
  - Geological structures
  - Climate and hydric conditions
- Risks
  - Forest fires
    - Example: The Rocky Mountains
  - Floods
    - Example: The Jammu and Kashmir State and the city of Srinagar, India
  - Landslides
    - Example: Nainital, India
  - Avalanches
    - Example: Galtür, Austria
  - Earthquakes
    - Example: Colorado, USA
  - Whirlwinds
    - Example: Slovakian Tatra Mountains - 2004, 2014
  - Heavy snow events
    - Example: Bavaria, Salzburg 2019
- Challenges
  - Seasonal demographic flux
  - Population loss / overpopulation
  - Climate change
  - Protection of mountain habitats
  - Improvement of living standards of inhabitants
- Strategies for a more sustainable future
  - Renewable energy in mountains
  - Water management
- What has been realized so far? - towards a more sustainable city?
  - Example 1: Grenoble, France
  - Example 2: Santa Fe, USA

Activities related to the lecture (lecture 7)
*IN-CLASS ASSIGNMENT (**1.5 hours**)* • *Identify in the article provided to your group the main challenges and risks that the area described faces. Afterwards discuss with the other groups on the distinct challenges and risks they have identified and the possible reasons behind the dissimilarities among sites.*

CONCLUSION OF THE COURSE - ecological aspects of urbanisation in mountain areas - concluding remarks (1 hour)

GROUP PROJECT

Activities related to the entire course (realisation after the completion of the in-class lectures) - GROUP PROJECT
*TASK 1 (**1/3 Basic analysis**) (**15 hours**)* ● *Create 4 working groups. Each group will be working on a different mountain town (e.g. the ski town of Chamonix), representative of the different main contexts that are embraced in the module: the Alps, the Himalayas, the Caucasus, and the Rocky Mountains. Use the videos and papers provided to perform a basic analysis of your study area: 1) main natural conditions (altitude, climate, and topography), 2) main activity sustaining the economy of the town, and 3) a brief description of the urbanisation evolution.* *TASK 2 (**2/3 Identification of critical areas**) (**17 hours**)* ● *Continue working on the project. Is your area facing any other issues that were not mentioned during the lectures and in the papers you discussed? Choose the issue(s) that are most critical to your area. Do research on this issue, this can include telephone interviews, mapping etc. Perform a comparison between your areas and those described in the papers by drafting a brief risk assessment.* *TASK 3 (**3/3 Development of sustainability strategies**) (**18 hours**)* ● *Finish your project with a sustainable development plan. Think of measures to solve the issues identified, suggest new ways of handling these issues in your area. You can support your ideas by referencing images, maps, figures, drawings, etc.*